

# Loss of health certificates among offshore petroleum workers on the Norwegian Continental Shelf 2002–2010

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## ABSTRACT

**Background.** A health certificate is required to work on the offshore petroleum installations of the Norwegian Shelf. Loss of health certificate (“loss of licence”, LOL) may cause economic problems for the individual worker. A private compensation system (OSO) was established for Norwegian offshore workers in 2002, comprising 8000–11,000 individual members of workers organisations: approximately one third of the population offshore. This study aims at describing the reasons for compensation of offshore workers who have lost their certificates.

**Materials and methods.** Of 595 workers who applied for compensation in the period 2002–2010, 38 declined to participate in the study. Of the remaining 557, 507 were granted and 50 were denied compensation. All medical records held by the scheme concerning the 507 compensated applicants were examined. Health data were systematically extracted, analysed, and compared with general population statistics.

**Results.** Musculoskeletal conditions were the most frequent conditions causing LOL for both sexes (42.5%), followed by psychiatric, neurological, and malignant diseases for women, and cardiovascular (19%), neurological, and psychiatric conditions for men. Musculoskeletal disorders were more prevalent than in the general population, and the prevalence of knee problems was particularly high. Among malignant diseases we found a high proportion of brain tumours and renal cancer. The causes are unknown and warrant further investigation in this population. Among women granted compensation, 78% were catering workers, while 50% of the men were process workers, reflecting the gender distribution in these working groups.

**Conclusions.** Musculoskeletal conditions were the most frequent cause of application for LOL compensation for both sexes, followed by psychiatric, neurological, and malignant diseases for women, and cardiovascular, neurological, and psychiatric conditions for men. The cause of the higher incidence of musculoskeletal diseases, brain tumours, and renal cancer found in this study compared to the general population warrants further investigation.

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**Key words:** Health certificate, offshore, petroleum industry, loss of licence

## INTRODUCTION

### LOSS OF LICENCE (LOL) AND THE SYSTEM FOR ECONOMIC COMPENSATION

A health certificate is required to work on the offshore petroleum installations of the Norwegian Shelf [1, 2]. "Loss of Licence" (LOL) is the term used in Norway for a situation where workers, who previously have held a health certificate, no longer meet the health requirements and therefore are not issued with a health certificate [3].

LOL means that workers can no longer work offshore, and this may eventually lead to economic problems for the employee. In 2002 three trade unions for offshore workers in Norway established a private compensation system to support workers who had lost their offshore health certificates due to injury or disease [3]. The offshore companies pay for collective membership of the compensation system. If employees lose their offshore health certificates and are members of the system, they can apply for compensation. The applications are handled by a board composed of trusted members of the trade unions. Approximately one hundred companies are members of this system, including an average of 9185 members of OSO during the study period. The number of members, which includes about one third of the total number of workers on the offshore petroleum installations on the Norwegian shelf, has been quite stable since the system was established.

While LOL is the result of not meeting the statutory regulations [1, 2], LOL compensation is the result of a separate process, where eligibility requirements are defined by the trade unions [3].

The presence of injury or disease that causes permanent loss of licence entitles a person to compensation within the OSO compensation system. Exclusions include conditions without clear signs that can be measured or observed by the doctor, anxiety about travel to or staying at offshore installations, abuse of alcohol, drugs, or restricted medicines, injuries resulting from criminal actions or attempts, as well as pregnancy and childbirth. Other disqualifying causes are gross negligence, breach of working agreement, accidents caused by extreme sports participation, and death – regardless of the cause [3].

### HEALTH RISKS ON OFFSHORE INSTALLATIONS

Workers on offshore installations are exposed to health hazards. Helicopter transport is needed to reach the installation. The flight itself, sometimes in rough weather conditions, and the location of the

installation far out at sea increase the accident risk [4]. The noise levels during the helicopter flights and in the production areas of a platform may be high and may cause hearing loss [5] unless proper hearing protection is used. Some production workers are exposed to oil and oil products during their work, with a possible risk of adverse health effects [6, 7]. Health problems can also result from shift work, which is unavoidable in the offshore industry [8, 9]. Some groups, such as catering personnel, have particular occupational risks due to strenuous working positions [10]. Walking on hard floors, carrying loads, and climbing ladders contribute to the increased incidence of musculoskeletal disorders of production workers [10]. Work offshore may also cause psychosocial challenges [11, 12].

### HEALTH REQUIREMENTS

The statutory health requirements for offshore workers are described in the Norwegian Regulations No 1164 of 1990-11-12 [1]. Revised regulations entered into force by 1<sup>st</sup> January 2011 (Regulations No 1780 of 2010-12-20) [1].

The health certificate for Norwegian offshore petroleum workers is valid for a maximum period of two years, and can be renewed. The purpose of this certification system is to exclude any offshore worker with a health condition that endangers himself or herself, other workers on the platform, or the safe operation of the platform.

There are specific requirements for vision and hearing abilities, and those workers with conditions such as serious mental illnesses, epileptic fits, and diabetes mellitus type I are not allowed to work offshore. Other conditions, such as cardiac disorders and cancer, may also lead to LOL depending on individual assessment. When the criteria for a health certificate offshore are not met, a declaration of unfitness will be issued by the examining physician.

### EXISTING KNOWLEDGE – AIM OF THE STUDY

Although several health risk factors have been described in the working environment offshore, information about the long-term or permanent health effects of offshore work are limited. Information of this kind may be used in work-related risk assessments in offshore working places to improve health and working conditions among this group of workers.

Scientific articles describing LOL in the offshore petroleum industry are almost non-existent. To our knowledge no studies of comparable compensation systems have been carried out. One study of LOL

was performed in 2001 of workers in one single Norwegian catering company offshore [13]. The study showed that more women than men lost their health certificate during the study period, and that musculoskeletal diseases were the most common diagnoses. Two studies have been performed among seafarers, a group with a similar health certificate system in Norway [14, 15]. Musculoskeletal diseases were the most common types of diagnoses also in these studies.

This study aims to describe the diagnoses associated with LOL compensation in a Norwegian offshore population. In the discussion these findings are compared to the general population statistics in Norway, noting the differences and possible relations to known occupational hazards.

## MATERIAL AND METHODS

### DESIGN

The present study is retrospective, cross-sectional, and descriptive, involving analysis of medical records from 507 LOL applicants for compensation.

### APPLICANTS

All persons who had applied for compensation in the period from January 2002 to April 2010 ( $n = 595$ ) were contacted by mail and were informed about the present research project. The applicants were given the opportunity to decline participation in the project by returning a signed statement. Thirty-eight persons declined to participate and were not included in the analyses, giving a final number of 557 participants available for the present study. A total of 507 were granted compensation, and information about these workers is presented in this study. Many of the workers who were not eligible for compensation had no persistent medical condition and their company was not a member of the OSO, so this group was not included.

### OSO PROCEDURES FOR EVALUATION OF APPLICATIONS

The applicants were asked to provide relevant health information from their physicians together with their application. The board evaluated this information in relation to the guidelines of the compensation system [3]. The amount of information available for analysis varied, as some people provided short summaries from their physician, while others submitted large documents from hospital records. The records were securely archived and were accessible only to the compensation board and their executive secretary.

### DATA COLLECTION

Five researchers examined the individual medical records. The following information was obtained for each applicant: Sex, age, home county, company, years at work prior to LOL, total years worked offshore, social status at time of LOL (working, sick leave, pension), and type of work (drilling, production, catering, maintenance, administration, and other). We attempted to record environmental risk factors, smoking habits, and drug and alcohol abuse, but little or no information about these conditions was present in the medical records.

The diagnosis stated to be the cause of the LOL was obtained for all those who were granted LOL compensation ( $n = 507$ ). A total of 179 (35.3%) of the workers had two different diagnoses (Table 1).

### ANALYSIS OF COLLECTED DATA

The information was coded in a database and processed by “Statistical Package for the Social Sciences” (SPSS) version 17.0. Descriptive statistics were used. Age comparisons were performed using Student’s t-test. A non-parametric test (Mantel-Henzel) was used for comparison of work experience among genders, as these data were not normally distributed.

### ETHICS

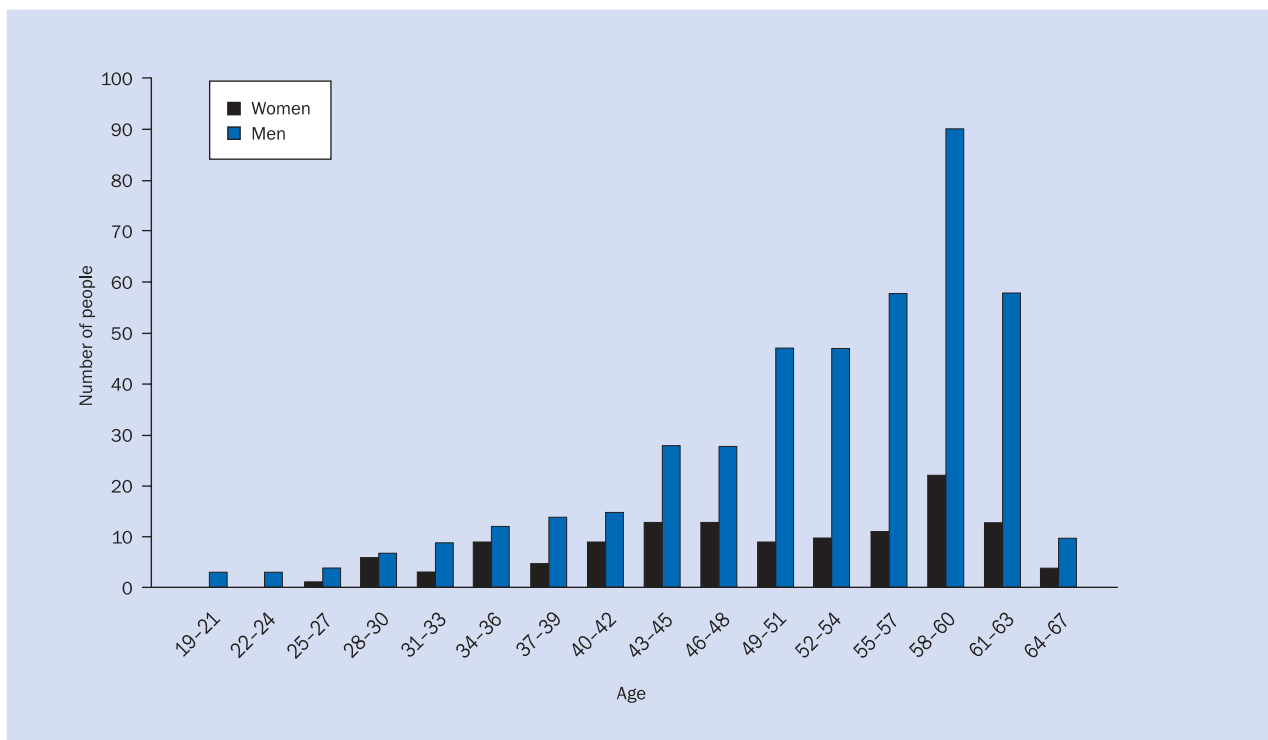
The study was approved by the Norwegian Committee of Research Ethics, South-East region.

## RESULTS

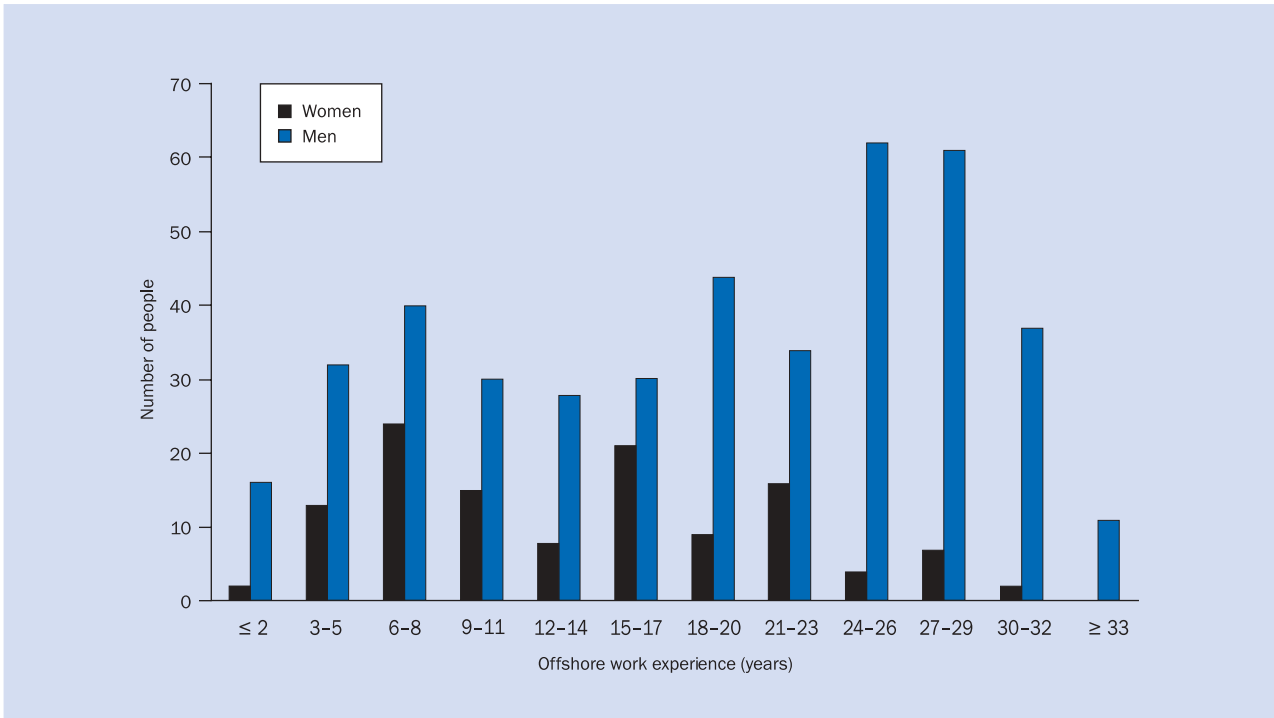
Among the 507 persons who had been granted compensation, 397 (79%) were men and 110 (21%) were women. The mean age was 52 years at the time of LOL, ranging from 19 to 67 years (Figure 1). There was no difference in age between the genders. The mean duration of work on installations on the North Sea was 18 years, with significantly longer work experience among men than among women (19 and 15 years, respectively) ( $p < 0.001$ ) (Figure 2). The majority of men had worked in production, while the majority of women had worked in catering (Figure 3). The average number of years of offshore work experience varied slightly according to work areas: 17 years in drilling, 18 years in production, 20 years in maintenance, 18 years in catering, and 24 years in administration. The average duration of the disease prior to a claim for LOL compensation was 4.3 years, and was almost identical for males (4.3 years) and females (4.6 years), ranging from less than one year to 36 years. Among the workers who were granted compensation, 98%

**Table 1.** The main diagnoses causing LOL in the petroleum industry offshore among 507 employed men and women. Two diagnoses are registered for 179 persons

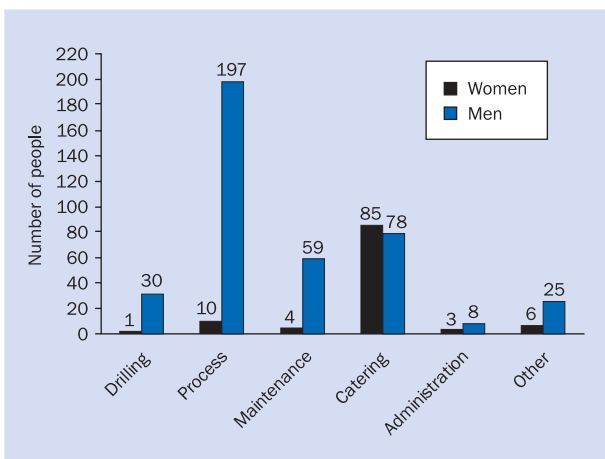
Diagnosis	Females		Males	
	n	per cent	n	per cent
Alcohol/drug abuse	-	-	4	0.7
Anticoagulants	-	-	9	1.7
Asthma	1	0.7	3	0.6
Blood disorders	-	-	4	0.7
Cardiac disorders	5	2.4	68	12.6
Cerebrovascular disorders	2	1.4	5	0.9
Diabetes mellitus	4	2.7	23	4.3
Gallbladder disorders	-	-	1	0.2
Gastrointestinal disorder	-	-	4	0.7
Goitre	1	0.7	-	-
Hypertension	4	2.7 t	23	4.3
Infections	-	-	2	0.4
Joint disease	6	4.1	12	2.2
Lung disease	3	2.1	20	3.7
Malignant disease	11	7.5	40	7.4
Musculoskeletal disorder	70	47.9	190	35.2
Neurological disorder	11	7.5	51	9.4
Obesity	3	2.1	5	0.9
Mental health problems	18	12.3	50	9.3
Reduced hearing	2	12.3 t	10	1.9
Reduced vision	-	-	1	0.2
Skin disorders	2	1.4	5	0.9
Urinary disorder	1	0.7	3	0.6
Other	2	1.4	7	1.3
<b>Total</b>	<b>146</b>	<b>100</b>	<b>540</b>	<b>100</b>



**Figure 1.** Age distribution among employees who lost their offshore health certificate



**Figure 2.** Years of offshore work experience among employees who were granted compensation for LOL



**Figure 3.** The distribution of men and women over the offshore working areas who were granted compensation after LOL

had a full-time employment prior to LOL, only a few had part-time employment. 83% were on sick leave when they applied for compensation, 2.8% were on rehabilitation, and 4.7% were on disability pension. Only 4.5% were working when they lost their health certificate (Figure 4).

**DIAGNOSES**

The most common diagnostic group associated with LOL compensation was musculoskeletal disor-

ders, represented in 42.5% of all participants: 48% among women and 35% among men (Table 1).

The most common location of musculoskeletal disorders was the lower back, with 39.3%, followed by neck and shoulder (22.7%) and osteoarthritis of the knee (10.4%), (Table 2). A few cases had the diagnosis fibromyalgia or pain syndrome (4.4%). Among catering workers 59.3% of the diagnoses associated with LOL were musculoskeletal disorders.

Other large diagnostic groups were mental health problems, cardiac diseases, neurological diseases, and cancer. Individuals with mental health problems had only minor psychiatric conditions such as anxiety and depression; none had major psychiatric diseases. A total of 12.4% of men and 5% of women had lost their health certificate due to cardiac disorders.

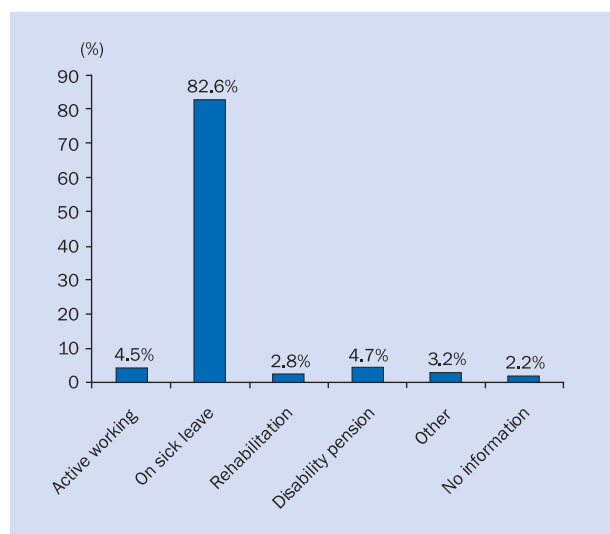
The types of neurological disorders varied (Table 3). The most frequent were epileptic fits, encephalopathy, or multiple sclerosis. A total of 51 cases of malignant disease were found in the compensated group. Nine cases of brain tumours were seen among men, accounting for 21.4% of all malignant diseases among men and 16.7% of all malignant diseases in the study (Table 4). For male workers, comparison with the general population showed a higher incidence rate in our study, especially for brain tumours and renal cancers (Table 4). Median duration of off-

**Table 2.** Localisation of musculoskeletal disorders among women and men who have lost their health certificate working in the petroleum industry offshore, in numbers and %

Localisation	Females		Males	
	n	%	n	%
Arm	2	3.4	4	2.6
Coccyx	0		1	0.7
Feet	0		1	0.7
Finger	2	3.4	2	1.3
General pain syndrome**	5	8.5	3	2
Hand	5	8.5	3	2
Hip	5	8.5	7	4.6
Knee	3	5.1	34	22.4
Leg	-	-	1	0.7
Lower back	20	33.9	63	41.4
Neck/shoulder	16	27.1	32	21.1
Trunk*	1	1.7	1	0.7
<b>Total</b>	<b>59</b>	<b>100</b>	<b>152</b>	<b>100</b>

\*Pain localised in the trunk after an accident

\*\*Fibromyalgia is included in this group



**Figure 4.** Social status for workers at the time they lost their health certificates (per cent) (n = 507)

shore work experience for workers with a brain tumour was 20 years (average 17 years) with a range from 2 to 34 years (34, 36, 23, 22, 20, 8, 8, 7, and 2). Five had been working in process areas, four in maintenance.

Based on the relative percentage incidence rate in the general male population, we would expect to find 2.8% renal cell carcinomas among men and 1.8% among women in our study. We found 9.5% (9 cases) among male workers, and none among female workers.

The incidence rate (new cases per 100,000 per 5 years) of cancer among males, calculated from our

**Table 3.** Neurological diagnoses among employees from the petroleum industry offshore who have lost their health certificate, numbers and %

Diagnosis	n	%
Amyotrophic lateral sclerosis	1	2
Decompression sickness	1	2
Dementia	2	3
Epileptic fits	7	11
Encephalitis	2	3
Head trauma	4	6
Huntington's disease	2	3
Ischialgia	2	3
Chronic head-pain	5	8
Encephalopathy	7	11
Encephalopathy, organic solvents	1	2
Multiple sclerosis	5	8
Narcolepsy	1	2
Polyneuropathy	4	7
Parkinson's disease	2	3
Spinal cord lesion	3	5
Vertigo	3	5
Unknown	10	16
<b>Total</b>	<b>62</b>	<b>100</b>

figures of 54 cases over a nine-year period using the population number of 9185 (average number of members of OSO) is 326 as compared to 351.9 in the general population [20].

## DISCUSSION

The main diagnoses associated with LOL among offshore workers in this study were musculoskeletal disorders, cardiac disorders, neurological disorders, mental health problems, and cancer. Higher inci-

**Table 4.** Types of cancer among male and female employees from the petroleum industry on the Norwegian Continental Shelf who have lost their health certificate, number and %. In addition, the relative% incidence rate 2004-2008 from the general population is given, calculated as incidence rate per 100,000 individuals at risk per 5-year period

Type of cancer	Females in our study n (%)	Females in general population Relative percentage incidence rate 2004-2008 [20]	Males in our study n (%)	Males in general population Relative percentage incidence rate 2004-2008 [20]
Brain	-	5.8	9 (21.4)	3.9
Breast	3 (25.0)	25.9	-	-
Colon	-	8	3 (7.1)	7.4
Kidney	-	1.8	4 (9.5)	2.8
Larynx	-	0.1	2 (4.8)	0.8
Liver	-	0.4	1 (2.4)	0.6
Lung	1 (8.3)	8.2	5 (11.9)	10.1
Malignant lymphoma	1 (8.3)	3.6	1 (2.4)	4.2
Myelomatosis	1 (8.3)	1	1 (2.4)	1.3
Oesophagus	-	0.4	1 (2.4)	1.1
Ovary	2 (16.7)	4	-	-
Pancreas	1 (8.3)	2.1	2 (4.8)	2.2
Pleura	1 (8.3)	<0.1	1 (2.4)	0.1
Prostate	-	-	6 (14.3)	28.4
Rectum	-	4	1 (2.4)	4.7
Skin (not including malignant melanoma)	-	5.8	2 (4.8)	4.5
Small intestine	1 (8.3)	0.4	-	0.4
Testes	-	-	1 (2.4)	3.2
Urinary bladder	-	2.2	1 (2.4)	6.3
Uterus	1 (8.3)	8.8	-	-
Unknown localisation	-	-	1 (2.4)	-
TOTAL	12 (100)	-	42 (100)	-

dence rates were also found for brain tumours and renal cancers for male workers, compared to the general population.

### MUSCULOSKELETAL CONDITIONS

The distribution of diagnoses among the workers in our study (2002-2010) shows that musculoskeletal diseases are slightly higher (42.5%) compared to the distribution of causes of doctor-prescribed sick leave in the Norwegian population. The proportion of cases with musculoskeletal disorders leading to sick leave was 34.0% [16, 17] and disability pension 31.4% [19], in the period from 2001 to 2010.

The high proportion of musculoskeletal disorders in the present study is surprising in relation to the health requirements in the LOL compensation system. These conditions often present subjective symptoms rather than objective signs, and therefore might not easily meet the criteria of LOL, which demand objective findings. The explanation might be that these disorders can be related to reduced functional capability relating to safety risks, but the present study reveals no evidence to support this point of

view. Similar findings, with high prevalence of musculoskeletal disorders, were also seen in a previous study of loss of licence offshore [13] and in similar studies in seafarers [14, 15]. Parkes (1999) found that as many as 46% reported musculoskeletal pain during the last 6 weeks in a cross-sectional study of all workers on 17 offshore installations [18]. This could indicate a possible relationship between musculoskeletal conditions and the working conditions offshore. This might, for instance, be relevant among catering workers. This type of work includes physical work which includes standing, walking for long periods, and handling heavy loads, often in strenuous working positions. Workers on offshore installations take turns of 14 days offshore and have 4 weeks off duty between turns. During work periods they work for 12 hours a day. This counts for 168 hours of work in the period, or 84 hours / week, resulting in a high impact during work periods.

Another indication of a possible relation to the work environment is the high prevalence of knee conditions found among men with LOL. A similar overrepresentation of knee problems has been reported



by Morken et al. in a study of work related musculoskeletal disorders offshore [10]. The authors suggested that walking on hard floors and on ladders offshore might be the cause, but there are no studies confirming this. There are few if any lifts on the deck and workers have to carry loads to a great extent, which may also contribute to the number of knee conditions observed.

## CANCER

The lower incidence rate of cancer among males in the present study as compared to the general population is probably related to the under-representation of individuals over the age of 67 years in the LOL population. Cancers are more likely to occur at older age; they do not always reduce working capacity and do not always lead to LOL. In particular, the lower incidence of prostatic cancer in our material can be explained by the age of our population.

Brain tumours among men are clearly overrepresented in the LOL population, with 9 cases. The incidence rate in the general population for tumours in the central nervous system for men in the period from 1999–2003 was 13.2 and in the period of 2004–2008 it was 13.8 [20]. The incidence rate for a five-year period calculated from the figures in the present study is 54 based on the average total number of members in the compensation system of 9185 and a study period of 9 years, resulting in a Rate Ratio (RR) of 3.9 (54/13.8). This finding calls for further investigation. Most of the persons with brain tumours had been working offshore for many years, increasing the possibility of a relationship between some adverse agents in this working environment. Also, all these persons had been working in production or with maintenance, giving the possibility for exposure to carcinogenic agents offshore, although this cannot be confirmed in the present study.

Four renal cancers were found among the male LOL population, 9.5% of all cancers among men and 7.4% of all cancers in our material. The incidence rate of renal cancer for men in the general public statistics in the period from 2004–2008 was 10.0 accounting for 2.8% of all cancers among men in the period. The incidence rate for a five-year period calculated from the figures in our study was 24, with a Rate Ratio (RR) of 2.4. Although the actual figures here are small, renal cancer in the offshore industry should be further investigated.

Our findings are different from the results in a study by Kirkeleit et al. performed among 24,765 male offshore workers linked to the Cancer Registry

of Norway and the Norwegian Cause of Death Registry [23]. The only cancers that were found to have an increased incidence rate in this register study were oesophageal and haematological cancers. We were not able to confirm these findings in our study. Kirkeleit et al. did not find an increased risk for brain tumours and renal cancer. However, the duration of offshore work in the study population used by Kirkeleit et al. was not specified, and a number of those included might have been offshore for very short periods of time. In addition, the Kirkeleit study reported from 1981 to 2003, while our study period was from 2002–2010. Differences in the findings can be related to historical changes in environmental exposure or lifestyle factors and different observation periods.

The causes of brain tumours are not well known. Connelly et al. [24] found no evidence of specific environmental causes for brain cancer besides ionizing radiation in a review of the literature from 2001 to 2007. The relationship between renal cancer and oil product exposure has been discussed for some time, and a relation between mineral oil exposure and renal cell cancer was demonstrated by Pesch et al. (2000) [25]. However, other occupational risk factors like asbestos and organic solvent exposure may also be related to this type of cancer [25]

## NEUROLOGICAL DISEASES

Frequently occurring neurological diagnoses were epilepsy (11%), encephalopathy (13%), and multiple sclerosis (8%). The incidence rate per year for epilepsy in Norway is 46 per 100,000 [26]. The incidence rate calculated from our figures is very low, only 8.5. Epilepsy is an absolute contraindication for a health certificate. Consequently, all individuals with an already established diagnosis of epilepsy will not start an offshore career; hence the frequency of incidents will be low in the offshore population. On the other hand, almost everyone with a new diagnosis of epilepsy will lose his or her health certificate. The age-adjusted incidence of epilepsy in the general population shows the highest rates among children and those over the age of 65. This means that the number of cases in our population is expected to be low.

We found five cases of multiple sclerosis, which is comparable to the general statistics. The incidence rate per 100,000 per year in Norway is 5.5 [27]. Based on these figures, with an average population of 9185 over a 9-year period, we should expect 4.55 cases.



Thirteen of the neurologic diseases are described as encephalopathy, which is a heterogenic group. The diagnosis might, for instance, be caused by head traumas or exposure to neurotoxic agents. It was not possible from the medical records to find detailed information about the basis for these diagnoses.

### **CARDIAC DISORDERS**

In the general public statistics of individuals in Norway, 6.2% (9.4% of men and 3.8% of women) receiving a disability pension had a cardiovascular diagnosis as their main disease. As the health requirements for offshore work usually exclude workers who develop cardiovascular disease even when a residual working capability still exists, it is not surprising that 13.5% of men in our study group had cardiovascular disease. The lower proportion of women, almost equal to that of the general population, is likely to be caused by the natural protection of oestrogen among women before menopause, and a lower occurrence among female workers [28].

### **MENTAL HEALTH PROBLEMS**

The medical records provided only general information about mental health problems and the diagnoses mirrored the rather old-fashioned terminology found in the national regulations and the OSO guidelines for compensation. We found 81 cases of neurosis or depression and no psychoses in the study. This is surprising since psychosis is the sole psychiatric diagnosis that qualifies for LOL compensation [3]. We may ask whether workers with LOL due to psychoses do not claim for compensation, or if some psychotic conditions are diagnosed as depression.

### **OTHER DIAGNOSES**

It is surprising that very few employees lost their health certificate due to reduced vision or hearing loss since the requirements are quite specific regarding vision and hearing. In an aging working population problems of this kind should be expected. Exposure to noise is known to be high in several places in the production areas of offshore platforms, and reduced hearing due to noise exposure is well documented [5]. Surprisingly, offshore workers did not lose their health certificate due to obesity. This condition was relatively common as a cause for LOL among seafarers [14], and would also have been expected in offshore workers. Given this background, one may ask whether people with these diagnoses do not apply for LOL compensation for some reason, or if the health examinations of the offshore workers

include less than ideal arrangements for hearing and vision testing and assessment of obesity. Another possible explanation is that they are given other diagnoses, for instance musculoskeletal disorders.

### **METHODS**

It is difficult to compare figures from our study with the general population statistics on sick leave or disability pensions; hence our comparisons and figures should be interpreted with caution. The study population was selected at the start of their offshore work in accordance with statutory requirements. They represent a healthier population than the general population onshore. Therefore, a lower frequency of disease incidence should be expected in our study. On the other hand, job demands and the statutory requirements for a health certificate may lead to persons having to quit working offshore – still with a working capacity that could be used onshore, and this may result in a higher frequency of unfitness being registered for the offshore population than in the general population. Our study presents data from a specific group of offshore workers who have claimed LOL compensation, coming from a population including about one third of all Norwegian workers offshore. The results might be of relevance to the Norwegian offshore workers in general; however, some groups who work offshore might not be represented as the selection into these arrangements for compensation was based upon the membership of workers' organisations. Maintenance and construction personnel often come from external contractors, usually working onshore, and occasionally working offshore. They may be underrepresented in the study.

### **CONCLUSIONS**

Musculoskeletal conditions were the most frequent cause of application for LOL compensation for both sexes, followed by psychiatric, neurological, and malignant diseases for women, and cardiovascular, neurological, and psychiatric conditions for men. The cause of the higher incidence of musculoskeletal diseases, brain tumours, and renal cancer found in this study compared to the general population warrants further investigation.

### **ACKNOWLEDGEMENTS**

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