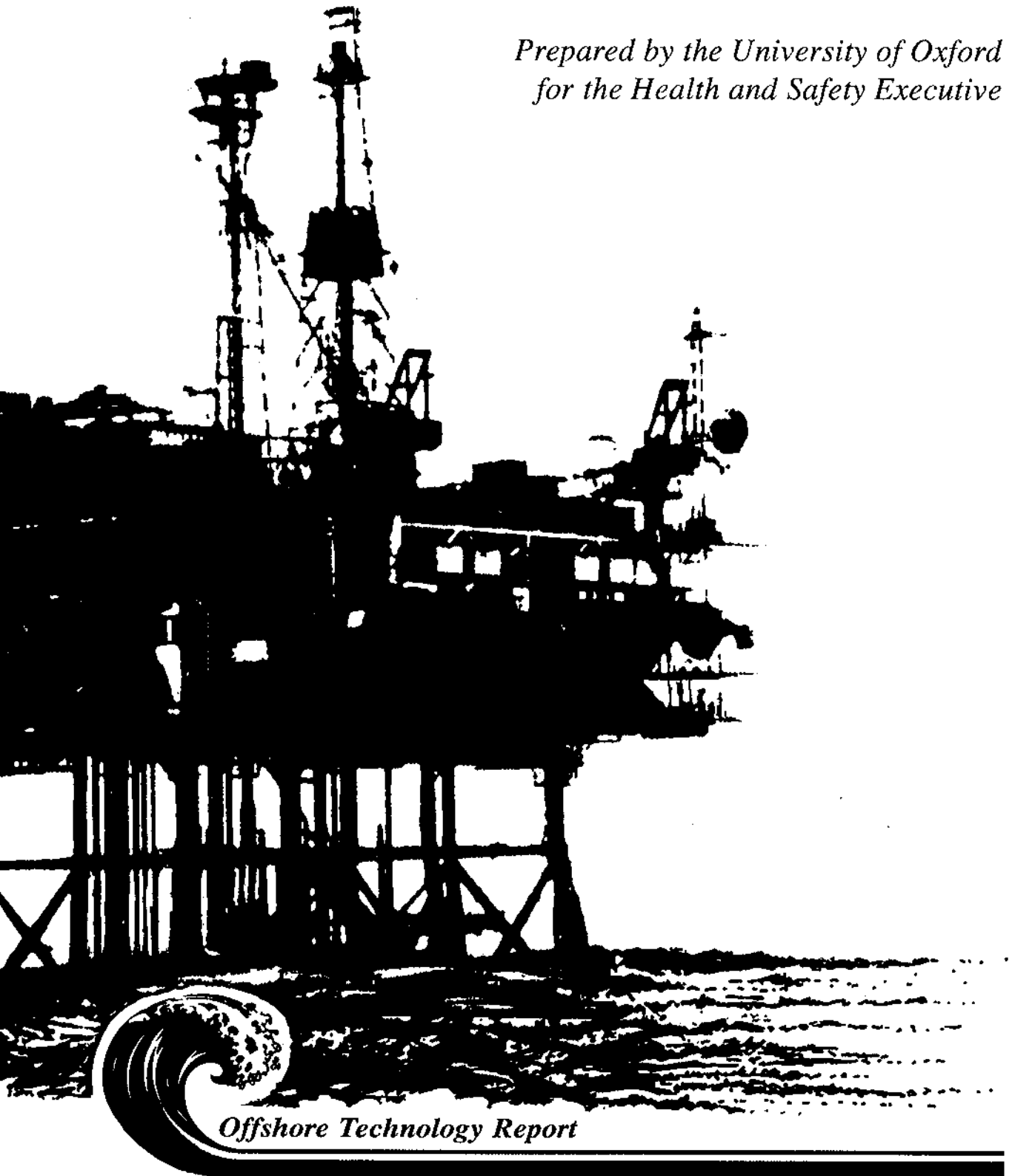




PSYCHOSOCIAL ASPECTS OF WORK AND HEALTH IN THE NORTH SEA OIL AND GAS INDUSTRY

*Prepared by the University of Oxford
for the Health and Safety Executive*



Offshore Technology Report

Health and Safety Executive

**PSYCHOSOCIAL ASPECTS OF
WORK AND HEALTH IN THE
NORTH SEA OIL AND
GAS INDUSTRY**

PART I

A Review of the Literature

Katharine R Parkes

PART II

***A Five-year Follow-up Study (1990-1995)
of Offshore and Onshore Personnel***

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PSYCHOSOCIAL ASPECTS OF WORK AND HEALTH IN THE NORTH SEA OIL AND GAS INDUSTRY

PART I
A Review of the Literature

Katharine R Parkes

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FOREWORD

The North Sea work environment has undergone extensive 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 current information about work and health in the offshore environment. The present research, under the general title '*Psychosocial aspects of work and health in the North Sea oil and gas industry*', seeks to contribute up-to-date findings in several areas of topical importance to the offshore oil and gas industry. The research was carried out by Oxford University with funding from the Health and Safety Executive, Offshore Safety Division; the main data collection took place during 1995-1996. The work is reported in four parts:

Part I reviews the available research literature relating to work and health (including psychosomatic complaints, mental health and stress, and health behaviours) among offshore personnel. General aspects of the psychosocial environment on North Sea installations and specific issues, such as offshore shift rotation, are considered; areas in which information is currently lacking are highlighted.

Part II reports a small-scale follow-up study which evaluated changes in mental health and job satisfaction in onshore and offshore personnel over the period 1990-95. A marked feature of the findings is the significant increase in perceived workload and anxiety in the occupational group concerned (production operators), both onshore and offshore, over a five-year period of re-structuring and down-manning.

Part III addresses the issue of offshore day/night shift rotation patterns. Repeated assessments of sleep, mood, and cognitive performance (e.g. reaction time, memory, reasoning) over the two-week offshore work cycle clearly demonstrated the adverse effects of a mid-cycle shift change as compared with a fixed-shift schedule in which either days or nights are worked for the entire two-week period.

Part IV presents the main findings of a survey of the perceived physical and psychosocial work environment, safety, health and job satisfaction among offshore personnel (N=1462) on 17 offshore installations. Overall, the offshore sample did not show elevated levels of stress symptoms relative to comparable onshore groups, but job types, shift patterns, and installation characteristics were significant predictors of safety, work, and health measures.

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. It is hoped that, in reflecting current offshore work conditions, the research findings will be of interest not only to the participating companies but also to the North Sea oil and gas industry more generally, and that the work 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.

SUMMARY

This report reviews the literature on psychosocial factors and health (particularly psychological health) among offshore personnel. The material 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 offshore 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.

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1. INTRODUCTION

Safe and efficient performance of demanding work tasks, and the more general well-being of the workforce, requires that individuals at all levels of the organization maintain good physical and psychological health. This is particularly true of the North Sea oil and gas industry, in which complex and potentially hazardous operations are carried out in a constrained, isolated, and remote environment. Thus, occupational health is a major concern of operating companies and contractors, and of regulatory authorities, industry associations, and trades unions involved in offshore work.

The review presented here seeks to bring together the findings of a number of studies which have investigated the health of offshore personnel in relation to the particular demands to which they are exposed. It is written from a psychological viewpoint and does not seek to cover material that is more appropriately the domain of medical practitioners, physiologists, and other specialists.

Thus, topics not considered in the present review include, for instance, offshore radiation problems, noise exposure, toxic hazards and gases, dermatitis, accidents, seasickness, and hypothermia. Several specialist texts (e.g. Cox, 1987) are available which cover these and other aspects of offshore medicine.

Furthermore, the material reviewed here is restricted to literature relating to personnel working on offshore drilling rigs and production installations. Health issues specific to other North Sea occupational groups, such as divers, helicopter pilots, and the crews of standby vessels are not addressed.

The review is divided into five main sections: general patterns of health and illness on North Sea installations as reflected in records of medical evacuations, sickbay visits, and sickness absence; psychosomatic complaints and minor health impairment; the particular health problems associated with offshore work patterns; mental health, stress and psychosocial factors; and health behaviours and lifestyle, as they relate to the offshore workforce.

The material considered 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. Whilst the primary focus is on studies of the offshore environment, where relevant the review draws on material from onshore research. More informally, discussions with occupational health professionals in the oil industry, including offshore medics, provided a first-hand background against which to assess research findings.

2. PATTERNS OF ILLNESS AND INJURY OFFSHORE

An integral part of the operation of the offshore oil and gas industry is the maintenance of records relating to production, safety, and health; the latter provide a valuable source of statistical information about patterns of illness and accidental injury among North Sea personnel.

2.1 MEDICAL EVACUATIONS

Serious medical problems which require treatment resources not available offshore necessitate evacuation from the installation. Information about the nature of health problems occurring in the offshore environment can be derived from analyses of the causes of medical evacuations. For instance, Norman *et al.* (1988) examined the patterns of illness and injury resulting in medical evacuation from offshore structures. Among the younger age groups (up to age 45 years), injury was more frequent than illness as a cause of evacuation. However, this was not true of older groups, in which illness and injury were equally frequent causes of medical evacuation.

Of the illnesses which required evacuation, disorders of the digestive system (with a total of 239, about half of which were dental problems) accounted for the largest number, followed by musculoskeletal (156), respiratory (117), and nervous system (96) problems. Mental disorders (42) came next in frequency. The high incidence of dental problems necessitating evacuation, an issue examined in more detail by Ballantine *et al.* (1990), led dental health requirements to be included in revised medical guidelines issued by the United Kingdom Offshore Operators Association (1995). In a later analysis, Norman (1991) found a striking similarity between offshore structures and British Antarctic Survey stations in the pattern of medical evacuations, particularly in the high incidence of dental problems.

A more recent analysis, based on offshore medical evacuations in the five-year period 1987-92, was reported by Horsley (1996, in press). The relative frequency of different types of illnesses necessitating evacuation corresponded closely to that reported by Norman *et al.* (1988) with digestive/dental problems heading the list, followed by musculoskeletal and respiratory problems. Mental problems, primarily neurotic and/or stress-related, accounted for almost 4% of the total illness evacuations in Horsley's data, as compared with slightly more than 5% in the data of Norman *et al.*

Overall, of the 3979 evacuations examined by Horsley, 55% were for illness and 45% for injury; the proportions of contractor and operating company personnel evacuated was consistent with their proportions in the work force as a whole. However, there were some differences between occupational groups; in particular, drillers and maintenance personnel tended to have higher proportions of evacuations due to injury than other groups. The proportions also changed over the five-year period studied, thus, evacuations necessitated by injury fell from 53% in 1978-8 to 36% in 1991-2, while the proportion due to illness increased correspondingly. General improvements in safety regimes, on the one hand, and an ageing offshore workforce, on the other, may account for this changing proportion of injury and illness.

An important aspect of the study by Horsley (1996) was that it identified a temporal pattern of evacuations in relation to the work cycle. Thus, the highest incidence of illness requiring evacuation was consistently found to be on the first day of the scheduled tour of duty; in contrast, the highest frequency of evacuation for injury was on the fourth or fifth day into the tour. A possible explanation of the high incidence of illness on the first day is that some personnel may be commencing their tour while unfit (possibly motivated in part by concern for 'back-to-back' crew members due to go on leave); furthermore, the stress of travel to the installation may in itself provoke or exacerbate illness. The incidence of dental and respiratory problems as a cause of first day evacuation was particularly marked relative to their overall incidence in the data set as a whole.

In Horsley's (1996) analysis, the day of occurrence of illness was taken to be the day of illness onset irrespective of when evacuation took place. However, in the analysis of a subsequent data set (relating to the 12-month period from September 1993), in which the day identified was the actual day of evacuation rather than illness onset, it was found that the highest incidence occurred seven days into the tour rather than on the first day (Horsley, 1995). The author suggests that this apparent change in the temporal pattern of medical evacuation due to illness is an artifact arising from the change in data collection procedures. Taken together, the findings suggest that illnesses which occurred early in the tour of duty generally did not result in medical evacuation until the end of the first week.

2.2 SICKBAY VISITS

Records of sickbay visits provide a further source of information about patterns of illness and injury offshore. Anderson and Cox (1987) gave the breakdown of reasons for sickbay consultations as: medical cases, 40%; skin problems, 10%; minor trauma, 5-10%; musculoskeletal problems, 5-10%; ear, nose and throat problems, 1-15%; and eye problems, 10-15%. Whilst most of the cases seen by an offshore medic do not need support from onshore medical staff, Anderson and Cox note the importance of having such support available; they point out that, in 1984-5, the North Sea Medical Centre had four or five calls per day from offshore medics seeking advice.

The Statfjord study (Hellesøy, 1985) also provided detailed information about health problems as reflected in reasons for sickbay visits. Somatic complaints (including digestive problems, chest pains, and respiratory symptoms) accounted for 47% of the total sickbay visits. Accidents and injuries accounted for 16%, and personal concerns for 15%, of the total. In terms of specific diagnosis, musculo-skeletal disorders were most frequent, accounting for 25% of sickbay visits.

The Statfjord data suggested that at least one third of the offshore population might be expected to consult the platform medic for somatic complaints during the course of a year, with significant proportions making more than one visit. There appears to be little evidence about temporal patterns of sickbay visits in relation to the offshore work cycle, although Cooper (1993) notes that the peak in medic consultations tends to occur three days after arrival offshore.

2.3 SICKNESS ABSENCE

Relatively few analyses of sickness and absence among offshore employees have been reported but Iversen (1991), analysing data collected in mid-1985, reported that absence rates among offshore personnel in the Norwegian sector (2.4% of work hours) were considerably lower than those among the Norwegian workforce as a whole (6%). Several factors may contribute to this apparently low rate of sickness and absence in the offshore population. In particular, there are stringent medical criteria for offshore work (see, for instance, Elliott, 1985; United Kingdom Offshore Operators Association, 1995), and all offshore personnel must have routine medical examinations at regular intervals; consequently, the offshore population is an exceptionally healthy workforce.

The use of formal personnel records for analysing sickness and absence rates is complicated by the fact that when an offshore employee is on an offshore installation, he or she is regarded as being at work even if temporarily not able to carry out normal duties through injury or illness. Thus, absences lasting a day or two, which form a significant part of sickness/absence statistics in an onshore workforce, do not normally appear on the formal records of offshore personnel. Some indication of the extent to which illness or injury offshore may result in time lost from work without medical evacuation is given by the Staffjord study; Hellesøy (1985) reported that, of those visiting the sickbay, 76% returned to work, 14% were given time off work but remained on the installation, and 14% were sent ashore (some individuals given time off were subsequently sent ashore).

The analyses reported by Iversen (1991) and Iversen *et al.* (1986) demonstrated significant relationships between number of days of absence due to illness and ratings of the physical and psychosocial environment. It is possible that the strain of coping with adverse work conditions gives rise to illness, but the cross-sectional, self-report nature of the data leaves the findings open to other interpretations.

Absence from work due to illness, whatever its cause, is damaging not only to individual morale but also to the productivity of organizations; recognition of the financial cost of such absences has led to the development of preventive programmes. Tuinman (1996) described three pilot programmes (exercise, smoking cessation, and an intervention to reduce absence due to back pain) designed to reduce sickness absence and improve psychological well-being among onshore oil industry employees.

Neither exercise, nor smoking cessation, was found to have a significant impact on absence levels, although there were other benefits from these programmes. However, the back management programme (which involved information, ergonomic improvements, fitness testing and monitoring of absence) achieved its primary aim of reducing absence due to back problems; a reduction of 54% was recorded in the study group, as compared with a reduction of 25% in similar absences in the organization as a whole. Tuinman estimated that the cost effectiveness of the programme was such that it could be of potential financial benefit over a three-year period.

3. PSYCHOSOMATIC COMPLAINTS AND MINOR HEALTH PROBLEMS

Much of the available information about psychosomatic complaints and minor health problems experienced by offshore employees has been obtained from survey data. In the Statfjord study, 'health profiles' were compiled from scores on health items, and comparisons made between different groups of personnel. Age was found to be one significant factor; although older employees reported a higher incidence of headaches than younger individuals, in most other respects they appeared to have a greater sense of well-being.

In terms of occupation, catering personnel reported higher levels of health problems, and operating company personnel lower levels, than other occupational groups. Gender effects may confound some of these apparent occupational differences; in general, women were found to report more health problems than men.

Comparisons were also made between those who did or did not report sickbay visits. As would be expected, those who had visited the sickbay tended to report more problems of physical health and general well-being than those who had made no visits; headaches were the most frequently stated cause of sickbay consultations, although 'flu-like symptoms and gastrointestinal symptoms were also quite frequently reported.

Several other studies also provide information about the self-reported health problems of offshore employees. For instance, Lauridsen *et al.* (1991) examined the frequency of psychosomatic complaints and minor impairment of well-being (including stomach troubles, headaches, leg cramps, and muscular tension) in a survey of male offshore personnel (N≈1600) employed by a large North Sea operating company. As in the Statfjord study, the proportion of employees complaining of problems varied by occupation; administrative and technical personnel, who tend to be in relatively sedentary jobs, were the most likely to report health problems.

However, and again as in the Statfjord data, the results also showed that age was an important factor; the highest average number of complaints was in the age groups between 30 and 45 years, with steadily decreasing averages for older age groups. The authors suggest two reasons for these age differences: first, beyond age 45 years, only the fittest employees remain offshore; and, second, older personnel are more likely to have reached senior positions in the organization, and consequently may be less exposed to adverse work environments.

The issue of 'survival of the fittest' in relation to psychosomatic problems is also raised by Milcarek (1993) in his analysis (based on survey data collected in 1980 and 1983) of job tenure among offshore catering personnel (a group known to have a high turnover rate). A relatively high incidence of psychosomatic problems was found to distinguish 'short-termers' (i.e. those with limited tenure in the job who had left before 1983) from 'indeterminants' whose employment status was unknown in 1991. Milcarek's explanation of his results is that selection processes resulted in 'acutely

non-adaptational types' being 'weeded out' of the workforce at a relatively early stage of their offshore employment. In contrast, chronic problems such as back pain, distinguished both 'short-termers' and 'long-termers' from the 'indeterminants'.

Other studies of minor health problems among offshore personnel have focused on particular occupational groups. Parkes (1993a, 1995) reported a study of control-room and production operators carrying out day/night shiftwork either onshore or offshore (N=172). Headaches and sleep problems were the most commonly reported minor health complaints, those working offshore being more likely to report such problems than those working onshore. Otherwise, onshore/offshore differences in the incidence of health problems were small, the offshore group (whose average age was younger than that of the onshore group) generally tending to show lower rates.

On the checklist of eight common health complaints, the reported incidence of problems in the study by Parkes was similar to that obtained by Vaernes *et al.* (1988) who used the same checklist with a small sample (N=89) of male shift-workers in the Norwegian chemical industry. However, the proportions reporting headaches in Parkes' offshore group (43%) and in that of Vaernes *et al.* (49.4%) were higher than the corresponding figure in the survey by Lauridsen *et al.* (1991). In their data, only 19% of shift workers reported headaches; Lauridsen *et al.* note the low value relative to previous studies (they quote 42%, citing Hakkinen, 1969).

A further source of information about psychosomatic complaints among offshore employees is provided by somatic scales of standardised mental health checklists, such as the General Health Questionnaire (Goldberg & Hillier, 1979). Relatively few studies have been reported in which somatic scales of this kind have been used with offshore populations; however, neither Parkes (1992) nor Cooper and Sutherland (1987) found that levels of somatic symptoms reported by offshore personnel were higher than those of their respective comparison groups.

The available evidence (albeit somewhat limited) does not suggest that psychosomatic problems are more frequent or more severe among the offshore population than among the onshore workforce. There is, however, evidence of links between the demands of day/night shift work and several types of health impairment which may partially account for some of the findings reported above. The topic of shift work and its impact on health in the offshore environment, and more generally, is further considered below.

4. OFFSHORE WORK PATTERNS AND HEALTH

4.1 SHIFT ROTATION

Numerous onshore studies highlight the potentially adverse health effects of shift work as compared with day work (for reviews, see Monk & Tepas, 1985; Monk & Folkard, 1992); some evidence also suggests that adverse health effects are apparent in past shift workers (Frese & Semmer, 1986; Vener *et al.* 1989), as well as those currently involved in shiftwork. Furthermore, prolonged exposure to shiftwork over a period of years has been shown to have cumulative adverse effects on health (Knutsson, 1989), and on sleep patterns (Foret *et al.* 1981), which are not accounted for solely by increasing age.

On North Sea installations, a significant proportion of the workforce (particularly those involved in production, maintenance, and drilling) is involved in round-the-clock operations. For these individuals, adaptation to shift changes imposes an additional source of stress over and above the more general demands of the offshore environment. However, the pattern of shift rotation is also important.

Research carried out in onshore work environments has shown differences between day/night shift rotation patterns in their effects on a range of health-related measures, including sleep duration and quality, circadian adjustment, psychosomatic complaints, job satisfaction, alertness, and accidents (e.g. Monk, 1986; Wilkinson, 1992). As a result of this research, the preferred 'fast rotation' patterns (in which only two or three consecutive night-shifts are scheduled, and periods of night work are interspersed with similar periods of day work and rest days) are increasingly being adopted onshore in place of weekly rotation systems.

On offshore installations, however, 12-hour shifts are the norm, and possible shift rotation patterns are much constrained by characteristics of the offshore environment, particularly remoteness and limited accommodation. The most common rotation pattern in the North Sea is one in which a shift change or 'rollover' occurs at the midpoint of the two-week duty period. Night work is usually scheduled for the first week, thus exposing personnel to the need for circadian adaptation very soon after arrival offshore, followed by readjustment back to day work after seven night shifts.

Under this arrangement, the break for rest and sleep between two work shifts during the rollover phase may be as little as five hours. The alternative shift pattern in which day/night rotation takes place on alternate trips allows 14 days or 14 nights to be worked consecutively without the mid-cycle rollover, but in spite of its potential advantages in reducing the frequency of day/night shift rotations, this pattern is less widely adopted than the 7/7 system.

The most extensive study of relations between offshore shift schedules and health problems is that of Lauridsen *et al.* (1991). This survey focused on health and psychosocial factors in relation to the main shift patterns in use in the North Sea, including 06.00 - 18.00 day work, rotating and non-rotating 06.00 - 18.00 / 18.00 -

06.00 shifts, and rotating and non-rotating 00.00 -12.00 / 12.00 -24.00 shifts (all times given in terms of 24-hour clock). A wide range of health indicators, including measures of sleep disturbance, use of sleeping medication, headaches, muscular tension, and stomach problems, are examined for different occupational groups.

As would be expected, shift patterns involving rotation tended to show a poorer profile on the health-related measures than non-rotating patterns. In general, the least favoured rotating pattern was 00.00 - 12.00 / 12.00 - 24.00; the authors note that, among those working such shifts, many have problems 'switching their circadian rhythms' on arrival offshore, and as soon as this adjustment is achieved, the shift in working hours from 00.00 - 12.00 to 12.00 - 24.00 brings new adaptational problems.

Individual differences are also important in relation to shiftwork adjustment; in particular, age is a critical factor. Shiftwork adaptation tends to become more difficult with increasing age (e.g. Akerstedt, 1990; Monk & Tepas, 1985); evidence suggests that at ages of about 50 years and above, shiftwork may impose very severe strains. Parkes (1994) examined age in relation to sleep patterns among onshore and offshore personnel working 06.00 - 18.00 / 18.00 - 06.00 rotating shifts. It was found that age was negatively related to sleep duration and, to a lesser extent, to sleep quality; however, there was no evidence to suggest that older personnel who worked offshore experienced more sleep difficulties than those working onshore.

A further relevant finding of Parkes' study was that number of years of shiftwork was negatively related to sleep duration, over and above the effect of age. This result raises the possibility of a cumulative adverse effect of rotating shift work on health, an inference supported by research showing that the relative risk of heart disease among shift workers increased progressively as shiftwork exposure increased from 11 years to more than 20 years (Knutsson *et al.* 1989). In view of the increasing age profile of the North Sea workforce, and of the demanding nature of offshore shift patterns, the possibility of cumulative adverse health effects of offshore shiftwork merits further research attention.

4.2 WORK/LEAVE CYCLES

Offshore work/leave cycles have few direct equivalents onshore, although Shrimpton and Storey (1993) note the analogy with work in Australian 'fly-in' mines which also involves periods of working and living in remote areas interspersed with home leave. The majority of North Sea personnel work rotas based on two-week offshore duty periods, usually alternating with two-week leave periods (2-2 pattern).

However, 3-3 rotas (three weeks of offshore work alternating with three weeks of leave) are becoming more common, and services personnel (who provide short-term specialist assistance offshore, for example, in computer applications, sub-sea operations, and safety systems) often have very irregular schedules depending on operational requirements at any particular time. Thus, among the North Sea workforce as a whole, a variety of different work/leave cycles are in current use.

Furthermore, on any one installation, several different work/leave patterns may be in operation. Thus, in some occupations (for example, catering), a three-week rota is not uncommon, irrespective of the schedules worked by others on board; conversely, some operating company personnel may work a schedule with alternate two- and three-week leave periods interspersed with two weeks offshore, rather than the usual 2-2 pattern.

In addition, either through personal choice or as a company requirement, Offshore Installation Managers (OIM's) do not always work the same schedule as other personnel. Flin and Slaven (1992) reported that in their sample of OIM's (n=134), 54.5% worked rotas based on two weeks' offshore, 25.3% worked one-week rotas, 14.2% three- or four-week rotas, and 2.2% variable rotas (3.7% gave no response).

In spite of this diversity of offshore work patterns, almost all the existing literature on health and psychosocial factors among North Sea personnel relates to individuals working 2-2 schedules. There appears to be no published research which compares the different offshore work/leave patterns in use in the UK sector in terms of the health and performance of personnel. Indeed, a study by Soviet scientists (Aleksperov *et al.* 1988) which examined the physiological effects of different work/leave patterns on drilling rigs in the Caspian Sea, is virtually the only published literature specifically addressing the issue of offshore work/leave cycles. The findings led the authors to recommend that, of the two schedules studied, the one-week work/rest cycle should be adopted rather than the two-week cycle.

The possibility that the use of 3-3 schedules may be an increasing trend offshore (particularly when economic conditions necessitate cost-reduction measures) is a source of concern to many of those presently working 2-2 schedules. In the absence of any existing empirical evidence, a strong case can be made for systematic research to be undertaken to investigate the possible effects of such schedules on the physical and mental well-being of offshore personnel and their families. This issue merits particular attention in the context of day/night shift rotation which, as outlined in Section 4.1, imposes adaptational demands on the personnel concerned over and above those of the offshore environment more generally.

5. MENTAL HEALTH AND STRESS OFFSHORE

Mental health disorders account for 4-5% of the total medical evacuations (Norman *et al.* 1988; Horsley, 1996, in press) but this proportion represents the 'tip of the iceberg' rather than the overall levels of distress in the offshore population. Information about sub-clinical levels of mental disturbance comes primarily from self-report symptom checklists, some of which assess general symptomatology, while others provide separate measures of specific types of symptoms, such as anxiety, depression, and social dysfunction.

In the material presented here, findings relating to mental health in the offshore population are considered under three main headings: information about patterns of psychological distress, and types of symptoms reported; comparison of mental health in onshore and offshore personnel; and, psychosocial and physical environment factors linked to mental health among offshore personnel.

5.1 PATTERNS OF PSYCHOLOGICAL DISTRESS OFFSHORE

In the Statfjord study, four dimensions of mental health impairment were identified, social isolation and depression, apathy and concentration problems, irritability and anxiety, and worries about home and work; these dimensions were found to be significantly related to a measure of physical health. When the four main occupational groups were compared, catering personnel were found to report the highest levels of anxiety and depression, while operator personnel showed average or lower than average scores on each factor.

Overall, it was found that women tended to report higher levels of distress than men; this finding, which is common to many studies of gender differences in relation to mental health, may explain the high levels of symptoms among catering personnel who include a relatively high proportion of women.

Evidence suggests that anxiety may be a particular problem among offshore personnel. Parkes (1992) found that several symptoms of anxiety were particularly characteristic of the offshore group in her study. These symptoms included '*felt constantly under strain*', '*been getting scared or panicky for no good reason*', and '*been feeling strung up and nervous all the time*'.

Thus, it appears that the offshore environment is associated with feelings of pervasive tension and apprehension, rather than more specific aspects of anxiety. North Sea employment exposes offshore personnel to a variety of psychosocial and physical stressors, and potential hazards, which could underlie this pattern of symptoms. Anxiety is also known to be linked to concerns about job insecurity (Fenwick & Tausig, 1994), which has become a major issue for many North Sea personnel in recent years.

5.2 COMPARISONS OF MENTAL HEALTH IN ONSHORE AND OFFSHORE PERSONNEL

Comparison of the Statfjord study findings with those of other studies, or with data for onshore employees, is not readily possible as the survey items used by Hellesøy (1985) were not taken from standardised measures, and no onshore comparison group was studied. However, some researchers have used standard checklists or interviews to assess psychological symptom levels among offshore personnel, and/or have collected data from an onshore comparison group; these approaches allow mental health in offshore and onshore groups to be compared.

Cooper and Sutherland (1987) reported that "although overall mental well-being compares favourably with that of onshore industrial males and of male groups in general, a disturbingly high proportion of offshore workers score high levels of free-floating anxiety." (p.122). In contrast, Gann *et al.* (1990) found no differences between offshore and onshore oil company employees in levels of either anxiety or depression, as assessed by a brief standardised interview. Parkes (1992, 1993a) reviews possible explanations for the conflicting findings obtained in these studies, and reports a comparison of the mental health and work perceptions of oil industry production operators working either onshore or offshore.

Parkes' study showed significantly higher overall levels of symptoms in the offshore group as compared with the onshore group. Furthermore, the offshore group was not found to have lower levels of symptoms than a cross-sectional sample of men employed in onshore industry (Banks *et al.*, 1980). A lower level would be expected among offshore personnel in that they are a particularly 'healthy worker' group, screened to preclude psychiatric as well as medical problems. In contrast, the onshore group reported symptom levels significantly lower than the comparison data.

Further analyses (Parkes, 1993a, 1993b) demonstrated that elevated symptom levels in the offshore group were very largely accounted for by anxiety symptoms. In addition, these high anxiety levels were significantly associated with above-average age (relative to the group as a whole), and with the Type A 'speed and impatience' component (characterised by a tendency to act quickly, a dislike of delay, and lack of patience). Neither age nor Type A traits predicted anxiety in the onshore group. Sutherland and Cooper (1991) also found that a measure of Type A behaviour significantly predicted mental health in offshore employees.

5.3 MENTAL HEALTH IN RELATION TO THE OFFSHORE ENVIRONMENT

Mental health problems among offshore personnel have often been linked to the nature of the environment in which they live and work. Particular sources of stress identified include the remote and isolated location of many North Sea oil and gas installations; adverse physical environment; confined work and living conditions; lack of privacy;

perceived hazards of offshore work and helicopter travel; demanding shift systems; fluctuating workload with an alternating pattern of boredom and high activity; job insecurity; separation from family and local community; and domestic problems associated with 'intermittent husband syndrome'.

These factors have implications for mental well-being in terms of anxiety, depression and other symptoms of distress, and also for job-related affective responses such as job satisfaction. In the present review, research into relations between environmental factors and the mental health of offshore personnel is divided into studies which examine mental health variables in relation to installation characteristics such as size and location, those which focus on the physical environment (for example, noise and ventilation), and those concerned with the psychosocial environment. Almost all these studies are based on cross-sectional survey data; in considering the findings, the limitations of this type of research (particularly the problem of identifying underlying causal factors) should be noted (see Section 5.3.4).

5.3.1 Physical characteristics of offshore installations

Evidence suggests that age, location, size, and type of installation are all linked to measures of mental well-being among offshore personnel. For instance, Sutherland (1993) reported that, in terms of mental health, installations in the Southern UK sector compared favourably with those in the more remote Northern and Central sectors; fixed platforms compared favourably with drilling rigs; and smaller installations compared favourably with larger ones. Consistent with these findings, Lauridsen *et al.* (1991) noted that the reported incidence of health and sleep complaints differed markedly between the twelve installations in their study.

The age of offshore installations is also related to satisfaction among offshore employees. Iversen, Marek and Hellesøy (1986), comparing three platforms in the Statfjord field, found that personnel working on the newest platform reported higher levels of satisfaction than those on the older ones. This finding can be attributed in part to the generally improved design standards, the wider range of recreational facilities, and the better state-of-repair of the living accommodation, on these platforms. However, it is also the case that new installations can attract (often from an existing offshore workforce) particularly highly motivated and adaptable personnel; thus, selection effects may contribute to the favourable responses which often characterise employees on newer platforms.

5.3.2 Physical environment

Factors such as noise, vibration, lighting, ventilation, adverse weather conditions, and confined living accommodation and work space, are also potential stressors for North Sea employees; empirical evidence suggests correlations between ratings of noise and other physical environment stressors and measures of psychological well-being (Hellesøy, 1985). However, the extent of exposure to adverse physical conditions in the offshore environment differs across occupational groups.

For instance, drill crews are particularly likely to be exposed to noise, vibration, and chemical contaminants, while cold or wet weather is more likely to be a source of stress to personnel working on the deck. Conversely, administration and catering personnel tend to be affected by poor ventilation and air quality in the accommodation areas and, in some cases, by lack of daylight. Occupational differences of this kind were found in the Statfjord study; for example, a higher proportion of drillers than catering personnel reported dissatisfaction with noise levels and cold ambient temperatures, whereas the opposite was true for dissatisfaction with ventilation.

5.3.3 Psychosocial environment

In considering the nature and impact of environmental stress on mental health among offshore personnel, it is important to take into account not only physical installation characteristics and other objective features of the offshore work situation, but also the *psychosocial environment* as subjectively perceived and interpreted by the personnel concerned.

Psychosocial stressors identified in offshore studies include time pressures, workload levels, lack of control over work tasks, monotonous work, lack of social support and co-operation, perceived risks, threats to job security, work schedule problems, constraints of living offshore, and concerns about relationships at home and work. Relations between scores on these dimensions and measures of health and job satisfaction have frequently been reported. These studies depend largely on self-report questionnaires for the assessment of both psychosocial dimensions and health outcomes although, in some cases, information from formal records (e.g. accident data or frequency of sick bay visits) is also analysed.

To date, the Statfjord study is the most extensive published research of this kind; much of the material reported by Hellesøy (1985) is concerned with relations between perceptions of the work environment (including job characteristics, safety, hazards and risks, social support, and other aspects of the offshore work situation) and measures of well-being (including job satisfaction, and mental and physical health). Mean scores, and relationships between work perceptions, perceived risks, job satisfaction and health measures, are reported separately for four personnel groups (operator personnel, catering, drillers, and flotel crew). Among the many findings linking subjective measures of social and organizational factors to mental health outcomes, it was clear that relations between the various dimensions assessed and measures of job satisfaction and health differed for the four groups.

Other studies that report significant associations between the perceived work environment and the health and job satisfaction of offshore employees include those by Iversen (1991), Rundmo (1992), Cooper and Sutherland (1987), Sutherland and Cooper (1991), and Lauridsen *et al.* (1991). The work of Rundmo (1992) focuses on perceived risk and its association with working conditions; although mental health is not central to this research, Rundmo reported that individual differences and perceived risk jointly predicted psychological symptom levels.

More directly concerned with mental health outcomes, Sutherland and Cooper found that two psychosocial factors ('relationships at work and home', and 'living in the environment') predicted psychological symptoms among offshore personnel, although personality, particularly Type A behaviour, was the strongest predictor. Consistent with the hard-driving, competitive, and impatient style inherent in the Type A personality construct, Whyte (1991) emphasises that the main instigator of stress in the offshore environment is time pressure, associated with a 'time is money' attitude.

5.3.4 Limitations of survey research

It is clear from studies such as these that there are significant empirical associations between offshore work conditions (as reflected in the physical characteristics of installations, in the physical environment, and in psychosocial measures) and mental health (or conversely mental distress) among offshore personnel. In theoretical models, work conditions are seen as playing a *causal* role in relation to these mental health outcomes.

However, it should be emphasized that the research methods used in the studies cited above do not allow the nature or direction of causal effects to be identified. Cross-sectional data provide only an instantaneous 'snapshot' of conditions at one time. Thus, causal effects of work conditions cannot be distinguished from effects due to the selection and 'survival' of particular types of individuals in the offshore environment; more probably, a combination of these environment and person factors is involved.

Furthermore, differences in work perceptions and health measures associated with characteristics such as type (e.g. drilling versus production), age and size of installation, and with different occupations, may be confounded by unmeasured or unknown differences in other demographic, physical, psychosocial, or organizational factors. Associations between self-reported work perceptions and health measures, are also open to a variety of interpretations; in particular, *negative affectivity* (the tendency to view both self and environment in a negative light) acts to inflate correlations between self-report measures of the perceived work environment and mental health, thus overestimating the actual magnitude of such relations.

An additional problem is that few surveys achieve a complete or near-complete response from the target population; indeed, response rates as low as 25-40% are not uncommon when questionnaires are sent out by mail (e.g. Cooper & Sutherland, 1987; Flin & Slaven, 1992; Sutherland & Cooper, 1991). Individuals who respond to such surveys tend to differ in psychological and psychosocial characteristics from those who do not; thus, low response rates give rise to further difficulties of extrapolating findings from a limited and possibly unrepresentative sample to a wider population.

6. HEALTH BEHAVIOURS AND LIFESTYLE

Whilst research reviewed above focuses primarily on the role of the offshore environment in relation to the physical and psychological well-being of offshore employees, individual lifestyle and health behaviours are also significant factors. In this section, findings relating to smoking, alcohol, drug use, diet and exercise among offshore personnel are considered.

6.1 SMOKING

Smoking is known to be a significant risk factor for many major diseases including cardiovascular disease, strokes, and lung cancer; it is also associated with increased rates of other illnesses, particularly respiratory problems, and with higher levels of sickness absence (e.g. Parkes, 1987). The incidence of smoking among offshore personnel, and the factors which affect it, are therefore important concerns of occupational health professionals in the oil industry. Gann (1989), in a study of cardiovascular disease risk factors in an offshore workforce, reported an overall figure of 31% of smokers among the 1066 male operating company employees in his sample. However, the rate varied with age, the highest proportion (34%) being in the 35-44 years age group.

In a more recent study, Horsley and MacKenzie (1996) found 37.2% smokers in a heterogeneous sample of 507 male offshore personnel. Of the 188 smokers, the majority reported smoking an average of 11-20 cigarettes per day; however, respondents tended to smoke more during offshore duty periods than during leave periods. The proportion of smokers found by Horsley and MacKenzie agrees closely with the overall value of 36.5% obtained from a recent survey of 1287 male offshore workers (Parkes & Clark, 1996); however, there were highly significant differences between different occupational groups in this latter sample.

For instance, only 25.3% of production operators reported smoking as compared with 44.1% and 48.1% among construction and drilling workers respectively. It was also found that among operating company personnel, the rate of smoking (27.3%) was comparable with Gann's (1989) data, and significantly lower than that among contractor personnel (40.7%). Data published by Cox *et al.* (1987) suggest that social class may partially explain these occupational differences in rates of smoking. However, it is more difficult to account for the high rate of smoking among women working offshore. In the (albeit small) sample of 44 women (primarily catering personnel) in the survey by Parkes *et al.*, 56.8% reported that they smoked as compared with 45% and 37% for unskilled and semi-skilled women, respectively, in the Cox *et al.* data.

As compared with the 1990 figures for smoking by males in Great Britain as a whole (31%) and in Scotland (34%) (Scottish Home and Health Department, 1991), the rates of smoking noted above are relatively high (particularly among contractor personnel) in spite of the fact that smoking on offshore installations is restricted to very limited areas of the accommodation. Gann (1989) points out that duty free cigarettes are

available to all personnel working on North Sea installations, concluding that "With the current state of industrial relations offshore, it is unthinkable that the oil industry would attempt to curtail this perk". Horsley and Mackenzie (1996) make a similar point, noting that any attempt to change current duty free arrangements would meet with stiff opposition.

Tuinman (1996) reported that onshore employees in a Netherlands oil and gas company had a 34% rate of smoking in 1994, and that the smokers had an excess of sickness absence per year of six calendar days per person. It is likely that a similar effect of smoking on sickness absence would be found in the offshore population, but at present there appears to be no information about health problems in smokers and non-smokers among offshore personnel.

6.2 ALCOHOL

A total ban on alcohol on offshore installations is strictly enforced. However, excessive use of alcohol by some employees while on shore leave, with residual effects after their return to the installation, is a potential cause for concern. Several studies have examined the alcohol consumption rates reported by offshore workers. Aiken and McCance (1982) found that 30% of their sample reported drinking in excess of 56 units in the week prior to offshore duty. Similarly, a mail survey of offshore personnel found that 24% of the sample reported regularly consuming more than three drinks a day (Sutherland & Cooper, 1986).

More recent data suggest that alcohol consumption rates among the offshore workforce remain relatively high; Horsley and MacKenzie (1996) reported that 32% of offshore workers claimed to drink more than 21 units a week (the recommended 'safe' level at the time) as compared with a value of 24% for the general male population in Scotland (Scottish Home and Health Department, 1991). These authors reported an association between alcohol consumption and living alone, and also a positive correlation between age and alcohol consumption. Whereas the former finding is common to national trends, the latter does not agree with national figures which show a decrease in alcohol use with age (e.g. Cox *et al.* 1987).

Whilst there appears to be no empirical evidence about patterns of drinking among offshore personnel during shore leave, anecdotal evidence suggests that in some cases, 'binge' drinking immediately before returning offshore may impair the safety and quality of work during the first few days of offshore work. Sutherland and Flin (1989) note the possibility that some workers commence their tour of duty in a post-alcoholic state. Similarly, Hellesøy (1985) reported that problems with alcohol during the transition from onshore leave to offshore work are linked to mental problems during the work period, but the Statfjord study does not include any specific information about levels of alcohol use. On a more serious level, Horsley (1996, in press) reported that among the 78 cases of mental disorders necessitating routine medical evacuation, there were 7 cases of alcoholic psychosis.

6.3 DRUG ABUSE

Reliable information about drug abuse among offshore personnel is not easy to obtain. Cox and Norman (1987) noted that "There is little evidence that hard drugs are a serious problem in the offshore workforce, though 'pot' is undoubtedly in frequent use, perhaps especially among the divers" (p.98). These authors point out that drug use can lead to dangerous operational and legal liability situations, and should not be tolerated in any circumstances. However, testing for drugs remains a sensitive issue, and primarily one for security personnel rather than for occupational health practitioners. In one of few empirical studies of drug abuse among offshore personnel, Calder and Ramsey (1987) found an incidence rate of 12% in a random sample of offshore drill crew whose urine was tested for the presence of cannabis residue.

6.4 DIET, OBESITY, AND EXERCISE

Considerable evidence has been published about the diet and exercise habits of offshore personnel, much of it (particularly that dating from the 1980's), suggesting that this population would benefit from becoming more health conscious. Gann (1989) compared onshore and offshore operating company personnel in terms of the body mass index (BMI, also known as the Quetelet index), a measure of weight in relation to height (Kg/m^2). The BMI was 7% higher in the offshore group than in the onshore group, the values being 25.65 ($n=723$, offshore) and 23.96 ($n=730$, onshore). Age, blood pressure, and cholesterol were found to be positively related to BMI.

In a separate study of offshore personnel, Light and Gibson (1986) assessed height, weight, and skinfold thickness in a sample of 419 male employees attending North Sea survival courses. The mean BMI value was 24.80 Kg/m^2 , somewhat lower than that found by Gann, but comparable to the values reported by Cox *et al.* (1987) for males in corresponding age groups in a large-scale survey of the general UK population. However, Light and Gibson also reported that 40.1% of their sample could be considered overweight using a standard classification system, and that an additional 5.5% were obese; comparing these values with published data, they found that the incidence of overweight was significantly higher among the offshore population than in the normative sample.

Cox and Norman (1987) point out that, in addition to the well-known health risks associated with obesity, obese offshore workers may have considerable difficulty in climbing stairs and negotiating narrow walkways, and may also be a liability in an emergency. Some offshore workers (for example, drillers and deck crew) expend a considerable amount of energy in the course of their work, but others have largely sedentary jobs, and weight gain can be a significant problem.

Detailed evidence of unhealthy eating patterns among offshore oil workers in the Norwegian sector is reported by Oshaug *et al.* (1992); this study was based on interviews (carried out in 1985) in which 203 offshore personnel were asked about their food intake over the previous 24-hour period. The results showed that average daily intake was 12.2 MJ (approximately 3000 kcal), 44% of which came from fats,

39% from carbohydrates, and 17% from protein. These percentages reflected the proportions of different types of foods purchased in the preceding five-month period for the installations concerned.

As compared with Norwegian dietary recommendations, almost all the offshore personnel interviewed by Oshaug *et al.* were consuming too little carbohydrate, and too much fat and protein, as proportions of their total intake. The excess intake of fats was particularly marked, the average being nearly 50% higher than the maximum recommended value (30%). However, there was a wide range of variation in energy consumption, with some individuals eating more than six times as much as others on the day of the interview.

As compared with the 1980's, more attention is now given to 'healthy eating' offshore, particularly to reduction in fat intake, and increase in fruit and vegetables. Nonetheless, the provision of meals every six hours (to cover both day and night shifts) is conducive to over-eating, particularly as meal breaks provide the main opportunity offshore for relaxing and socialising. Fenn (1994) reported that the average daily intake of energy by offshore employees of a major gas company was 3091 kcal, a value which closely corresponds to that reported by Oshaug *et al.* More recently, Horsley and Mackenzie (1996) reported that, when asked to rate their dietary habits on a 10-point scale (from unhealthy to healthy), the majority of respondents (64%) in their sample gave scores of 5-7, again suggesting scope for improvement in the diet of offshore personnel.

The extent of energy expenditure among offshore employees is also relevant in relation to dietary intake. As noted above, some offshore workers expend considerable energy in the course of their work, but this is not true of all North Sea personnel. Although many offshore installations provide gymnasium facilities, Light and Gibson (1986) reported that very few of their sample participated in any form of active leisure-time pursuit during their offshore work period. In contrast, 41% of respondents in the survey by Horsley and MacKenzie claimed to undertake some form of regular exercise while offshore, and a slightly higher proportion when onshore.

6.5 LIFESTYLE PROGRAMMES

On the basis of the age profiles of the offshore population in 1986, and the mortality rates for coronary artery disease in England and Wales, Gann (1989) estimated that the death rate from coronary disease among offshore personnel could increase six-fold by the turn of the century. Increased rates of heart disease in offshore personnel would present a significant management problem, and Gann identified smoking and diet as particular targets in attempts to lessen cardiovascular risk factors among the offshore population.

The likelihood of an increasing incidence of cardiovascular disease in the offshore population highlights the significance of the 'lifestyle' programmes introduced by several major oil and gas companies in recent years. One of the most extensive of these initiatives is the 'Lifestyle' plan described by Lobban (1996) as a "major health,

fitness and safety motivational programme". This programme, which is run by an independent contractor, has several areas of focus, two of which are particularly relevant here.

- The '*Fit for Life*' programme offers two levels of health screening, vision testing, and opportunities for sports activities. All screening is carried out by 'Lifestyle' nurses, and all information obtained remains confidential to the individual and is not reported to the sponsoring company. A 'mini-health check' (covering weight, height, blood pressure and cholesterol level) is offered in addition to a more comprehensive assessment, with the aim of encouraging those who are less motivated to become involved. This program is now in full operation; about a quarter of nearly 6000 assessments carried out up to the end of 1994 were reassessments, thus allowing changes in health status (e.g. reductions in smoking and alcohol consumption, excess weight lost, high blood pressure reduced) to be examined.
- The '*Food sense*' component of the programme aims to encourage and promote healthy eating; as implemented offshore, it seeks to establish a dialogue with catering staff and platform personnel, including arranging visits by a nutritionist to provide nutritional advice and to generate interest in healthy eating.

Other oil and gas companies have also introduced sophisticated health screening programs; for instance, one major North Sea operating company is currently equipping offshore installations with the 'Pulsebeat' computer-based screening program and providing medics with training in its use. This program guides the participant through a series of fitness tests including, for instance, body fat, blood pressure, flexibility and stamina. It also records information about smoking, alcohol consumption, and exercise. Confidential feedback to participants is provided in the form of a personalised booklet giving test results in relation to normative standards on each measure, and exercise, healthy eating, and stress management recommendations.

7. GENERAL DISCUSSION

It is clear from the material reviewed above that considerable research effort has been directed towards understanding the physical and psychosocial environment of North Sea oil and gas platforms, and its implications for the health of offshore personnel. Whilst the evidence demonstrates that a significant proportion of offshore personnel experience minor health problems and psychological distress, and a small proportion are involved in serious health emergencies, either through illness or accident, the picture that emerges is in many respects a confusing one. In particular, it is difficult to identify particular causal factors in the environment, or even consistent trends in the findings. However, as outlined below, a number of issues common to several studies can be identified.

- The potential problems associated with the increasing age profile of the offshore workforce have been a source of concern in the oil industry for some years. In the literature reviewed here, age is frequently reported to be a relevant factor; however, the findings present an ambiguous picture. On the one hand, older individuals tend to report fewer health problems than their younger counterparts, and are less likely to visit the sickbay. On the other hand, age is positively related to the proportion of medical evacuations necessitated by illness rather than injury. It is inherently difficult to predict future trends and long-term health patterns. However, several authors have pointed out that evidence relating to the age profile of offshore personnel, their current health status, and their dietary patterns, suggests that the incidence of heart disease is likely to become an increasingly serious problem in this occupational group (Gann, 1989; Horsley & MacKenzie, 1996; Oshaug *et al.* 1992).
- Production and drilling operations on offshore installations involve round-the-clock work, requiring operators to work day and night shifts. Evidence from onshore research highlights the health implications of shift work. This research is also relevant to the offshore situation, although the shift rotations worked offshore are particularly demanding, and the typical 12-hour shift duration is longer than that normally worked onshore. The literature reviewed suggests that the health and sleep patterns of offshore shift workers are impaired relative to those of offshore employees who work day shifts. Drill crews are perhaps exposed to the most demanding conditions; they usually work a 00.00 - 12.00 / 12.00 - 24.00 shift rotation pattern rather than the more favourable 06.00 - 18.00 / 18.00 - 06.00 schedule, their work is physically and/or mentally demanding, and they are often exposed to noisy and cold conditions. Furthermore, work on the drill floor is potentially hazardous and can lead to serious accidents, as is shown by the fact that this occupational group accounts for a disproportionately high number of medical evacuations for injury.
- Very few systematic comparisons of onshore and offshore oil industry employees have been carried out; thus, it is difficult to determine whether the health of offshore personnel is more likely to be impaired by their work

experience than that of their counterparts working onshore. One problem is that the medical criteria for the recruitment of offshore personnel are more stringent than for those onshore; thus health differences between onshore and offshore personnel may be solely or partly attributable to selection effects. Without long-term studies it is difficult to determine the extent to which health outcomes derive from initial selection processes and pre-existing individual differences, as compared with the cumulative effect of work demands and offshore living conditions. The issue is further complicated by differential 'survival' effects, arising from the fact that less healthy individuals are more likely to move to similar jobs onshore or to leave the industry altogether.

- In recent years, the oil and gas industry has undergone major structural changes, one of the main effects of which is down-manning; as a result, redundancy and job insecurity have become major sources of concern in the industry. Equally, down-manning implies increased workloads for those who stay, and may necessitate multi-skilled operators; thus, the remaining employees are exposed to additional demands both quantitative and qualitative in nature. Research in the oil industry has yet to document the effects on mental and physical health of these changes, although the damage to the morale and security of the workforce is widely recognised.

Most of the research cited in this review dates from earlier stages of North Sea development when the problems facing the industry were different from those which are currently of concern. A particular problem is that so much reliance has still to be placed on the Statfjord study for information about health and work conditions offshore. To date, this study remains the most comprehensive data set available, but it has two major limitations. First, conditions on North Sea installations have changed greatly since 1980 when the Statfjord data were collected, and up-to-date information is required to understand the offshore work environment in the 1990's.

Second, the Statfjord data were collected from personnel in the Norwegian sector, and thus relate to a largely Norwegian workforce. The findings may therefore not closely reflect psychosocial conditions and health in the UK sector. In particular, Moore (1988) highlights the striking contrast between the British and Norwegian sectors of the North Sea; he notes the comments of one observer who compared the "pub culture" of the British offshore worker with its "warm sociability" of card-playing, dominoes, and organised activities, with the "the Norwegian worker sitting in his cabin thinking of home, or of his boat" and vulnerable to becoming withdrawn or "lonesome". Whilst the "pub culture" analogy may not have been entirely valid even in the 1980's, these observations highlight important cultural differences and raise the question as to what extent findings from studies of psychosocial factors and health among personnel in the Norwegian sector are applicable to the UK sector.

In the light of these points, there is a need to identify particular areas of offshore research which could most usefully be addressed in the future. On the basis of the material reviewed in this report, a number of such topics are outlined below.

- Medical evacuations provide a potentially useful source of information about offshore health, and important aspects of these data have not yet been fully explored. For instance, is there statistical evidence for the widely-held view that stress-related evacuations have increased markedly in recent years? If so, can any common themes (e.g. quantitative or qualitative work overload, family problems, job insecurity) underlying these evacuations be identified? Such information could potentially throw light on less serious, but none the less significant, problems of stress among offshore employees in general.

A further question of interest in relation to medical evacuations is whether certain groups (e.g. those characterised by smoking, overweight, or other potentially unfavourable lifestyle patterns) are disproportionately represented among those requiring evacuation. If so, such information would provide further impetus to the implementation of smoking cessation and other health promotion programmes.

- Offshore employees are required to undergo regular medical examinations at periodic intervals; information from such examinations could potentially provide valuable information about changes in health, among offshore personnel. The introduction of computer-based health and fitness assessment programs onto some offshore installations could facilitate the collating and analysis of medical and psychosocial data in an anonymous form.
- To date, there has been relatively little attempt to combine medical and psychological research in the offshore environment. There would be considerable advantages in more collaborative work; at present (and to the detriment of both) medically-oriented work tends to ignore psychosocial aspects of the work environment, while psychological work lacks biomedical input. One area in which a combined medical, physiological and psychological approach would be especially valuable is the question of offshore work patterns, as reviewed in Section 4. In particular, very little information is presently available about the effects of different work/leave schedules on the work effectiveness, and the physical and psychological health of offshore employees, or on the general well-being of their families.
- Women at present make up only a small proportion of the offshore workforce in the UK sector. In contrast, in the Norwegian sector, approximately 30% of the offshore personnel are women. The proportion of women in the UK offshore sector is likely to increase in parallel with the more general trend (noted by, for instance, Hughes, 1995; Rossi, 1993) for women to move into non-traditional occupations. Thus, there is a need to assess whether there are any particular health issues that may need special attention in women offshore. In this context, research into the physical and mental health of women working in the UK sector, considered jointly with information about the experience of Norwegian oil industry in this context, would be valuable.

- As noted above, the age profile of the offshore workforce is increasing, with the result that significant proportions of those employed offshore are now in their late 40's or older. More information is needed about the adaptational patterns of these older offshore personnel. To what extent do the advantages of age compensate for the disadvantages? Are there particular problems of adaptation for older personnel working offshore day/night rotating shifts? Which is more important in relation to health, age *per se* or duration of exposure to the offshore environment? Research into the effects of age on the health of offshore personnel highlights the more general need for longitudinal prospective studies of psychosocial and biomedical factors among offshore employees.
- Existing offshore research has largely ignored one of the most important issues in the stress literature, that of coping behaviour. Thus, little is known about how offshore personnel and their families attempt to cope with the psychosocial demands of offshore work and the offshore lifestyle more generally. Several related questions are relevant in this context. What forms of coping are most effective in terms of promoting favourable adaptation to the offshore work situation? Do individuals with particular backgrounds (e.g. merchant navy) develop coping patterns which facilitate adaptation to offshore work? Is effective coping constrained by environment factors offshore? Some evidence suggests this may be the case (Parkes, 1986). How can families collectively cope with the intermittent work/leave pattern of offshore employees? Are there particular patterns of effective coping among offshore spouses?
- In recent years, increasing numbers of offshore personnel have been offered 'Employee Assistance Programmes' (EAP's) run by independent contractors, and accessed in the first instance by telephone. Such programmes are well-suited to the particular features of the offshore environment, but there is presently little information about the uptake of such assistance. For instance, what kinds of individuals make use of EAP's? Do they find them helpful? To what extent are the problems for which EAP help is sought work-related rather than domestic or personal in nature? Is there a measurable difference in psychological well-being between installations which do or do not have such programmes in place? If so, to what extent can the difference be attributed to the EAP? Information of this kind would provide guidance to operating companies as to the most effective way to develop and focus such programmes.
- Finally, it is important that future psychosocial research in the offshore environment seeks to remedy the weaknesses in conceptual framework, in methodology, and in statistical techniques, which currently characterise much of the available research. This weakness is particularly marked in comparison with the general level of current research publications into occupational stress, the psychosocial work environment, and health. There is a need for offshore research to be represented in the wider literature on psychosocial factors and work-related stress generally, rather than remain a backwater of specialist reports.

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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***

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HSE BOOKS

FOREWORD

The North Sea work environment has undergone extensive 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 current information about work and health in the offshore environment. The present research, under the general title '*Psychosocial aspects of work and health in the North Sea oil and gas industry*', seeks to contribute up-to-date findings in several areas of topical importance to the offshore oil and gas industry. The research was carried out by Oxford University with funding from the Health and Safety Executive, Offshore Safety Division; the main data collection took place during 1995-1996. The work is reported in four parts:

Part I reviews the available research literature relating to work and health (including psychosomatic complaints, mental health and stress, and health behaviours) among offshore personnel. General aspects of the psychosocial environment on North Sea installations and specific issues, such as offshore shift rotation, are considered; areas in which information is currently lacking are highlighted.

Part II reports a small-scale follow-up study which evaluated changes in mental health and job satisfaction in onshore and offshore personnel over the period 1990-95. A marked feature of the findings is the significant increase in perceived workload and anxiety in the occupational group concerned (production operators), both onshore and offshore, over a five-year period of re-structuring and down-manning.

Part III addresses the issue of offshore day/night shift rotation patterns. Repeated assessments of sleep, mood, and cognitive performance (e.g. reaction time, memory, reasoning) over the two-week offshore work cycle clearly demonstrated the adverse effects of a mid-cycle shift change as compared with a fixed-shift schedule in which either days or nights are worked for the entire two-week period.

Part IV presents the main findings of a survey of the perceived physical and psychosocial work environment, safety, health and job satisfaction among offshore personnel (N=1462) on 17 offshore installations. Overall, the offshore sample did not show elevated levels of stress symptoms relative to comparable onshore groups, but job types, shift patterns, and installation characteristics were significant predictors of safety, work, and health measures.

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. It is hoped that, in reflecting current offshore work conditions, the research findings will be of interest not only to the participating companies but also to the North Sea oil and gas industry more generally, and that the work 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.

SUMMARY

This report describes a small-scale follow-up study of psychosocial factors and health among onshore and offshore control-room operators and production personnel in the oil industry. The initial data were collected in 1990 from employees (N=172) of a major North Sea oil and gas company. The work reported here covers collection of the follow-up data in 1995 (N=104), and analysis of the longitudinal data set.

The results showed a significant increase in anxiety over the follow-up period; this finding applied both onshore and offshore, and in all sub-groups defined by 1995 job situation (except those who had retired). In 1995, no significant onshore/offshore difference in anxiety was found, in contrast to the higher anxiety observed offshore in 1990. Increased anxiety was partly accounted for by increased workload. These results are consistent with the down-manning which took place in the company during 1990-95, and with the resulting job insecurity and low morale among the workforce.

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.

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1. INTRODUCTION

Offshore work imposes environmental and job-related stressors over and above those experienced in comparable onshore occupations. In particular, constrained work conditions, noise and other physical stressors, demanding shift patterns and associated sleep problems, helicopter travel, and isolation from family, may not only combine to produce short-term effects on the physical and mental health of offshore personnel, but may also have a longer-term impact. Little is currently known about the potential effects on health of continued offshore employment, although the increasing proportion of personnel with long exposure to North Sea work makes this an issue of current importance.

In this context, the major weakness of existing research into the psychosocial environment offshore and health of offshore personnel is that it is very largely based on cross-sectional survey data. This approach precludes any attempt to track patterns of change over time in the psychosocial work environment and the well-being of offshore personnel. Furthermore, data collected at only one point in time do not allow the nature and direction of causal effects to be reliably established; thus, our understanding of psychosocial stress in the offshore environment, and the development of effective intervention strategies, is inevitably limited.

The present study is intended as a pilot study of changes over time in psychosocial factors and health. It took advantage of an opportunity to follow up groups of onshore and offshore production workers who had originally participated in a survey carried out approximately five years earlier. In the material presented here, the 1995 follow-up data are analysed in relation to the original 1990 data set, with particular reference to changes in psychological well-being in relation to onshore/offshore location and changes in job situation. Changes in the perceived work environment are also examined. In addition, several measures of particular interest (including duration of shiftwork and offshore experience, sickness absence and self-reported health) are analysed, and comparisons made between onshore and offshore groups.

2. COLLECTION OF FOLLOW-UP DATA

Over a period of several months in 1989-90, data were collected from 172 male control-room operators and production personnel working either offshore (n=84) or onshore (n=88). Follow-up data were collected in 1995. For those still employed in 1995 (whether in the same company or elsewhere), information about psychological and physical health, sleep patterns, job satisfaction and work perceptions was obtained; for those not employed at time of follow-up, items relating to work perceptions and job satisfaction were omitted. In addition, sickness absence data covering the five-year follow-up period were included in the analysis.

3. 1995 FOLLOW-UP GROUP

3.1 FOLLOW-UP GROUP IN RELATION TO ORIGINAL SAMPLE

As it was not possible to trace all the original participants, the extent to which the 1995 respondents represented those in the original 1990 sample was examined. For this purpose, the 1990 group was divided into three sub-groups: *Group I* could not be traced in 1995 (n=24); *Group II* were sent follow-up questionnaires to their last known addresses, but either did not receive them, or did not respond (n=39); and *Group III* who were traced, and responded to the follow-up questionnaire (n=104). Of the five remaining individuals, two were deceased, and three had long-term illnesses and were unable to respond; they were added to *Group I*.

The proportions of the original onshore and offshore samples in each of these three groups were not significantly different. Further analyses were carried out to determine whether the groups working at different sites (3 offshore installations, and 5 onshore sites) in 1990 were equally represented in the follow-up sample. There was no evidence to suggest significant differences in the proportions followed up from each site, either onshore or offshore.

Overall, 60% of the original sample (104/172), and 73% (104/143) of the potentially available sample, were successfully followed-up in 1995. Multi-variate comparison of the three groups in terms of personality variables and symptom levels assessed in 1990 showed no significant differences. However, there were two relevant findings:

- Group I was significantly higher in average age than Groups II and III. As compared with the other groups, a higher proportion of Group I was aged 50+ years in 1990, and would therefore be more likely to have retired and moved away before 1995. However, the mean age of the follow-up group (47.4 years, N=104) in 1995 was very close to five years greater than the mean age of the original group (42.7 years, N=172) in 1990.
- Group II had significantly higher scores on the '*competitive drive*' component of Type A personality than Group III. However, this difference was not found for the second Type A component '*speed and impatience*' for which the Group II and Group III mean scores were almost identical.

Thus, Group III (on whom all the follow-up analyses were carried out) was broadly representative of the original 1990 sample. Furthermore, the response rate in 1990 was above 90%; thus, the initial sample closely reflected the target population.

3.2 CHARACTERISTICS OF THE FOLLOW-UP GROUP

Table 3.1 shows demographic and background characteristics of the follow-up sample for each of three 1995 employment categories: *working onshore*, *working offshore*, or *not working* (this latter group included both retired and unemployed). Those in the

latter group were significantly older than those in the other two groups, and were more likely to report having experienced a major health problem in the previous year.

Table 3.1
Characteristics of the follow-up sample

Employment situation in 1995			
	Working onshore N=47	Working offshore N=44	Not working N=13
Age (1995)	48.0 ± 6.0	43.9 ± 5.0	56.6 ± 6.9
% married	91.5%	88.6%	84.6%
Total years offshore	3.3 Range 0 - 18	13.4 ± 4.6 Range 1 - 21	7.8 Range 0 - 22
Total years of shiftwork	21.6 ± 6.7 Range 10 - 37	21.8 ± 5.7 Range 4 - 35	23.9 ± 7.0 Range 12 - 34
% reporting major health problem	21.3%	14.0%	46.2%

It is also clear from Table 3.1 that participants in the follow-up study had long experience of shiftwork, the average being in excess of 20 years in both the onshore and offshore groups. The offshore group reported an average of 13-14 years of offshore work. In contrast, those in the onshore group had an average of about 3 years offshore experience, but this value represented a very wide range; 55.3% of the onshore group had not worked offshore, while among the remainder the maximum offshore experience reported was 18 years.

3.3 JOB SITUATIONS OF FOLLOW-UP GROUP IN 1995

In 1995, employed respondents were asked for information about their current jobs. Table 3.2 shows the breakdown of responses divided into the onshore and offshore groups as identified in 1990. There was no difference between the onshore and

offshore groups in the frequencies shown in Table 3.2 (Chi-square=3.01, df=4, ns). Among those still in employment (n=91), some individuals had moved from onshore to offshore or *vice versa*, but the great majority had remained in the same location.

Table 3.2
Employment at 1995 follow-up

Employment situation	1990 Onshore group	1990 Offshore group
Still with same company (same job level)	22	27
Still with same company (promoted)	16	13
Moved to a different company	6	7
Unemployed	3	1
Retired	4	5
	51	53

Although the numbers of individuals moving from onshore to offshore or vice versa were very small (see Table 3.3), there were significant differences between those who moved, and those who remained in the same location. In particular, those who moved from onshore to offshore were significantly distinguished from others by their relative youth (mean age 35 years in 1990) and high achievement motivation, and by their perception of their onshore job in 1990 as relatively undemanding and low in autonomy. In summary, it appears that these individuals were seeking a challenge. In contrast, those who moved to onshore jobs were characterised by higher age, and poorer health.

Table 3.3
Changes in onshore/offshore location, 1990-1995

Job locations, 1990-95	N
Remained offshore	41
Remained onshore	41
Moved from onshore to offshore	3
Moved from offshore to onshore	6

4. MENTAL HEALTH CHANGES, 1990-1995

4.1 SYMPTOM LEVELS IN RELATION TO 1995 JOB SITUATION

Two measures of mental health (anxiety and social dysfunction, both measured by the General Health Questionnaire) were analysed using 1995 data from the entire follow-up group, and 1990 data from the same individuals (i.e. $N=104$ at both time points). Within-subject changes in scores on these measures were examined in relation to 1995 job situation using the employment categories shown in Table 3.2. In statistical terms, the analysis used a mixed-model design, with 'time' (i.e. 1990-95) as the repeated-measures factor, and *job situation* as the between-groups factor. At this stage, the onshore and offshore groups were analysed together.

4.1.1 Social dysfunction

Although the overall level of scores on the 'social dysfunction' scale of the General Health Questionnaire (GHQ) (a measure of low morale) did not change significantly between 1990 and 1995, there was a highly significant difference in the extent to which scores changed in the five groups defined by 1995 job situation. This was revealed by the significant *time x job situation* interaction, $F(4,98)=4.23$, $p<.005$. As shown in Figure 4.1, those who moved to work for a new company showed an improvement in morale (i.e. decreased scores), while all others showed some deterioration, particularly those who had become unemployed.

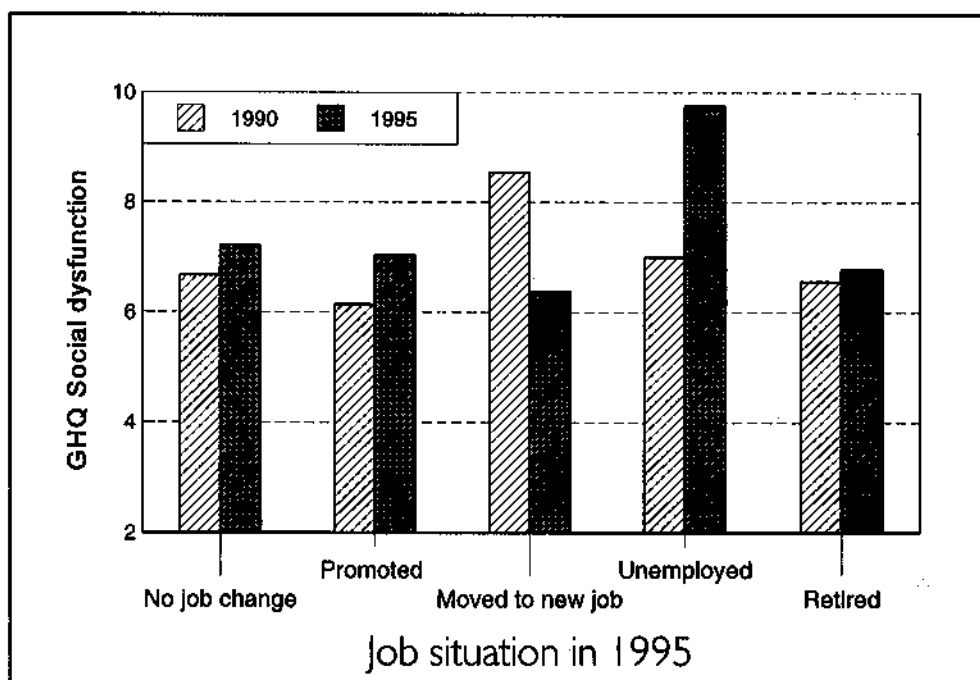


Figure 4.1
Social dysfunction in 1990 and 1995 in relation to 1995 job situation

4.1.2 Anxiety

The pattern of results for the GHQ anxiety scores was markedly different from that for the social dysfunction measure. As shown in Figure 4.2, there was a highly significant, $F(1,99) = 18.62, p < .0001$, overall increase in anxiety between 1990 and 1995. The increase occurred in all 1995 job groups, with the sole exception of those who had retired. For this measure, the interaction between time and employment group was only marginally significant, $F(4,99) = 2.31, p = .06$. Although the increase in anxiety was largest for those who became unemployed, it was also highly significant in the employed groups, especially among those who had remained with the same company.

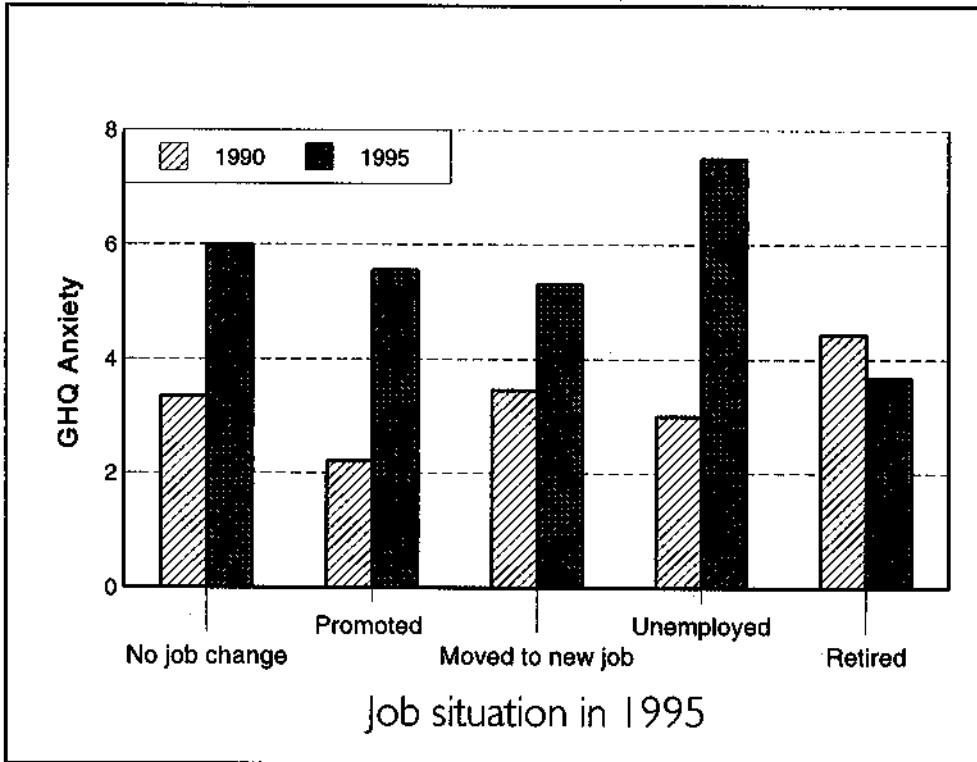


Figure 4.2
Anxiety in 1990 and 1995 in relation to 1995 job situation

4.2 SYMPTOM LEVELS ONSHORE AND OFFSHORE

To compare the effects of continued employment in the onshore and offshore environments, the data from those who remained working onshore or offshore over the period 1990-95 ($n=82$) were analysed. Unemployed and retired personnel, and those who had moved from onshore to offshore or *vice versa*, were excluded from these analyses. These analyses were carried out for social dysfunction and anxiety.

4.2.1 Social dysfunction

For social dysfunction, the onshore and offshore groups differed in the magnitude of change in scores between 1990 and 1995. Thus, the *time x location* interaction was

highly significant, $F(1,75)=8.44$, $p<.005$. As shown in Figure 4.3, the onshore and offshore groups showed very similar scores in 1990; however, in 1995, the onshore group was markedly higher than the offshore group. Thus, it appeared that morale had deteriorated in 1995 relative to 1990 only among the onshore group.

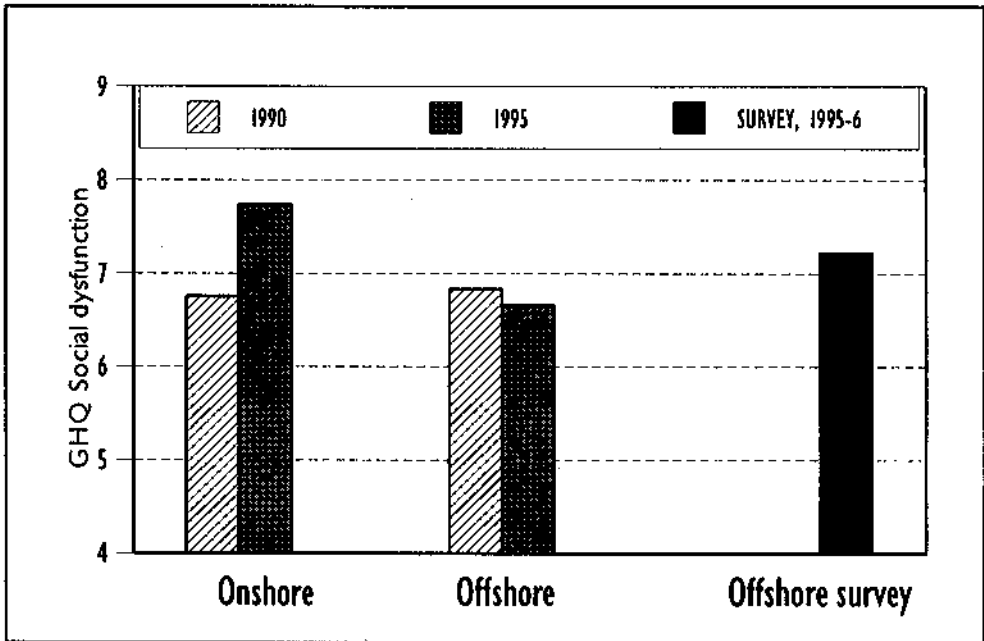


Figure 4.3
Social dysfunction onshore and offshore in 1990 and 1995,
compared with current offshore survey

For comparison purposes, the mean social dysfunction score obtained from production operators ($n=160$) who participated in a more recent large-scale survey of offshore personnel (Parkes and Clark, 1996) is also shown in Figure 4.3. This value is intermediate between the onshore and offshore means obtained in 1995, and was not significantly different from either of them.

4.2.2 Anxiety

The results showed that, in addition to the highly significant overall increase in anxiety from 1990 to 1995, there was a weaker interactive effect, $F(1,76)=3.64$, $p<.10$, indicating a tendency for the magnitude of the change to be different in the two groups. As shown in Figure 4.4, anxiety levels were similar in the two groups in 1995, whereas in 1990 the onshore group had shown significantly lower scores. It appears therefore that changes occurring between 1990 and 1995 had a more marked effect on anxiety among onshore personnel than among those working offshore.

Anxiety levels in the offshore group in 1995 were compared with the corresponding mean from the current survey data. The survey mean was marginally lower than that in the 1995 offshore follow-up study, but the two values did not differ significantly ($t=1.49$, $df=206$, ns); thus, these findings suggest that anxiety in the follow-up group was typical of 1995 anxiety levels among offshore production personnel.

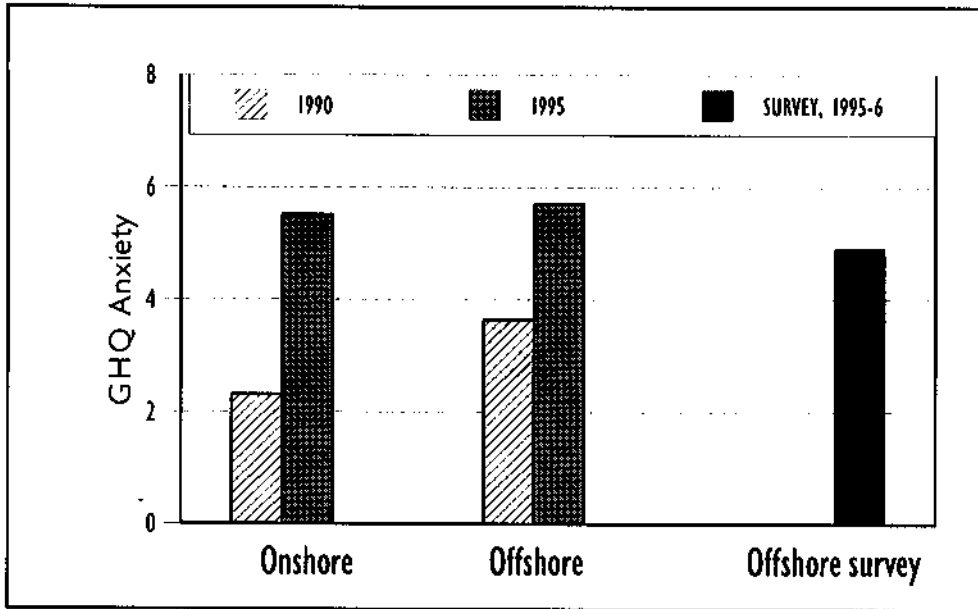


Figure 4.4
Anxiety onshore and offshore in 1990 and 1995, compared with survey

4.2.3 Change in job demand and job discretion, 1990-95

An analysis similar to that described above was carried out on two measures of the perceived work environment, job demand and discretion scores. For demand, the pattern of results was generally similar to, although less marked than, that for anxiety. Thus, both onshore and offshore, perceived demand increased between 1990 and 1995 but the increase was more marked for the onshore group than for those working offshore ($p < .02$), so that the two groups reported equivalent levels of demand in 1995.

For discretion (a measure of the variety, skill and involvement in decision-making), there was a significant overall increase between 1990 and 1995, but the magnitude of this change depended on 1995 job situation. Thus, those who had moved to a new employer or been promoted showed a marked increase in discretion but, among those who had remained in the same job, there was virtually no change.

4.2.4 To what extent did increased job demand account for increased anxiety?

Further analysis, in which job demand scores were treated as co-variables in the analysis of anxiety, allowed evaluation of the extent to which the 1990-95 increase in demand directly accounted for the corresponding increase in anxiety. Figure 4.5 shows the changes in anxiety with and without control for change in demand. Both onshore and offshore, approximately 30% of the increase in anxiety was statistically accounted for by the corresponding increase in job demand.

This finding suggests that part of the increase in anxiety was directly attributable to the increase in job demand, which itself is a likely product of the extensive re-

structuring and down-manning in the employing company early in the 1990's. A smaller effect was associated with changes in job discretion (i.e. the degree of perceived control over work tasks and the work environment more generally); however, in this case, an increase in discretion over the period 1990 to 1995 (particularly shown by those who had moved jobs or been promoted) tended to mask what would otherwise have been a larger increase in anxiety.

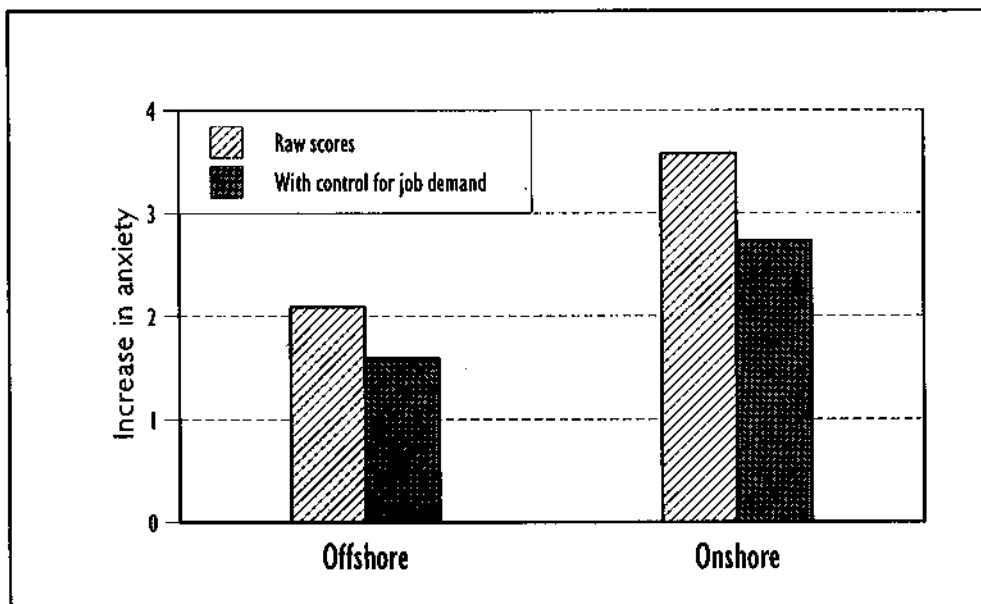


Figure 4.5
Increase in anxiety onshore and offshore, 1990-95, with and without control for increase in job demand

None of the other work environment measures made in the present study contributed significantly to the observed change in anxiety between 1990 and 1995. Thus, reasons for the marked increase in anxiety over this period remain partially unexplained by the present data; however, the role of job insecurity (which increased considerably in the five-year period concerned) should not be overlooked. Job insecurity in the local and national environment is known to contribute to individual 'stress levels', as measured by anxiety, and effects such as these provide a plausible explanation for part of the overall increase in anxiety not accounted for by the analyses above.

4.2.5 'Speed and impatience' traits in relation to anxiety change

In view of the 1990 finding that 'speed and impatience' (S-I), a component of Type A behaviour, was implicated in anxiety levels offshore but not onshore, it was of interest to examine the role of S-I scores in relation to 1990-95 anxiety change. The analysis described in Section 4.2.2 was therefore extended to distinguish between high and low S-I groups. The results indicated that the magnitude of anxiety change was affected not only by onshore/offshore location but also by differences in S-I levels.

As shown in Figure 4.6, the 1990-95 increase in anxiety onshore for those in the high S-I group was greater than for those in the low S-I group. However, this was not true

offshore; in the offshore group, both the high and low S-I groups showed a similar increase in anxiety over the 1990-95 period. Thus, in the 1995 data, it appears that 'speed and impatience' traits predicted anxiety in both the onshore and offshore groups to a similar extent whereas in 1990, this personality characteristic was related to anxiety only for those working offshore.

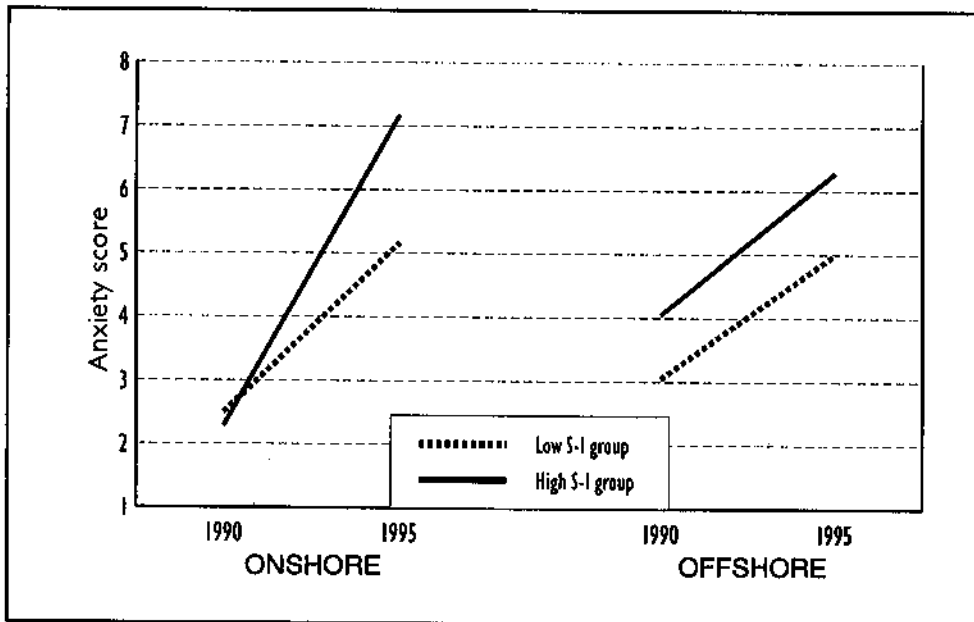


Figure 4.6
Anxiety change 1990-95: the role of 'speed and impatience' (S-I) traits, onshore and offshore

4.3 JOB SATISFACTION

In contrast to anxiety and perceived job demand, job satisfaction and perceived discretion were more strongly influenced by job situation in 1995 than by onshore/offshore differences. The potentially favourable effects of job change, irrespective of whether the change involved promotion within the company or a move to employment with a different company, were directly reflected in job satisfaction levels.

Thus, as shown in Figure 4.7, positive employment changes (i.e. promotion or a new job) gave rise to positive change in job satisfaction. In contrast, those who remained in the same job without promotion over the 1990-95 period reported a deterioration in job satisfaction. This effect (represented by the *time x job situation* interaction) was highly significant, $F(2,76)=8.28, p<.001$. However, onshore vs. offshore location was not a significant factor in this analysis.

4.3.1 To what extent did changes in discretion account for changes in job satisfaction?

As job satisfaction tends to be positively associated with perceived discretion, it was of interest to determine to what extent changes in discretion accounted for the

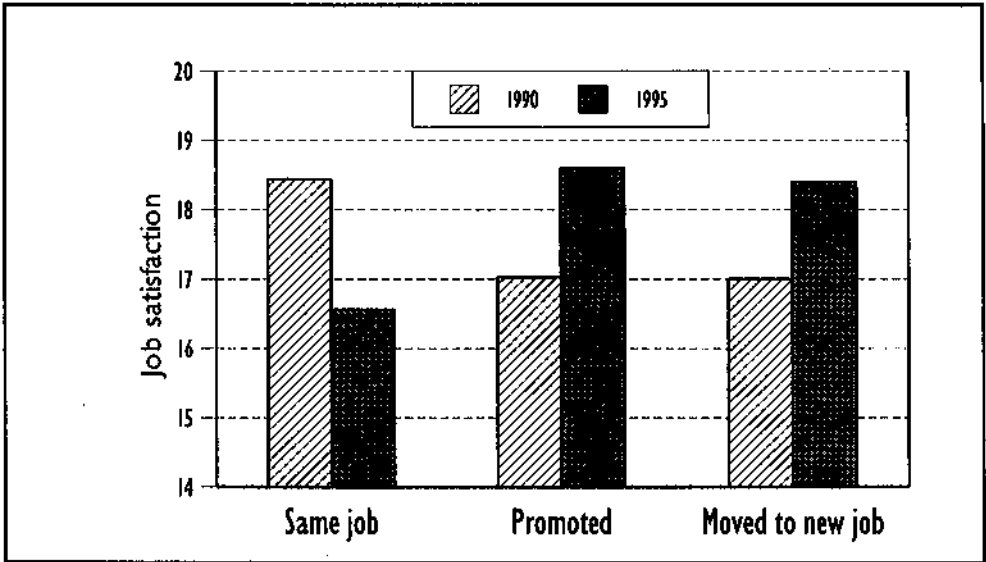


Figure 4.7
Job satisfaction in 1990 and 1995 in relation to 1995 job situation

observed changes in job satisfaction. Analyses showed that job discretion was a highly significant covariate in the prediction of job satisfaction, and that the positive changes in satisfaction were very largely explained by the corresponding increases in job discretion associated with promotion or a new job. Thus, as shown in Figure 4.8, had promotion or a new job not been accompanied by increases in discretion, the favourable change in job satisfaction would not have occurred; indeed, as for those who remained in the same job, there would have been a decrease in satisfaction over the 1990-95 period.

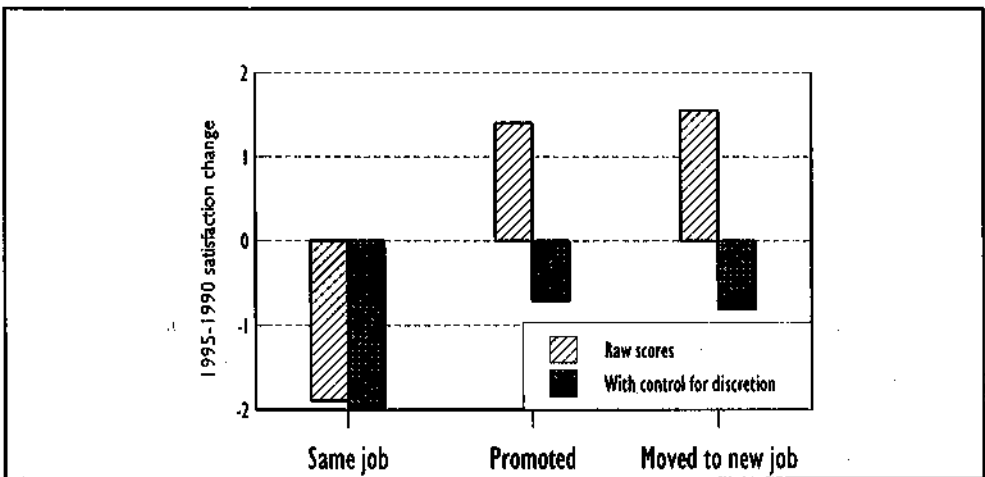


Figure 4.8
1990-95 changes in job satisfaction, with and without control for increases in job discretion

4.4 MENTAL HEALTH CHANGES, 1990-95: SUMMARY TABLE

<i>Measure</i>	<i>Time (Overall 1990-1995 change)</i>	<i>Time by 1995 job situation interaction</i>	<i>Time by onshore/ offshore interaction</i>	<i>Difference between 1995 level and current survey data</i>
Social dysfunction	<i>ns</i>	F = 4.23 df = 4,98 p < .005	F = 8.44 df = 1,75 p < .005	<i>ns</i>
Anxiety	F = 18.62 df = 1,99 p < .0001	F = 2.31 df = 4,99 p = .06	F = 3.64 df = 1,76 p < .10	<i>ns</i>
Job demand	F = 49.85 df = 1,76 p < .0001	<i>ns</i>	F = 8.01 df = 1,76 p < .01	—
Anxiety controlled for job demand	F = 9.05 df = 1,75 p < .01	<i>ns</i>	<i>ns</i>	—
Job satisfaction	<i>ns</i>	F = 8.28 df = 2,76 p < .001	<i>ns</i>	—
Job discretion	F = 23.12 df = 1,76 p < .0001	F = 7.95 df = 2,76 p < .001	<i>ns</i>	—
Job satisfaction controlled for job discretion	<i>ns</i>	F = 3.11 df = 2,75 p = .05	<i>ns</i>	—

5. OFFSHORE AND SHIFTWORK EXPERIENCE

All participants in this study were production operators, an occupational group whose work requires day/night shift rotation. In the light of research findings suggesting that shiftwork may have a cumulative impact on health, it was of interest to determine the duration of exposure to shiftwork and to the offshore work environment in the onshore and offshore groups, and to evaluate whether these exposure durations predicted measures of well-being. The initial step in this analysis was to examine the cumulative distributions of years of shiftwork and offshore work experience in the offshore and onshore groups in relation to the age distributions.

5.1 YEARS OF SHIFTWORK AND OFFSHORE EMPLOYMENT

Cumulative distributions of age, shiftwork years, and offshore employment years as reported in 1995 are shown in Figures 5.1 - 5.3. It can be seen from Figure 5.1 that the 4-5 year difference in the mean ages of the onshore and offshore groups is reflected throughout most of the cumulative age distribution. However, as shown in Figure 5.2, there was very little difference between the two groups in the distributions of shiftwork years. Both groups reported long exposure to shiftwork, with very few in either group having less than 10 years of shiftwork experience, and nearly 25% having in excess of 26 years.

Examination of the cumulative distributions of offshore experience showed that the offshore group reported a greater number of years of working offshore than those in the onshore group. However, a significant proportion of the onshore group had been employed offshore; only 55% reported no offshore experience and 10% reported having worked offshore for more than 13 years.

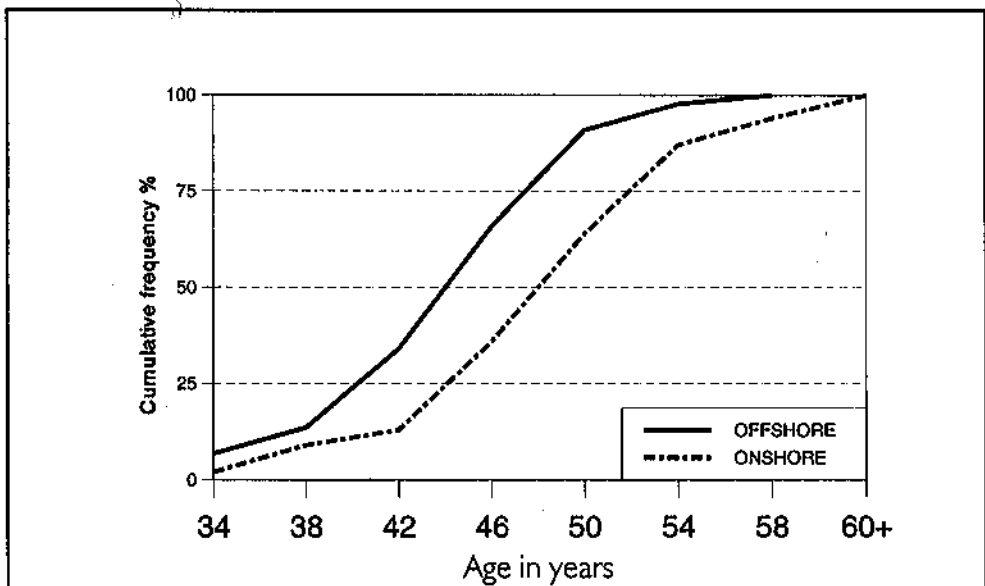


Figure 5.1
Cumulative age distribution in onshore and offshore groups, 1995

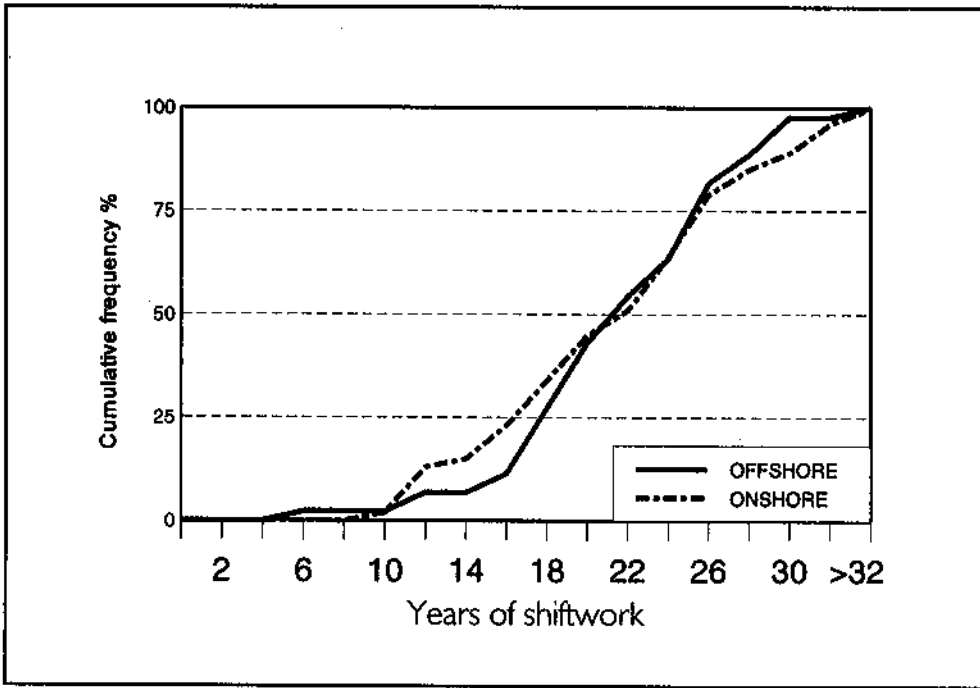


Figure 5.2
Cumulative years of shift work in onshore and offshore groups

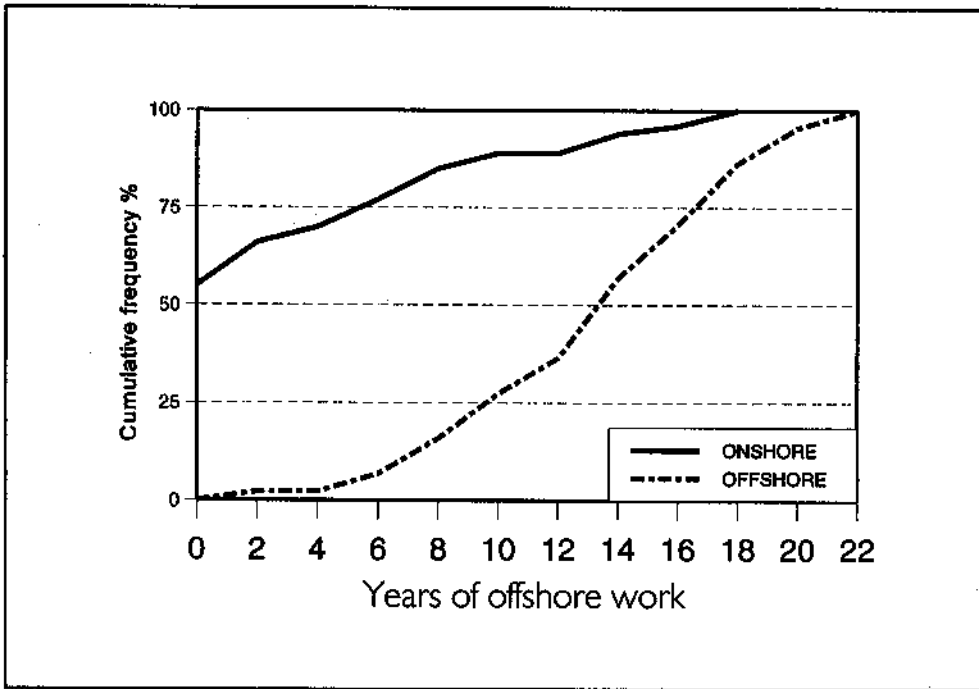


Figure 5.3
Cumulative distributions of offshore work years: onshore and offshore

5.2 WORK EXPERIENCE VARIABLES AND HEALTH

In the present study, interest in the duration of shiftwork and offshore work experience focused on the extent to which they predicted health-related measures. In examining these relationships, it was necessary to incorporate relevant control variables in the analyses.

First, as would be expected, in the group as a whole, age was highly correlated ($r=.46$, $p<.001$) with shiftwork years. Thus, it was important to include age in the predictive model to ensure that any relations between work experience and health were not solely attributable to age. In the offshore group, the correlation of offshore work years with age was .24, but this correlation was small and non-significant in the onshore group, more than half of whom had no offshore experience at any stage in their working life.

Second, to take account of overall differences in health measures between the onshore and offshore groups, it was necessary to include onshore/offshore location as a main factor prior to examining the effect of offshore work years. In addition, control for negative affectivity was included, and in order to examine changes in health in relation to shiftwork and offshore years, the 1995 measure of health was chosen as the dependent variable with the corresponding 1990 measure controlled.

The health outcome measure used was a rating of current health made on a five-point scale from poor (1) to excellent (5). In addition, the anxiety, social dysfunction, and somatic symptoms sub-scales of the GHQ were analysed in the same model to examine relations between work experience and psychological health.

To summarise, therefore, the issue addressed in these analyses was: *“To what extent do durations of shiftwork experience, and of offshore experience, predict health outcomes in 1995, after controlling for age, onshore/offshore location, and other possible confounding factors?”* The analyses were carried out on data from the 104 participants in the follow-up study.

5.2.1 Shiftwork years

In a multiple regression analysis, 1995 health rating was treated as the dependent variable, and the set of predictor variables was entered in a pre-determined order: 1990 health rating, age, onshore/offshore location, and neuroticism (a measure of negative affectivity) at the first step, followed by durations of shiftwork and offshore work. Shiftwork duration was a significant predictor ($t=-2.12$, $p=.036$), indicating that longer exposure to shiftwork is associated with poorer health ratings, and that age, prior health status, and onshore vs offshore location do not account for this relationship.

Similar findings were obtained for the GHQ social dysfunction measure, which assesses low morale. In this case, duration of offshore shiftwork was a positive and significant ($t=2.39$, $p<.02$) predictor of social dysfunction when entered into the equation following the control variables. However, this finding was specific to social dysfunction; it did not apply to either anxiety or to somatic symptoms, nor to measures of sleep quality. Figure 5.4 shows social dysfunction in relation to shiftwork years

plotted directly from the regression equation for two arbitrarily chosen examples. The lower line represents offshore employees with 10 years of offshore experience, while the upper line represents onshore employees with no offshore experience.

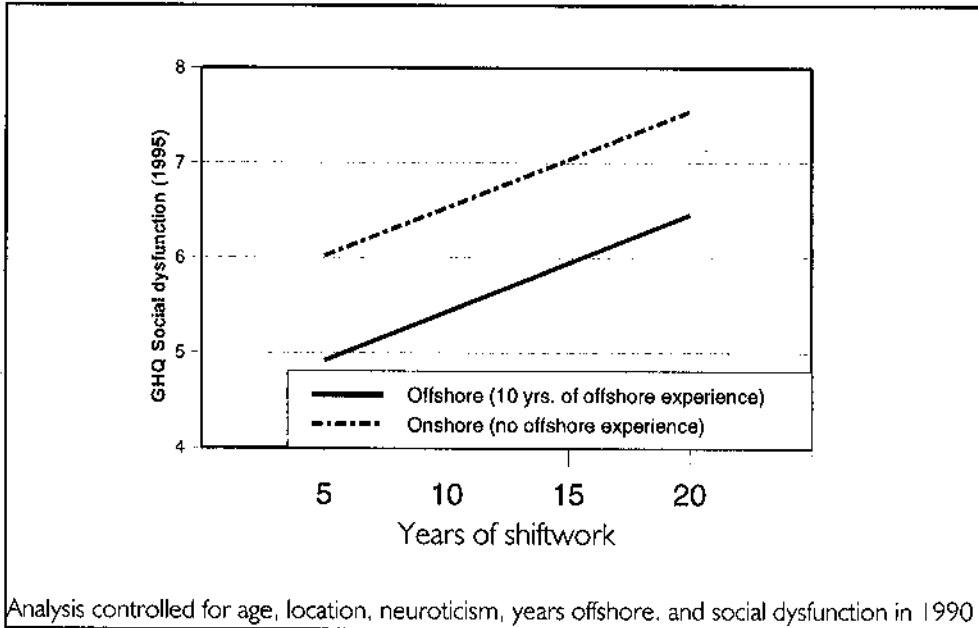


Figure 5.4

Relationship between years of shiftwork and 1995 social dysfunction scores

5.2.2 Offshore years

The findings relating to years of offshore work as a predictor of health outcomes were less clear-cut than those for shiftwork years. Duration of offshore experience was included in the analyses described above but it played no role in the prediction of social dysfunction levels. Years of offshore work acted as a significant positive predictor of health ratings in 1990 ($t=2.33, p<.025$), but did not contribute to the prediction of 1995 health ratings when 1990 ratings were included in the equation. This result suggested that health ratings were relatively stable over the follow-up period, and that general level of health was predicted by offshore work years rather than change in health over the five-year period. The magnitude of the correlation of health scores across time ($r = .50, p < .001$) was consistent with this interpretation.

5.2.3 Interpretation

Whilst the results described above are of potential interest, the inherent problem of distinguishing selection and survival effects (e.g. the offshore population is more stringently selected on medical grounds, and the less healthy of them are more likely to move to onshore work) from possible cumulative effects on health of shiftwork and offshore work cannot be resolved by this study. The findings are perhaps best regarded as sign-posting directions for future work with larger samples than as definitive conclusions. Nonetheless, the tentative results presented above add to the limited existing evidence suggesting cumulative health effects of shiftwork.

6. SICKNESS ABSENCE

Information about sickness and absence episodes covering the five-year period 1991-1995 inclusive was provided by the Personnel Department. Information was only sought for the follow-up group (N=104), and it was not available for employees who had left the company (unless they had left only very recently), nor was it requested for three individuals who had indicated that they were unwilling to allow disclosure. Taking both these factors into account resulted in data being available for 72 participants (n=35 onshore; n=37 offshore). Initial analyses indicated that the group for whom absence data were available were younger than the remainder of the follow-up sample, but were otherwise representative of the follow-up group. Nonetheless, analysis of the absence data was inevitably limited by the relatively small sample size.

6.1 DATA ANALYSES

Four measures were compiled from the sickness absence records obtained: number of short-term episodes (duration less than one week); number of days lost through short-term episodes; number of episodes of 1-2 weeks; number of episodes of more than two weeks. Descriptive statistics (mean, median, minimum, maximum, cumulative frequency distribution) were calculated for each measure. These data are shown in Table 6.1 and in Figures 6.1 - 6.3.

Table 6.1
Sickness absence statistics for onshore and offshore groups

Absence measure	Mean	Median	Minimum	Maximum	% ¹
ONSHORE (n=35)					
Total short-term days lost	8.1	6	0	40	80%
Short term episodes	3.7	2	0	19	80%
1-2 week episodes	.87	0	0	4	43%
2+ week episodes	.34	0	0	2	29%
OFFSHORE (n=37)					
Total short-term days lost	.35	0	0	5	11%
Short-term episodes	.11	0	0	1	11%
1-2 week episodes	.49	0	0	3	35%
2+ week episodes	.54	0	0	2	46%

¹ The percentage values give the proportion of the group with one or more episodes in each category

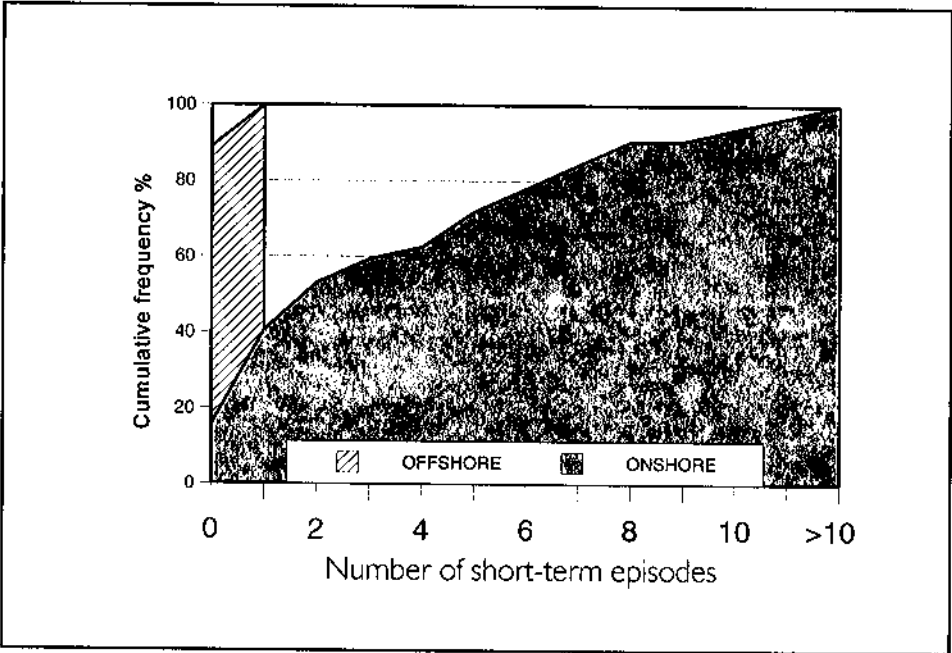


Figure 6.1
Cumulative frequencies of short-term episodes: onshore and offshore

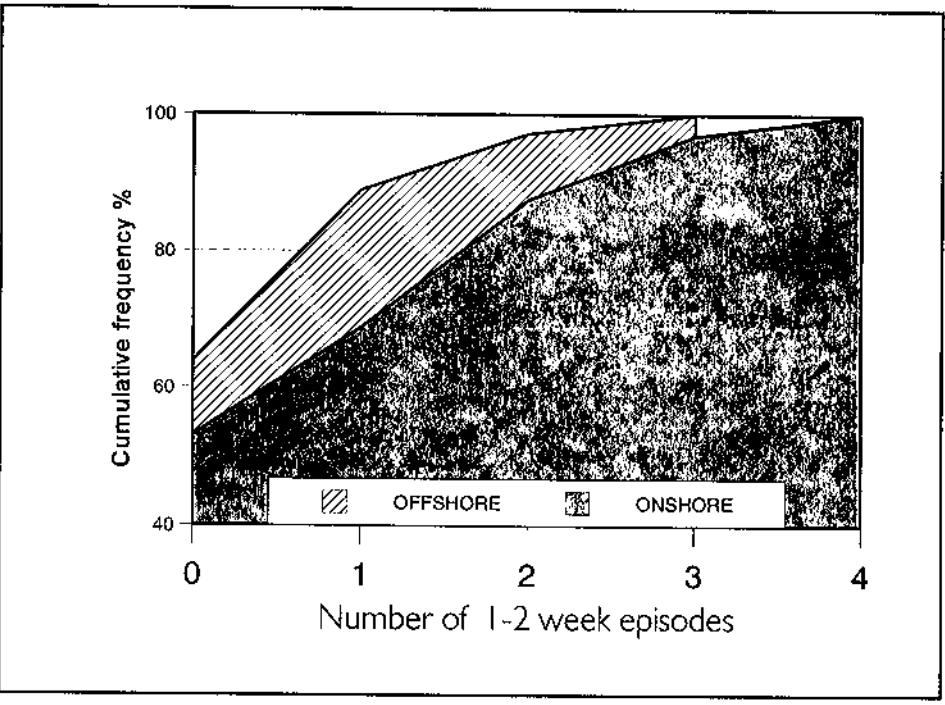


Figure 6.2
Cumulative frequencies of 1-2 week episodes: onshore and offshore

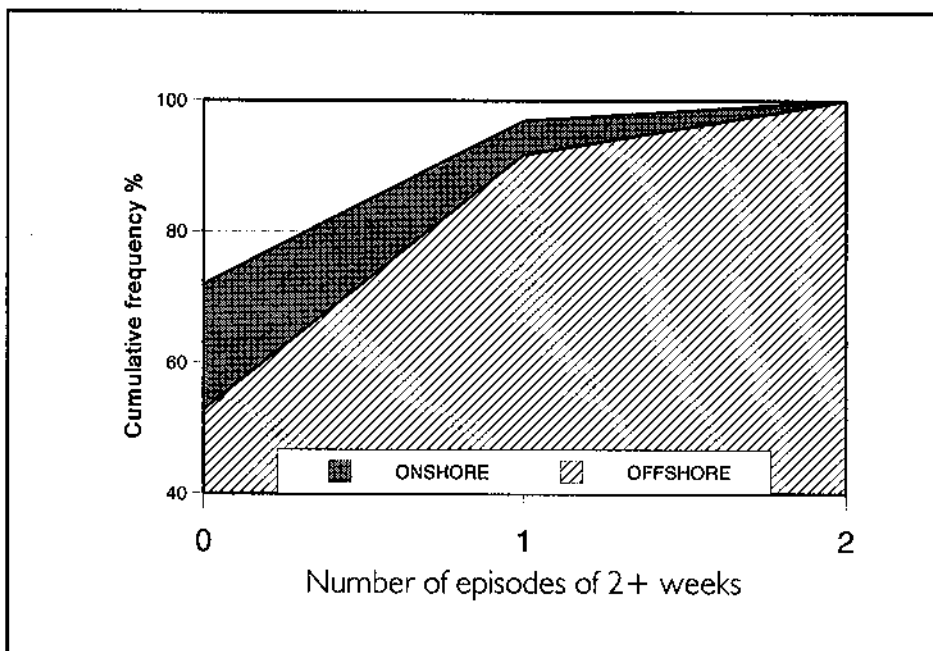


Figure 6.3
Cumulative frequencies of 2+ weeks episodes: Onshore and offshore

The absence rates shown in Table 6.1 are relatively low in both groups, but the distributions are different in the onshore and offshore groups. Thus, for the offshore group, there is very little short-term absence recorded (offshore personnel are regarded as being at work if they are offshore, even if they are not able to carry out their normal duties); in contrast, only 20% of the onshore group had no short-term absence and the group as a whole lost an average of about 8 days over the five-year period. A different pattern was observed for episodes of two weeks or more in duration; for this measure, the offshore group showed higher rates than the onshore group, with 29% and 46%, respectively, having no absence in this category.

6.2 PREDICTORS OF SICKNESS ABSENCE

As the distributions of absence scores were very skewed, scores were dichotomised for the purpose of examining predictor variables. Thus, on each absence measure, individuals were divided into two groups contrasting 'some absence' with 'no absence'. Differences between the groups were examined using multivariate analyses of variance. The aim of these analyses was to determine whether person or environment variables were stronger predictors of absence, and then to identify significant predictive variables. The results showed that individual differences, as assessed in 1990, distinguished between those who had absence and those who did not over the years 1991-95, whereas measures of the perceived work environment in general failed to predict absences.

Extraversion was found to be a significant predictor of absence. In each analysis higher scores on extraversion (a personality characteristic describing sociable, outgoing, and lively individuals) were found in the absence group relative to the no-

absence group. In addition, those who had more long-term (i.e. more than two weeks) episodes were significantly characterised by low achievement motivation, and were more likely to be working offshore. In general, health reports were not strong predictors of absence with the exception of complaints of musculo-skeletal problems (summed over three individual items assessing neck, shoulder and back pain). As would be expected, there was a positive association between musculo-skeletal complaints and sickness absence.

Thus, those who had one or more absences of more than 2 weeks, were characterised by extraversion, low achievement motivation, offshore work, and reports of musculo-skeletal problems in 1990. The discriminant function derived from these variables was highly significant (Chi-square=20.5, df=4, $p<.001$). Absences of 1-2 weeks in duration were not strongly predicted by individual difference measures.

However, in the onshore group, high extraversion also played a significant role in relation to short-term absences. Short-term episodes among offshore personnel could not be analysed in this way as the frequency of recorded episodes was so low; in this context, information about frequency of sickbay visits would have been particularly valuable but such information could not be obtained for inclusion in the present analysis.

The relationship between extraversion and absence from work is consistent with the published literature; more generally, the finding that individual differences predicted absences (whether due to illness or to other factors) better than environmental measures is consistent with the stability over time of individual absence rates. This stability underlies the observation that the best predictor of future absence is previous absence (e.g. Breugh, 1981).

7. HEALTH ASSESSMENTS

7.1 MINOR HEALTH COMPLAINTS

Minor health complaints were assessed using the same checklist as used in the 1990 study. Table 7.1 shows the main results obtained in 1995 for the onshore and offshore groups, and for those who were unemployed or retired in 1995. Data from the 1990 study are reported by Parkes (1993), but are shown in Table 7.1 for comparison purposes.

Table 7.1
Percentages of onshore and offshore groups reporting minor health problems

	Onshore	Offshore	Not working	Significance of difference ¹
Headaches	57% (34%)	34% (43%)	23% ---	p = .025 (ns)
Sleep problems	57% (36%)	77% (54%)	15% ---	p = .05 (p < .04)
One or more of the other health problems	66% (67%)	71% (54%)	54% ---	ns ns (p = .11)

¹ Comparison across onshore and offshore groups only (chi-square tests)
Values shown in brackets are the corresponding data from 1990

The main points arising from the data in Table 7.1 are outlined below:

- With the exception of sleep problems, headaches were the most frequently reported health concern. In contrast to the findings in 1990, a significantly higher percentage of the onshore group (57%) than the offshore group (34%) reported headaches. As also shown in Table 7.1, individuals who were no longer working (either retired or unemployed) reported fewer health problems than the other groups and, in particular, did not report severe headaches.
- Reports of sleep problems were significantly more frequent offshore than onshore, and in both groups the incidence was considerably increased relative to the 1990 levels.

- The proportion of the offshore group reporting one or more of the other health problems (e.g. neck, shoulder or back pain, indigestion, stomach problems) increased sharply between 1990 and 1995, but this was not true of the onshore group.

7.2 HEALTH PROFILES: COMPARISONS WITH NORMATIVE DATA

In the 1995 follow-up study, a standard checklist of health items which asked respondents to report the problems they had experienced over the past month was included for comparison with published large-sample normative data. Figures 7.1 and 7.2 show the onshore/offshore comparison, and the comparison of the follow-up group as a whole with the normative data taken from Cox *et al.* (1987). Only individuals who were still employed in 1995 were included in these analyses (n=91). The data are plotted in terms of the percentage of respondents reporting each type of problem.

- Overall, the most common health problems were headaches, indigestion, back problems, painful joints and colds/flu, all of which were reported by at least 30% of respondents as having been experienced in the past month. Headaches and sinus trouble were significantly more frequently reported by the onshore group than by those offshore ($p < .03$ and $p < .05$ respectively), while the difference for colds/flu was marginally significant ($p < .10$), onshore personnel again reporting a higher incidence; for the other types of health problems, onshore/offshore differences were small and non-significant.
- Chi-square analyses comparing the incidence of each problem in the follow-up group with published normative data for the corresponding age range showed significant differences between the follow-up group as a whole and the normative data for painful joints ($p < .01$), back problems ($p < .001$), and indigestion ($p < .001$). For headaches, the overall difference in reported frequency between the present sample and the normative data was also significant ($p < .002$), but in this case, the difference was entirely accounted for by the high rate among the onshore group.

7.3 SLEEP PATTERNS

A more detailed analysis of sleep duration and sleep quality ratings showed a very similar pattern of results to those reported by Parkes (1993, 1994). The main finding in comparing the onshore and offshore groups was that onshore, sleep quality was better for dayshift work than for nightshift work, whereas the opposite pattern was found for the offshore group.

In addition, the onshore group showed a particularly short mean duration of sleep when working night shifts (less than 6 hours), whereas for the offshore group sleep duration was very similar (6.5 - 7 hours) for both day and night shifts.

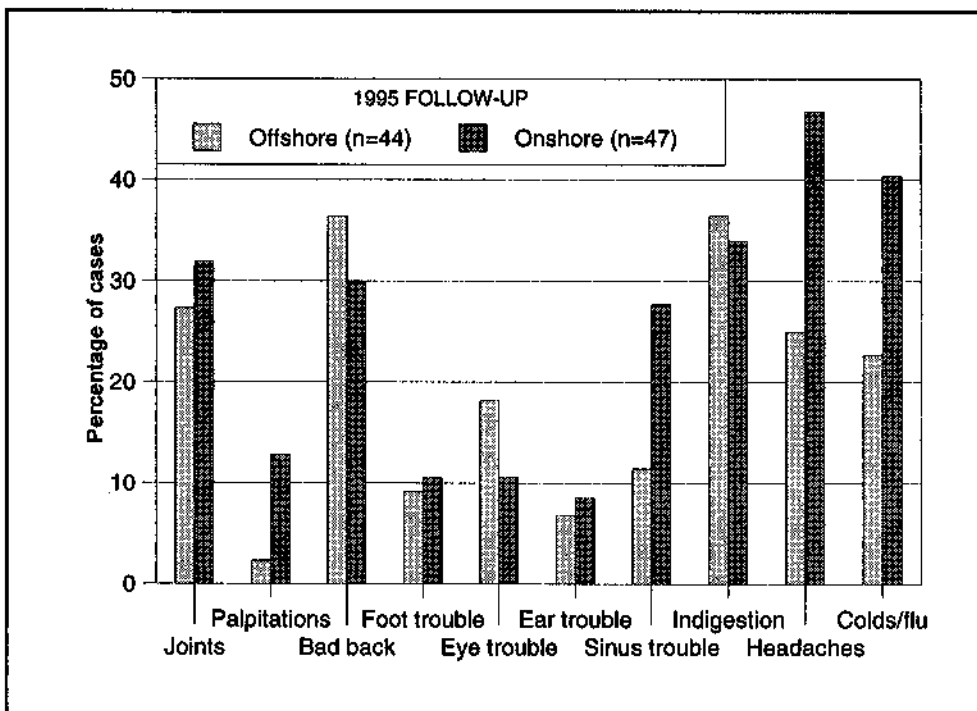


Figure 7.1
Health profiles for onshore and offshore groups

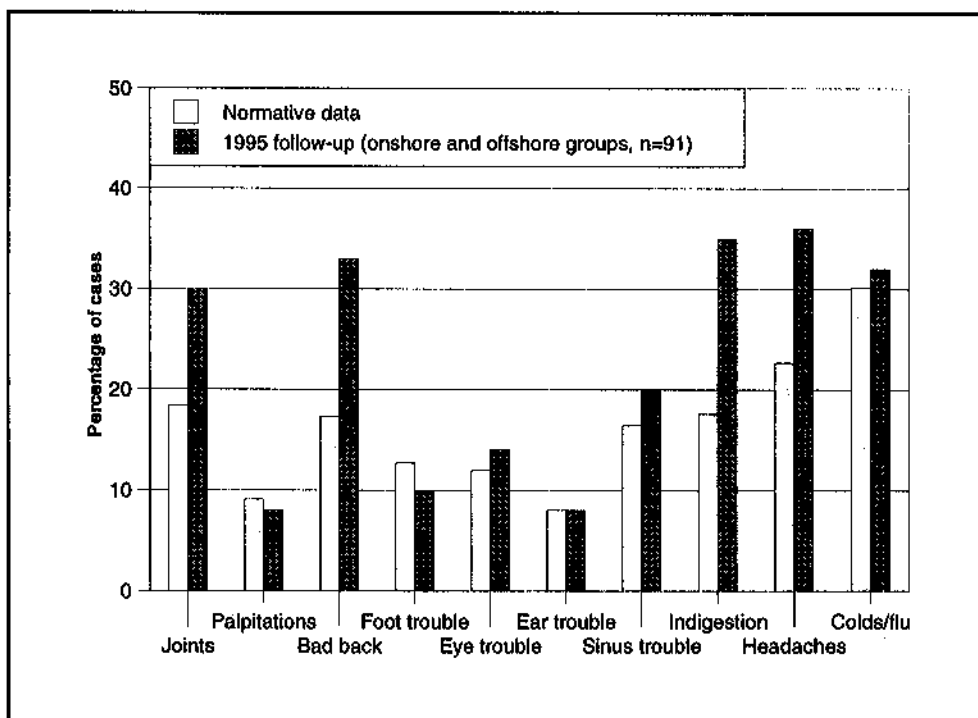


Figure 7.2
Health profile for follow-up group compared with published data

8. CONCLUSIONS

8.1 CHANGES IN PSYCHOLOGICAL WELL-BEING, 1990-95

In general, the findings outlined in this report are consistent with the changes that have taken place in the oil industry over the past five years. Thus, analysis of psychological symptom levels and measures of the psychosocial environment demonstrated a marked increase in anxiety (one of the most characteristic symptoms of stress) between 1990 and 1995, and an increase in workload. There was also evidence that the reported incidence of some minor health problems had increased, and that some specific health complaints in the follow-up sample were more frequent than in a normative group in the same age range.

Comparisons between the onshore and offshore groups suggested that morale (as assessed by the social dysfunction scale) had deteriorated over the years 1990-95 only among the onshore group. This group also showed a more marked increase in anxiety, with the result that in 1995 anxiety levels onshore and offshore were not significantly different. Thus, changes in work conditions between 1990 and 1995 tended to have a more detrimental impact on the psychological well-being of onshore personnel than on those working offshore.

Indeed, in several respects onshore work appeared to have acquired some of the psychosocial characteristics which previously had been more typical of offshore work. It is possible that some down-manning, and associated increase in workload, took place prior to 1990 in the offshore environment, and these changes were subsequently extended to onshore sites during the follow-up period.

In both onshore and offshore groups, job changes were also important in relation to well-being. Those who had moved to a new employer or had been promoted during the follow-up period showed an increase in anxiety (common to all employed groups in the follow-up sample), but also increased job satisfaction relative to those who stayed in the same job. This finding illustrates the specificity of different outcome measures, i.e. different types of affective outcomes do not necessarily respond in the same way to job changes, a point widely made in the occupational stress literature (e.g. Watson *et al.* 1986).

In the present study, it was also revealing that the one sub-group who showed favourable changes at follow-up in both symptom levels and minor health complaints was the small group who had retired between 1990 and 1995. This result contrasts with the more usual finding that retirement is associated either with no change in measures of well-being or with negative change (e.g. Bosse *et al.* 1987).

Two factors, one a measure of personality traits and one a measure of the work environment, which were found to be implicated in anxiety in the 1990 cross-sectional data analysis were also significant in the follow-up analyses.

- First, it was found that the significant relationship between Type A behaviour and anxiety, observed only in the offshore group in 1990, applied to both groups in 1995. The relevance of Type A behaviour in the offshore environment has been noted in the literature by several authors, and this topic could merit further longitudinal study in the light of a possible link between components of Type A behaviour and accidents (Sutherland, 1993).
- Second, the increase in anxiety was partly explained by the corresponding increase in perceived job demand over the same period. This result provides support for the view that increased workloads are one cause of increased stress in the oil industry and more generally. Recent research also suggests a strong causal link between job insecurity and anxiety (Fenwick & Tausig, 1994) and health impairment more generally (Ferrie *et al.* 1995). It is likely therefore that part of the increase in anxiety not explained by the measures used in this study is attributable to the extensive down-manning and resulting threats to job security which occurred in both the onshore and offshore environments between 1990 and 1995.

8.2 OTHER FINDINGS

Although the main analyses reported were concerned with factors predicting changes in well-being over the follow-up period, several other findings of interest emerged from this study.

8.2.1 Duration of shiftwork and offshore work experience.

The participants in the follow-up study were in their mid or late forties in 1995, and reported an average of more than 21 years experience of shiftwork; furthermore, in the offshore group, the duration of offshore work averaged approximately 14 years. In the light of evidence suggesting that shiftwork, particularly if it involves day/night rotation, may have cumulative adverse effects on well-being, and concerns that prolonged exposure to offshore work may also have negative implications, these two aspects of work experience were examined in relation to health measures in the present study.

The results for shiftwork years tended to support the view of cumulative adverse effects in that, over and above the effects of age, number of years of shiftwork predicted both self-reported health status and social dysfunction symptoms, although not symptoms of anxiety. Whilst the interpretation of findings such as these is fraught with difficulty, especially in a small sample, further investigation of this issue would be merited, not least because of the increasing number of industrial processes operating round the clock. The results relating to offshore years were less clear, but it is undoubtedly a topic of potential importance in the light of the increasing age profile of offshore employees, and the correspondingly extended years of offshore work.

8.2.2 Sickness absence

From the point of view of research into sickness absence, the present study had the advantage of a relatively long follow-up period of five years, but it also had the major disadvantage of a very small sample for whom information about absence was available. However, two points of general interest emerge from the data analysis. First, overall recorded absence rates were low relative to general levels of absence in the workforce as a whole, a finding which accords with that reported in Iversen's (1991) study of sickness absence among offshore personnel.

There was also a difference between onshore and offshore groups in the relative frequencies of short-term and long-term absences; onshore personnel had fewer absences of more than two weeks than those working offshore but they had a relatively high frequency of short-term absence. There was almost no recorded short-term absence among the offshore group. It is difficult to make direct comparisons of absence levels in the two groups as offshore personnel may be ill during leave periods without any information being recorded; furthermore, short periods of incapacity offshore are not recorded as absence unless the individual has to leave the installation on medical grounds.

Relationships between individual differences, particularly extraversion, and absence rates were generally consistent with findings in the research literature. However, among offshore employees, the fact that extraversion is a predictor of sickness absence rates is probably less important than the capacity of extraverts to adapt more readily than introverts to the demands of the offshore environment.

8.2.3 Health profiles of onshore and offshore groups

Comparison of the profiles of the present sample on standard measures of health impairment with normative data for males in the same age range revealed that the follow-up group reported significantly higher incidences of musculo-skeletal problems (including back pain and painful joints), indigestion, and headaches. These findings are generally consistent with the data reported by Hellesøy (1985), who also notes the relatively high incidence of musculo-skeletal diagnoses among offshore personnel attending the sickbay, and the frequency with which they reported headaches. Furthermore, all the present sample worked day/night rotating shifts, and this pattern of shiftwork is associated with increased incidence of indigestion and other gastrointestinal problems, including gastric ulcer (Tuchsen *et al.* 1994; Vener *et al.*, 1989).

It is also of interest that, in the present study, elevated rates of these particular problems were just as common, if not more so, in the onshore group as in the offshore group, in spite of the generally higher medical standards required of offshore personnel. To what extent the causal factors were the same in the two environments is difficult to establish from the present data, but if indeed oil industry personnel do have higher rates of certain kinds of health problems than comparable groups in other industries, then identification of the causes and, where possible, remedial interventions, such as that described by Tuinman (1996) could be advantageous.

8.3 POSTSCRIPT

Whilst the study reported here contributes up-to-date findings to offshore research, it should be emphasised again that the longitudinal analysis was based on a relatively small sample, and the study involved only one occupational group. In both these respects, the results must be interpreted cautiously. Indeed, the work is perhaps most appropriately regarded as a pilot study highlighting some areas of research interest for a future larger-scale longitudinal study of psychosocial factors and health among offshore personnel.

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