

Internat. Marit. Health, 2005, 56, 1 - 4

WORK RELATED DISEASES AND INJURIES ON AN OIL RIG

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ABSTRACT

The analysis of diseases and injuries in the workers on an American oil rig, operating in the Mediterranean Sea, was done in the period of one year, from 1 May 1996 to 1 May 1997. In total, 518 medical examinations of sick and injured workers were conducted. At the first place in morbidity, there were injuries and poisonings (26.7% of all registered cases). Then followed musculo-skeletal (17.5%), respiratory (14.2%), gastrointestinal diseases (12.1%), mental disorders (10.3%), nervous system (9.2%), skin (6.5%), urogenital (2.9%) and circulatory system diseases (0.6%). Out of

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key words: occupational injuries, oil rig

all cases, the hand and finger injuries (48.3%) were most frequent, followed by injuries of the leg (13.4%), eye (11.3%), head and neck (10.1%), arm (7.9%), foot (6.7%) and trunk (2.3%). To reduce the incidence of diseases and injuries, special attention should be paid to the workers' basic medical education, to protective measures and providing first aid at the work site.

INTRODUCTION

Living and working conditions of offshore workers are an important factor for their productivity as well as for safety and work satisfaction. Specific conditions of working at sea (tides, fog, waves, sea currents and storms) are added to the usual difficulties of working on land (wind, rain, snow, intensive cold or heat). Nowadays, oil rigs are built larger, safer and better equipped than in the past. Depending on the nature of their working process some workers are more exposed to injuries and diseases than the others. All oil rig workers must be thoroughly trained in occupational safety. They must be instructed in procedures regarding all possible cases of work accidents, fire, platform abandonment etc. This is covered by international regulations. [1,2,3,4].

In spite of that, small mistakes caused by human factor always seem to happen in practice. Therefore, obligatory alarm drill is introduced in practice on the platform every week as the Emergency Fire, Gas H₂S, and Abandon Ship Drills. The evaluation of the drill, perception of mistakes and the analysis of their future prevention is made after each exercise, with obligatory discussion and useful suggestions (Safety Meeting) [1,2,5,6].

International Maritime Organisation (IMO) in 1978 adopted "Standards of Training, Certification, and Watchkeeping for Seafarers" convention (STCW). It came into force in 1984. One of the most important requirements of this convention is that each seaman must be familiarised with handling all rescue devices as well as with all risks and proper procedures in the case of sea disaster. The use of rescue devices is from 1983 regulated by "Safety of life at sea" (SOLAS) convention. At the conference held in 1988, IMO determined the directions for further development of safety at sea through future Global Maritime Distress and Safety System (GMDSS). Without these courses, tests and certificates it is impossible to get a work permit [1,2,3,6]. In spite of these tests, pre-sea and periodic medical fitness examinations of seafarers are conducted. Well-organised health protection of workers on oil rigs is one of important pre-conditions for normal working process of underwater soil drilling and oil or natural gas exploration [1,6,7,8].

Few data were published so far on morbidity and accidents among workers on oil rigs. This study was aimed at providing additional data and analysis of work-related accidents and morbidity among the crew of the oil rig.

MATERIAL AND METHODS

Cases of diseases and injuries at work were recorded in 518 examined workers on an American oil rig located in the Mediterranean Sea, in the period from 1st May 1998 to 1st May 1999. Data were used from the register of the oil rig hospital for offshore workers, kept by medical officer (physician) on duty. The physician was on duty 24 hours a day, during 28 days. The records were collected by two physicians who worked on the same platform in regular 28-days turns. In all patients, the history of disease or accident were noted down, and the medical examination was made. Among the crew of the platform, there were Americans, Englishmen, Scots, Italians, Croatians, Bosnians, Albanians, Malteses and Indians. Working cycles for the crew were 28 days on the rig, and 28 days at home. Working shifts were: from 12 to 24 o'clock (day shift) during 14 days, then change to the night shift (24-12 o'clock). During the day shift, another group of people worked in the shift lasting from 6 to 18 o'clock during 14 days, and after the period changed to day shift. There was two shifts overlap from 12-18 o'clock. The crew was exclusively male, and their working and living space was limited.

The collection of data was performed as case series study of one-year cumulative incidence (CI) of diseases and injuries. Denominator in the calculation of the CI was the total number of workers employed on the oil rig during the study period. We used the standard epidemiological variables (person, place, time) to describe distribution and association between variables. Variables analysed were: age, job assignment, source of injury, injured body parts and the type of injury. Chi-square test at alpha level of 0,05 was used to test statistical significance.

Diseases and injuries were classified in the groups following the 10th revision of International Classification of Diseases and Related Health Problems (ICD).

RESULTS

The majority (197) of workers were aged up to 35 years (38.0%), 150 of them were in the age from 36 to 45 years (29.0%), 93 subjects in the age from 46 to 55 years (18.0%), and 78 workers were older than 55 years (15,0%).

About 80% (414) of ill and injured workers were those engaged in the direct work process. Occupational injuries were most frequent in the oil drillers (223), their assistants and manual workers at the drilling floor, rotating drill under the tower and around drilling tubes. Then followed injuries in deck hands and engineers (192) and auxiliary personnel (41), catering (36) and specialized services staff (26). No injuries were recorded in the management personnel.

The majority of patients were treated for injuries [Table 1]. Regarding the seasonal distribution, the number of ill and injured workers was three times higher during winter than in summer. The highest number of injuries was registered during the first three days of the 28-day working cycle.

The injuries during a day mostly occurred early in the morning and after the main meal.

Table 1. Injuries and diseases recorded in oil rig workers during one year

Range	Group of diseases in accordance to ICD*	N	%
1	XVII – Accidents, poisonings	138	26.6
2	XIII - Diseases of the musculoskeletal system	90	17.4
3	VIII - Diseases of the respiratory system	74	14.3
4	IX - Diseases of the digestive system	63	12.2
5	V - Mental disorders	53	10.2
6	VI - Diseases of nervous system	48	9.3
7	XII - Diseases of skin and subcutaneous tissue	34	6.6
8	X - Diseases of the genito-urinary system	15	2.9
9	VII - Diseases of the circulatory system	3	0.5
Total		518	100.0

*International Classification of Diseases (ICD) 10th Revision

The most common among them were contusions, cuts and lacerations of the fingers and hand. Chemical and thermal injuries occurred rarely. There were also registered a few cases of bone fracture and joint dislocation, and the amputation of phalanges of fingers or of the whole hand (Table 2). Injuries of the hand and fingers were most common (Table 3).

Table 2. Nature of injuries recorded in workers on the oil rig during one year

Range	Nature of injury	N	%
1	Contusion	41	29.7
2	Cut	32	23.2
3	Laceration	24	17.4
4	Alien body	16	11.6
5	Chemical injury (acids, lyes)	9	6.5
6	Thermal injury (flame, vapour)	6	4.3
7	Luxation	5	3.6
8	Fracture	3	2.2
9	Amputation	2	1.5
Total		138	100.0

Table 3. Injured body parts in the workers on the oil rig

Range	Injured body part	N	%
1	Hand and fingers	67	48.6
2	Leg (without foot)	18	13.0
3	Eye	16	11.6
4	Head and neck	14	10.1
5	Arm (without hand)	11	8.0
6	Foot	9	6.5
7	Trunk	3	2.2
Total		138	100.0

Injuries of the leg, without foot, were the second on the list. The leg most often suffered impacts from moving or falling objects. As for eye injuries, they were mainly caused by alien bodies. Welders and deck crew were most commonly exposed to this kind of injury. The head and neck, arm and foot were mostly affected by strokes from moving objects or when slipping or falling, while the trunk was less exposed to injuries. The injuries mostly resulted from direct impacts of hard metal objects, jamming extremities or other part of the body, and overstrain or stretch and slipping from different levels or on one level [Table 4].

Table 4. Causes of injuries in the workers on the oil rig

Range	Cause of injury	N	%
1	Direct stroke	50	36.2
2	Jamming	32	23.2
3	Overstrain, stretch	18	13.0
4	Fall or slipping from different levels	14	10.2
5	Fall or slipping on one level	11	8.0
6	Contact with chemicals and dangerous substances	8	5.8
7	Electrical shock, vapour, flame, other	5	3.6
Total		138	100.0

In few cases, the cause of injury was careless contact with chemicals or poisonous substances. Thermal injuries by flame or hot vapour and electric shock occurred rarely. The most frequent cause of injuries was inattention of the casualty, then inattention of one or more members of the working team. The production workers and catering personnel of younger age groups were more affected by injuries, while in older workers chronic diseases were more often recorded.

Diseases of the musculo-skeletal system were on the next place in the morbidity of workers employed on the oil rig [Table 1]. They were followed by diseases of the respiratory system, gastrointestinal (mostly acute and chronic gastritis), mental disorders (mostly sleeping disorders and depression) and nervous system diseases, mostly headaches.

Diseases of the skin and subcutaneous tissue (usually fungal infections and allergic dermatitis), urinary system (mostly cystitis) as well as cardiovascular diseases were rarely recorded.

DISCUSSION AND CONCLUSIONS

The age distribution of our patients clearly indicated that for hard work on the oil rig only young, strong and healthy people should be employed.

We compared our data with other observations on morbidity published in the past. Among foreign seamen employed on ships entering the port of Rijeka, on the first place there were gastro-intestinal diseases, then respiratory and musculo-skeletal diseases [9]. Regarding the morbidity among passengers and the crew on passenger ships, respiratory and gastro-intestinal diseases, and kinetoses occurred most frequently [10-12].

Several other populations of seafarers showed certain differences in the frequency of specific groups of diseases and injuries [9,13,14].

In 1982, a study conducted on about 2 million ill and injured seafarers from leading maritime countries indicated that injuries and accidents among them were predominant (28.4%), as it was the case in our study. Gastro-intestinal, respiratory and musculo-skeletal disorders followed, 16.6%,14% and 11% of the total of recorded cases respectively [14,15]. Our study showed a similar order of frequency of the same groups of diseases, but in reverse order: diseases of musculo-skeletal system (17.4%), then respiratory system (14.3%) and gastro-intestinal diseases (12.2%). According to data published in 1991, injuries in seafarers were slowly decreasing due to better safety measures at work, while skin diseases, infections and nervous system diseases were increasing [16].

The analysis of morbidity in dock workers of the port of Split published in 1998 showed the same incidence of specific groups of diseases as in the offshore workers in our study [17].

A low occurrence of cardiovascular diseases among workers on the oil rig can be explained by relatively young age of the subjects. Their age ranged mostly from 20-50 years, and the majority of them were 25-35 years old. Those in older age were not many, and they were mostly employed in the management and were assigned to easier work. Replacement of the personnel occur on the platform regularly, and this is often related to accidents and injuries [1,4,6,7,19].

The incidence of injuries in industrial units on the land is similar to the incidence of injuries of workers in ports and on oil rigs. One study reported that injuries of hands ranged from 29.2% to 47.8% of the total number of injuries on ships, in the port and in industrial units [13]. An analysis of trauma among workers showed that 46.3% of the total number of cases were injuries of hands [20]. Our finding that there were 48.3%

cases of hand injuries, exceeded but not significantly the figures published in the literature, especially those referring to the hand injuries among seafarers. It has indicated a great risk of hand injuries in the working process on an oil rig [7,18].

Hand injuries were the subject of many analyses by other authors, and they were related to the age, gender and workplace [13,20-22]. The hand is exposed to injuries due to its role in catching, reaching, showing and instinctive defence [13,20,22-24]. Young males are more exposed to injuries. It can be explained by inadequate readiness to work and lack of working experience [25-29]. The risk group involves also elderly workers with maybe some decreased working performance because of their visual and/or hearing impairment due to their age, although after the medical examination they were declared fit to work [29,30]. Workers on an oil rig may be injured by winches, steel hooks and ropes, steel tubes and various loose and inadequately fixed objects, and also when they climb steep stairs and go on slippery surfaces [13-15,23,24]. Tiredness, inattention, carelessness, inexperience, clumsiness, lack of concentration and sleepiness of workers can also cause accidents. Noise, exposure to stress, limited space, isolation and monotony are also important factors that lead to psycho-somatic disorders in workers which can result in increased liability to injuries [8,9,13,14,20,23,31-33].

Certain periods in a month, a week, and during the night and the day are directly connected with the rate of injuries because concentration and vigilance of workers may periodically decrease, and biological resistance to stress at work is abruptly reduced [4,7,10,31-33,34].

The difference in the seasonal distribution of accidents can be explained: the wind, rain and cold weather increase the number of injuries because the majority of subjects work in the open space and without adequate protection against their effects on the human body.

During one working cycle of 28 days, injuries occurred most commonly in the first 3-4 days, then in the last 3-4 days, and rarely in the middle of the cycle. On arrival of the new group of workers, the most frequent cause of injuries was their insufficient readiness, and shortly before their departure it was fatigue.

During the day, injuries occurred most commonly early in the morning, from 4 to 6 hours, then about midnight and after main meals, about 12 and 18 hours. Many accidents occurred in the morning due to reduced physical and mental capacity of workers, and their sleepiness [13,23,24,31,35]. Injuries which occurred after main meals were connected with hyperglycemia and sleepiness.

To prevent injuries and meet high working standards, oil companies introduced the practice of tests for alcohol consumption and drug addiction among workers. Only negative tests confirm adequate working ability and ensure efficiency at work

[8,29,31,32,34,36]. If necessary, a person suspected of alcohol or drug abuse should be tested immediately.

Due to improved medical care, proper education of workers and introducing effective measures of protection and control of their risk groups, the rate of accidents and injuries at work at the sea has decreased [1,7,16,37].

One author showed that certain industrial companies protected their workers in the best possible way because they introduced a modified, restricted work program for their injured employees and thus the number of lost working days was cut by half [39]. Another author in his analysis proved that the results of regular, effective surveillance of occupational safety contributed to the reduction of occupational injuries, and in this way enormous financial benefits were achieved [40].

REFERENCES

1. Anonymous: Summary of Occupational Injuries, IADC, Houston, (1997), pp195-205.
2. Anonymous: Offshore Drilling Units, American Bureau of Shipping, New York, (1985), pp.140-143.
3. Brisky T, Ostojić I, Pogorelić M, Čorkalo Z: Nautical Catastrophe in the View of General Practitioner. Pom Biblioteka, 39 , (1990), pp261-265 (in Croatian).
4. Duffy JC: Search and Rescue Medicine - Survival at Sea; in Handbook of Nautical Medicine, Springer Verlag Berlin (1984) pp399.
5. Anonymous: Drilling contractor. Official Magazine IADC (1998) 5, 35-37.
6. International Medical Guide for Ships. 2nd Edition, WHO, Geneva (1988).
7. Fleming M, Flin R, Mearns K, Gordon R. Risk Perceptions of Offshore Workers on UK Oil and Gas Platforms. Risk An. (1998) 18, 103-110.
8. Sherlock P: Duties and Responsibilities of Ship's Surgeon, Nurses and Hospital Attendant, Moore-Mc Cormack Linis Inc, Medical Department Manual, London (1969).
9. Vukelić M, Kontošić I: Selected Problems of Occupational Medicine in Croatian Sailors; in Proceedings of the 1st Scientific Colloquy of Maritime, Underwater and Hyperbaric Medicine, HAMZ, Split (1996) pp.50-55 (in Croatian).
10. Goethe H, Vuksanovic P: Morbidity and Mortality among Seafarers of Various Countries; in Proceeding of the 6th European Nautical Medical Meeting, Gothenburg (1987).
11. Tomaszunas S: Health Problems of International Seafarers. J Occup Med (1994) 36, 465.

12. Anonymous: Fatal Occupational Injuries-United States, 1980-1994. *Morb Mortal Wkly Rep* (1998) 47, 297-302.
13. Tomaszunas S: Health Promotion on Board Ships. *World Health Forum* (1992) 13, 52-54.
14. Korin N: Some Regional Characteristics of Injuries and Diseases, with Special Reference to Ports and Ships; in IV Symposium on Hand Injuries and Diseases, Zbor liječnika Hrvatske-Podružnica Rijeka, Opatija (1974) pp9-19 (in Croatian).
15. Vuksanovic P, Goethe H: Diseases and Accidents among Seamen - an International Comparison of Distribution of Diagnoses. *Bull Inst Mar Trop Med Gdynia* (1982) 33, 13-33.
16. Vuksanović P: The Injuries of Seamen. *Pom Biblioteka* (1983) 34, 181-185 (in Croatian).
17. Andrić D: Five Years Follow-up of Morbidity of Dockers in the Port of Split; in Proceedings of the 1st Croatian Congress of Maritime, Underwater and Hyperbaric Medicine, Split, 1998 (in Croatian).
18. Stevens SC, Parsons MG. Effects of motion at sea on crew performance: A survey. *Marine Technology & S. News* (2002) 39(1): 29-47.
19. Vuksanović P, Low A, Herrmann R: Diseases and Accidents among European Seafarers, a Review; in Proceedings of the International Symposium on Maritime Health, Session IV, Turku (1991).
20. Valentić D, Vukelić M, Kontošić I: Analysis of Morbidity of the Oil Rig Crew Members in the Period of One Year. *Medicina* (1990) 26, 41-43 (in Croatian).
21. Bailer AJ, Stayner LT, Stout NA, Reed LD, Gilbert SJ: Trends in Rates of Occupational Fatal Injuries in the United States 1983-92. *Occup Environ Med* (1998) 55, 485-489
22. Weiss MD: Standardizing Work Injury Care in Aligned Systems. *J Nurs Care Qual* (1998) 12, 4-8.
23. Pechlaner S, Hussl H: Complex Trauma of the Hand. *Orthopedy* (1998) 27, 11-16.
24. Skov O, Jeune B, Lauritsen JM, Barfred T: Trade Specific Occurrence of Occupational Hand Injuries. *Ugeskr Laeger* (1998) 160, 3398-3402.
25. Jovičević M: About Some Problems of Professional Traumatism Psychophysiology. *Ergonomija* (1984) 1, 31-40 (in Croatian).
26. Vukelić M: Health Care of Foreign Seafarers in the Port of Rijeka. *Pom. Biblioteka* (1987) 38, 243-249 (in Croatian).
27. Anonymous: Surveillance for Non-Fatal Occupational Injuries Treated in Hospital Emergency Departments-United States, 1996. *Morb Mortal Wkly Rep* (1998) 47, 302-306.
28. Lowery JT, Borgerding JA, Zhen B, Glazner JE, Bondy J, Kreiss K. Risk Factors for Injury among Construction Workers at Denver International Airport. *Am J Ind Med* (1998) 34, 113-120.

29. Miller ME, Kaufman JD: Occupational Injuries among Adolescents in Washington State, 1988-1991. *Am J Ind Med* (1998) 34, 121-132.
30. Soukup BJ: Risk of Injury among Workers with Disability. *JAMA* (1997) 278, 2163-2166.
31. Zečević M: The Analysis of Hand Injuries in Factory "Crvena Zastava" from 1970 to 1972; in the 4th Symposium about Hand Diseases and Injuries, (1974) pp481-485 (in Serbo-Croatian).
32. How JM, Foo SC, Low E, Wong TM: Effects of Total Sleep Deprivation on Performance of Naval Seamen. *Ann Acad Med Singapore*, (1994) 23, 669-675.
33. Micklewright S. Problem Drinking in the Naval Service : a Study of Personnel Identified as Alcohol Abusers. *J R Nav Med Serv* (1996) 82, 34-40.
34. Oliver PO: Medical Hazards at Sea. *Brit J Hosp Med* (1979) 22, 615-621.
35. Shafran LM: Toxicology in Seafaring-Dangerous Goods; in *Handbook of Nautical Medicine*, Springer-Verlag, Berlin-New York (1984) pp329-36.
36. Vukelić M, Kontošić I. *Medicina rada*, Medicinski fakultet Rijeka, (1996).
37. Driscoll TR, Ansari G, Harrison JE, Frommer MS: Traumatic Work Related Fatalities in Commercial Fishermen in Australia. *Occup Environ Med* (1994) 51, pp612-616.
38. Hughes KJ, Glattly J, Kelly-Doughtie R: A Stay at Work Plan for Injured Employees. *Nurse Manage* (1998) 29, 42-43.
39. Lindell MK: Occupational Safety and Health Inspection Scores Predict Rates of Workers' Lost-Time Injuries. *Accid Anal Prev* (1997) 29, 563-571.