Accidents among drillers in the Venezuelan oil industry in 1993.

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Abstract: In 1993 a total of 356 accidents with injuries occurred in workers of 26 companies of oil and gas extraction in the eastern coast of Maracaibo Lake in Venezuela. 288 of them worked in drilling tasks. With the purpose of analyzing the factors that are associated with the drilling activities, the data base of the Venezuela Institute of Social Security, was reviewed. Only the first two digits of the Standard Industrial Classification were used in this study. For preventive reasons this study focused on six variables: unsafe condition or mechanical cause, insecure action, external agent, type of the accident, part of the body injured and the nature of the injury. The following results were obtained: the frequency rate was 222.3 by 1,000, most of them were minor and were caused by not paying attention when walking on or around labor areas (37%), thus favoring being struck by lifting machines (14%); also 62% occurred in non-classified conditions that injured the upper and lower extremities (48% and 24%) producing contusions and crushing (39%). In conclusion, most injuries occurring in the activity of oil and gas extraction are due to factors controllable with preventive strategies.

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Palabras clave: Accidentes, lesiones, perforadores de pozos, causas de accidentes, estudio de registros, plataforma.

Resumen: En 1993 ocurrieron 356 accidentes con lesiones en 26 compañías de la extracción de petróleo y gas en la costa oriental del Lago de Maracaibo, Venezuela. De ellos, 288 ocurrieron en trabajadores que de-

sempeñaban tareas de perforación. Con el objeto de analizar los factores asociados en las actividades de perforación, se analizó la base de datos del Instituto Venezolano de los Seguros Sociales. Únicamente se utilizó en este estudio los primeros dos dígitos de la Clasificación Internacional Estándar. Por razones de prevención, este estudio se enfocó en seis variables: condición insegura o causa mecánica, acto inseguro, agente externo, tipo de accidente, parte del cuerpo lesionado y la naturaleza de la lesión. Se obtuvieron los siguientes resultados: la tasa de frecuencia fue de 222,3 por 1.000, la mayoría de ellos fueron leves y producidos por no prestar atención al caminar o alrededor de las áreas de trabajo (37%), siendo causados por golpes por aparatos de izar (14%); también 62% ocurrieron en condiciones no clasificadas, que lesionaron las extremidades superiores e inferiores (48% y 24%), por contusiones y aplastamientos (39%). Se concluye que muchos accidentes que ocurren en la actividad de extracción de petróleo y gas son debidos a factores controlables con estrategias de prevención.

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INTRODUCTION

The main economic activity in Venezuela is the extraction of oil. Workers in the oil and gas drilling industry are injured at an unacceptably high rate (1), and are exposed to hazardous conditions in a working environment that is recognized to be dangerous, arduous and socially isolating. Living and working offshore present the physical hazard one would expect in a densely populated construction site or factory, but with additional specific dangers (2). Common safety hazards include tripping, unguarded machinery, and wet or slippery floors. Drilling operations are continuos (24 hours/day, 7 days/week) until the well has been completed (3). Large wrench-like tongs are used to connect and disconnect lengths of drill pipe. This process presents a high risk of bodily injury particularly to the hands and fingers but also to the back and other parts of the trunk (4).

In Venezuela, from the beginning of the oil gas drilling industry operations in 1891 (5), both newer equipment and technologies have been introduced and with them new hazards, and their subsequent greater risks for workers. Both national and international companies are required to report accidents occurring on oil and gas extraction platforms to the Venezuelan Institute of Social Security (IVSS), which uses the general occupational code "driller worker". However this term includes many different job titles and activities, such as derrickman, floormen, roughneck, roustabouts, etc., so it is not possible to know from the IVSS registry which jobs have higher risk of accidents. In Venezuela, statistics on occupational accidents are collected and

published mainly for economic and administrative purposes. Also, to set worker's compensation insurance premiums more than to establish preventive and control measures directed to diminish the risk in the work environment.

In a national IVSS report, the accidents in the economic activity of mines and stone pits were presented, classified in the 8th place of total accidents occurred, with a frequency rate of 11.4/1000 (6). By 1993, there was an almost twenty fold increase only in this sector. The possible explanations are the introduction of new technologies for unskilled workers in this type of activity, high rotation of workers in many jobs on the platform, unenforced preventive measures and supervision, or to economic pressures and governmental actions that resulted in a substantial increase in oil field activity with insufficient crew training and lack of experienced hands. This has also been addressed as the greatest problem facing the industry today (7, 8).

A 1979-1990 study of labor accidents in Maracaibo, Venezuela, showed that accidents in the activity of exploitation of mines, including exploration, exploitation and servicing, were in 5th place with 5% of total accidents. The frequency rate was not reported then, due to the fact that the population at risk in the oil industry was not known (9). On the other hand, to conduct a risk analysis of an offshore platform is a difficult task and sufficient data are not available (10).

The objective of this paper is to identify factors contributing to the occurrence of accidents among drillers of the oil and gas extraction industries in Venezuela, to describe the types of occupational accidents in well drilling and to recommend feasible preventive strategies.

MATERIALS AND METHODS

An observational, descriptive and cross-sectional study was realized to evaluate the accidentability rate occurring during 1993 in workers of 26 companies of oil and gas extraction on offshore platforms on the eastern cost of Maracaibo lake, Venezuela.

The accidents that occurred and were reported on the 15-411 form of obligatory accident report of the Venezuelan Institute of Social Security were analyzed. The register uses the Standard Industrial Classification (SIC) codes of two digits for oil and gas extraction. Using existing registers, compiled for insurance purposes, is not an ideal situation when it comes to the quality of the data analyzed. However, it was decided to make use of the existing information.

For preventative reasons the study was concentrated on the six factors more related with the sequence of accident: unsafe conditions or mechanical causes, insecure action, type of accident, part of the body injured, nature of the injury and the external agent.

The frequency distribution and the frequency rate (FR) for the year

1993 were obtained by formula (12, 13):

$$\text{Frequency Rate} = \frac{\text{Number of accidents}}{\text{Number of exposed workers}} \times 1000$$

RESULTS

In 1993, 356 accidents with injuries identified in the 15-411 Form, occurred in 1684 contracted and subcontracted workers of whom 288 worked in drilling tasks.

The frequency rate of the accidents was 222.3 of 1000 workers. In almost two thirds of the reported accidents, no unsafe conditions had been identified (62%). Defective agents (21%), inadequate protection (5%) and unsafe procedures (5%) were the most frequently observed causes. However, in 168/180 accidents (93%) neither unsafe conditions nor mechanic causes were reported, Table I.

In 37 % of accidents, these occurred by not paying attention when walking on or around labor areas, by lack of protection or prevention, 27%, and the inadequate use of hands (14%) and fingers (28%), Table II. When the relationship between the unsafe condition and the insecure act was examined, it was found that workers that do not pay attention while walking on the platform or its surroundings were involved in 24% of the cases, whereas 19% of the cases were injured by lack of protection and/ or prevention.

Similarly, when the insecure act was related to an external agent, it was observed that not paying attention when walking on or around the outdoor work environment was responsible for 11% of the accidents, followed by the lack of protection and/or prevention when lifting machines were contacted (5%).

The workers were "struck by" something in 37% of the accidents, and caught in or between objects in 16% of the accidents. Falling or stumbling were registered in 10% of the accidents, Table III. Injuries occurred mainly in the upper and lower extremities (48% and 24%) and fingers 28%. As a group, injuries of the upper and lower extremities constituted 76%, Table IV. Con-

TABLE I
UNSAFE CONDITION ON WORK ACCIDENTS AMONG WELL DRILLERS. VENEZUELA 1993

Unsafe Condition	Accidents (%)
Nonclassified unsafe condition	62
Defect of agent	21
Inadequate protected/preserved	5
Unsafe procedure	5
Other unsafe conditions	7
Total	100

TABLE II
INSECURE ACTS ON WORK ACCIDENTS AMONG WELL DRILLERS. VENEZUELA 1993

Insecure Acts	Accidents (%)
Not paying attention	37
Not protect/prevent	27
Inadequate use of hands	14
No insecure act	10
Non classified or insufficient data	8
Total	100

TABLE III
TYPE OF ACCIDENTS ON WORK ACCIDENTS AMONG WELL DRILLERS. VENEZUELA 1993

Type of Accidents	Accidents (%)
Struck by	37
Caught in or between	16
Fall to the same level	10
Treading by	8
Fall to different level	7
Fall of objects	6
Other types	16
Total	100

tusions and crushing were produced in 39% of accidents, Table V.

Additionally, the occurrence of injuries due to insecure acts were analyzed and it was observed that injuries in the upper extremities occurred by not paying attention when walking on the platform (15%) and lack of protection and/or prevention (14%). In lower extremities injuries were due to not paying attention when walking (13%); contusions and crushing were the more frequent consequences (13%) of not paying attention when walking.

Table VI shows the cause of accidents because of the external agent. It was observed that the greatest frequency was due to being struck by lifting machines (14%) and other machines and accessories (14%). However, because different agent categories were responsible for a small number of accidents, it was decided to group them for data presentation and they constituted 48% of the total accidents.

TABLE IV
PART OF BODY INJURED IN WELL DRILLERS ON WORK ACCIDENTS.
VENEZUELA 1993

Part of Body Injured	Accidents (%)
Upper extremity	48
Lower extremity	24
Head/face	13
Trunk	9
Multiple placement	4
Other placement	2
Total	100

TABLE V
ACCIDENTS IN OFFSHORE PLATFORMS BY NATURE OF INJURY.
VENEZUELA 1993

Nature of Injury	Accidents (%)
Contusion and crushing	39
Wounds	15
Superficial trauma	13
Sprains, strains	9
Brain injury	9
Fractures	8
Others	7
Total	100

TABLE VI
EXTERNAL AGENT ON WORK ACCIDENTS AMONG WELL DRILLERS.
VENEZUELA 1993

External Agent	Accidents (%)
Lifting Machines (Ex. Strings, cables, lifting harness, block of chain)	14
Other Materials (Ex. Other materials no specified, pieces of metal)	14
Work Environmental (Outside) (Ex. Fixed alleys, fixed stairs, floors)	12
Other Machines and Accesories (Ex. Valves, supplies, multiples of pipes)	12
Other Agents (Ex. Agents of different categories)	48
Total	100

DISCUSSION

This study reveals a high frequency rate of accidents among well drillers in the Venezuelan oil and gas industry. The alarming rate of work related accidents in contracted workers in 20 oil industry companies on the eastern coast of Maracaibo lake, Venezuela, is a matter of concern. It is probably due to the lack of preventive measures and to the employment of poorly trained workers. That makes the reduction of accidents imperative. Accidentability is a serious and frequent problem in well drilling activity in the oil industry. In Venezuela the situation has been described as alarming, according to the information obtained from the IVSS registers. It is not easy to analyze the occurrence of accidents on offshore platforms and to compare it with other studies due to insufficient information and in others cases, due to the fact that reports use different incidence or severity rates that make comparisons difficult.

The calculated rate is not directly comparable with other studies like the U.S. Bureau of Labor Statistic rates, since the population at risk was limited to the workers at risk in drilling operations and does not include the entire population of drilling companies (13). Rates of nonfatal work-related injuries (NFI) from United States are 49% higher for the oil and gas field service industry (SIC code 138, which includes oil and gas drilling, exploration and service), than for all U.S. industries combined (14, 15).

A study of the U.S. Department of Labor (BLS) concluded that regardless of the data source and the estimating method used, workers in the oil and gas drilling industry are injured at an unacceptably high rate (1). Moreover, very little occupation specific NFI rates or circumstance data are available on petroleum drilling workers. In the present study the accident frequency by specific activity developed by drillers as roustabouts, floormen and derrickman is not reported.

Personal factors such as age, rate of job transfer, rate of rig transfer (reassignment), and type of behavior have been shown to affect NFI rates among petroleum drilling workers (16,17). However, previous studies, have not addressed the geographic location and occupation – specific factors directly associated with the injury, ex. the type of equipment used, specific location on the rig, and other detailed circumstances surrounding the injury event (which in and of themselves refer more to applied prevention).

Offshore petroleum well drillers work under extraordinarily hazardous conditions. Their stress and levels of anxiety are also high (17). They manually manage very large pieces of equipment, often moving rapidly, with agility, dexterity, and alert attention to detail. The long work shifts and the stressful working schedule of 7 days on and 7 days off, combined with a wet and

slippery work environment, conspire against safety. In addition, individual circumstances of frequent rig changes and youthfulness contribute to increase injury rates (4). In almost two thirds of the reported accidents, no unsafe condition has been identified, but it was not possible to know their nature because the IVSS´s records do not provide this information; it is not collected from industries, so it is not clear and does not allow further analysis.

Some insecure conditions can be controlled or reduced with prevention and good safety measures. It is necessary to have more precise reports or to make the supervisors more aware of these insecure conditions, that need urgent intervention. Also, there are multiple environmental and working practice factors that could be important contributors to nonfatal accidents, such as weather conditions, prior training, number of rig transfers and time on the job, the impact of which was not evaluated because the data was not available.

Safety and work environment in the drilling function should be carefully considered when deciding about the design and selection of equipment. A closed mud treatment system and mechanized pipe handling system are examples where improvements to both work environment and efficiency may be obtained (18).

Drillers on offshore platforms are exposed to hazardous conditions that are acknowledged to be dangerous, arduous, socially isolating and they are exposed to physical hazards with additional specific dangers (2).

Carelessness when walking on or around work areas was registered as the second most important factor and considering that 62% of non classified insecure conditions exist, it creates a mayor risk of having an accident. This may explain the greater occurrence of contusions and crushing (39%) (Table V), damaging of the upper extremity (including the fingers, hands, or arms) 48% (Table IV) in a higher proportion than in other studies reported elsewhere, showing 31% of NFI, the largest proportion of NFI to any body part (19).

The two key types of accidents and the insecure act identified in this study, included being struck due to lack of protection and/or prevention (15%) and falling at the same level, by not paying attention when walking on or around work areas (8%) (Table III). Proper training, appropriate equipment, and operational supervision can prevent the workers from being struck while installing pipes.

In a drilling operation, the process of making pipe joints is a normal and fatiguing task, but the drillers can be struck because of the lack of operational information such as protection from falling objects, proper rigging techniques, equipment inspections and the use of safety chains or other redundant safety equipment (18).

In conclusion, most injuries occurring in the activity of oil and gas

extraction are due to controllable factors with prevention strategies. There is a need to raise the level of safety on the platform installation and education and training of workers in order to establish a safety culture in the work place. These results provide the basis for further research of accidents among well drillers in the oil industry to facilitate prevention. A classification system that reflects higher quality of safe conditions in the work environment is recommended.

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