Low Back Pain among Workers in Offshore Oil Industry

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Abstract

Background: Workers in oil and gas companies are in general engaged in different tasks and duties, some of which may lead to various diseases. Occupational Low Back Pain (LBP) is considered one of the most prevailing problems among the workers of different industries, which has been identified as a common cause of disability. The objectives of this study were to determine prevalence of LBP among workers of Offshore Oil Company and to assess risk factors associated with LBP occurrence. *Materials and Methods***:** A cross sectional study was conducted among eighty workers of the Offshore Oil Company. Information was collected by a semi-structured questionnaire about socio-demographic data and occupational history, Physical Workload Index Questionnaire, and Job Content Questionnaire. Anthropometric measurements for each participant were also evaluated. *Results:* Eighty workers employed in oil and gas industry were included in the study. About two thirds of them (65.0%) complained of LBP. Job strain score was 11.49±3.84 and the mean total score of the physical work load index was 33.45±8.25, while one half of all workers had high physical work load index (50.0%). The most significant risk factors of LBP among workers were plant working, work shift >12 hours, age ≥40 years, smoking, obesity, and high work load. *Conclusion:* workers in oil and gas industry were at risk of having LBP due to various job risk factors and high work load, which calls the attention to the importance of conducting an interventional ergonomic health education program to improve workers' knowledge, regular training programmes and periodical medical examinations.

Key Words: Low Back Pain, Offshore, Oil and Gas industry

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LIST OF ABBREVIATIONS:

BMI: body mass index
IRB: Institutional Review Board
JCQ: Job Content Questionnaire
LBP: Low Back Pain
MSDs: Musculoskeletal Disorders
O&G: Oil and Gas
OR: Odds ratio
OHS: Occupational Health and Safety
PWI: Physical workload Index
SPSS: Statistical Package for Social Science
WBV: Whole body vibration

INTRODUCTION

The oil and gas (O&G) sector has a significant place in the world's economy. This sector is expanding rapidly and providing many new job opportunities; but at the same time there is an increasing risk of work-related fatality, injury and diseases. Workers in oil and gas companies are in general engaged in different tasks and duties, some of which may lead to various diseases. These duties include exposure to physical, chemical and ergonomic hazards (Golara and Sadry, 2015). Occupational Low Back Pain (LBP) is considered one of the most prevailing problems among the workers of different industries (Aghilinejad et al., 2015), which has been identified as a common cause of disability, job absence and paid compensations in the working fields (Abaraogu et al., 2016).

Occupational exposures associated with LBP can be divided into physical and psychosocial subsections. Lifting, bending, twisting, whole body vibration, sustained sitting, physical effort, and awkward back posture had been reported as main LBP related physical exposures; and job control, job demand, job satisfaction, social support, and job strain can be mentioned as LBP related psychosocial factors (Aghilinejad et al., 2015).

A review of the related literature suggested that there is a lack of studies concerning occupational LBP among workers in O&G industry, especially in Egypt. Such research would help in identifying occupational factors of high-risk for LBP as well as quantifying the extent of the problem. We aimed in this study to promote health of workers in oil and gas companies through determining prevalence of LBP among Offshore Oil Company workers and to assess some socio-demographic and occupational risk factors that may be associated with LBP.

MATERIALS AND METHODS

A cross sectional study was conducted at Offshore Oil Company working in oil and gas exploration and production in Ras-Gharib city, Red sea Governorate, through the period from February 2016 to April 2017.

Study sample:
The sample size was calculated through Open Epi-Info (Epidemiological information package) software version 6.1, according to the prevalence of LBP among workers in O&G industry in a previous study which was 51.0% (Jensen and Laursen, 2014) and at a confidence interval of 95%, power of the study 80%, the estimated sample size was calculated to be 80 workers. They were selected using simple random sampling technique after preparing a list of workers who met the inclusion criteria.

Inclusion criteria included any worker worked in Offshore Oil Company for more than 1 year and agreed to be involved in the study.

A pilot study was conducted before the start of the study, the pre-designed questionnaire was tested on 10% of the sample size (8 workers) to explore any essential modifications to be done. The questionnaire was tested several times to ensure that the wording, format, length and sequence of questions were appropriate. The questionnaire was tested for reliability and calculation of the reliability coefficients (Cronbach's alpha) which were generally high for all questionnaire parts, and suitable for scientific purposes. The participants included in the pilot study were excluded from the main sample. After the pilot study was completed, necessary minor modifications were made.

Study tools:
A semi-structured questionnaire included the following sections:
Section I: Personal and socio-demographic data: Age, residence, level of education, marital status, smoking habits, regular exercise, caffeine intake and medical history of LBP.
Section II: Occupational history: The current occupations, duration of employment, work shifts, daily working hours, and ergonomics training.

Section III: Perceptions of job risk factors for LBP: Seven conditions and tasks at work that may contribute to development of LBP adapted from previous studies (Tinubu et al., 2010; Aghilinejad et al., 2015). All participants were asked to indicate, on a scale of 0 to 10, how much of a problem (if any) each item is for them by circling the appropriate number. A score of 0 to 1 was equivalent to a job factor being "no problem", a score of 2 to 6 was rated as a "minimal to moderate problem", and a score of 7 to 10 indicated that a job factor was considered a "major problem".

Section IV: Physical Workload Index (PWI) Questionnaire: It was comprised of 4 subscales: Postures of the trunk (5 items), positions of the arms (3 items), positions of the legs (5 items), and lifting of weights (6 items). Physical load index was classified as follows: low (≤22.46 points), middle (22.47–36.37 points), and high (≥36.38 points) (Hollmann et al., 1999).

Section V: Job Content Questionnaire (JCQ): It was a 14-item questionnaire used to measure psychological job demands and decision latitude (control) rated on a 4-point Likert scale (strongly disagree, disagree, agree, and strongly agree). It was comprised of 4 subscales: psychological job demands (5 items) and decision latitude (9 items) comprising decision authority (3 items) and skill discretion (6 items) (Karasek et al., 1998).

The job strain score was calculated using the difference between mean psychological job demands and mean decision latitude (i.e. the strain by subtraction method). Higher scores reflected higher levels of job strain.

Anthropometric measurements:

The height and weight of each participant was measured with the subject standing bare-foot, using a tape measure and a bathroom scale. The body mass index (BMI) was calculated as follows: the weight in kilograms divided by the height in square metres.

The World Health Organization (2006) classified BMI as follows: underweight (<18.5), normal (18.5–24.9), overweight (25.0–29.9), obese (30.0–39.9), and extremely obese (≥40).

Ethical considerations

The Institutional Review Board (IRB) of the faculty of Medicine, Zagazig University approved the study protocol. Official permissions were obtained from the administration and management of the Company. Ethical considerations and confidentiality were respected. An informed verbal consent was obtained from all participants of this study. The workers were told about the aim of the study, and they were informed that the data would be used for scientific purposes only. The workers were also given the right to refuse or participate in the study.

Statistical Analysis

The collected data were computerized and statistically analysed using SPSS programme version 19.0. Frequencies and percentages were calculated for qualitative variables, and means, median, range and standard deviations for quantitative variables. Chi-square test was used to calculate difference between qualitative variables in different groups. Independent t-test was used to calculate difference between quantitative variables of two groups with normally distributed data.

RESULTS

Eighty workers were included in the study, about two third of them (65.0%) complained of LBP, and only 35.0% had a negative history of LBP. There were significant differences between workers with and without LBP regarding age (OR=7.56, 95% CI=2.68–21.30), and educational level (OR=2.85, 95% CI: 1.09–7.39) as LBP was found to be more frequent among workers above 40 years of age and having only basic level of education. Daily habits like smoking, increased caffeine intake and lack of physical exercise significantly increased the odds of having LBP, and anthropometric measures played also a role as increased BMI (OR=4.40, 95% CI=1.34–14.51) significantly increased the risk of LBP while height (OR=0.08, 95% CI=0.02 –0.27) showed a protective effect on LBP *(Table I).*

Table I.

Frequency distribution of study participants by socio-demographic characteristics and physical profile

Socio-demographic and physical characteristics	Total (N=80) n (%)	With LBP (N=52) n (%)	Without LBP (N=28) n (%)	χ^2	OR (95% CI)
Age (years):					
<40 years	28 (35.0)	10 (19.2)	18 (64.3)	16.24	1.00
≥40 years	52 (65.0)	42 (80.8)	10 (35.7)		7.56 (2.68–21.30)*
Education					
Basic education	50 (62.5)	37 (71.2)	13 (46.4)	4.75	2.85 (1.09–7.39)*
Higher education	30 (37.5)	15 (28.8)	15 (53.6)		1.00
Regular exercise					
Yes	33 (41.3)	8 (15.4)	25 (89.3)	41.02	0.02 (0.01–0.09)*
No	47 (58.8)	44 (84.6)	3 (10.7)		1.00
Smoking					
Current smoker	51 (63.8)	40 (76.9)	11 (39.3)	11.16	5.15 (1.90–13.93)*
Non- smoker	29 (36.2)	12 (23.1)	17 (60.7)		1.00
Caffeine intake					
Yes	41 (51.3)	33 (63.5)	8 (28.6)	8.87	4.34 (1.61–11.75)*
No	39 (48.8)	19 (36.5)	20 (71.4)		1.00
Height (cm)					
<170.0	39 (48.8)	35 (67.3)	4 (14.3)		1.00
≥170.0	41 (51.3)	17 (32.7)	24 (85.7)	20.48	0.08 (0.02–0.27)*
Weight (kg)					
<80.0	26 (32.5)	13 (25.0)	13 (46.4)		1.00
≥80.0	54 (67.5)	39 (75.0)	15 (53.6)	3.81	2.60 (0.98–6.88)
BMI (kg/m^2)					
Normal	31 (38.8)	13 (25.0)	18 (64.3)		1.00
Overweight	23 (28.8)	17 (32.7)	6 (21.4)	12.45	1.78 (0.61–5.21)
Obese	26 (32.5)	22 (42.3)	4 (14.3)		4.40 (1.34–14.51)*

* Statistically significant (p<0.05)

Occupational history had a significant role in increasing the risk of LBP as we found a statistically significant difference between the two groups as LBP increased in working in the plant rather than office (OR=14.80, 95% CI=4.38–49.97), working hours/day ≥12hrs (OR=9.40, 95% CI=2.88–30.67), having night shifts (OR=3.14, 95% CI=1.10–9.02), and years of experience ≥17 years (OR=2.68, 95% CI=1.04–6.90) *(Table II)*.

Our results showed that there was a statistically significant relationship between developing LBP among study participants and job characteristics such as improper work scheduling (OR=3.29, 95% CI=1.26–8.58), working in awkward positions (OR=2.85, 95% CI=1.10–7.39), and whole body vibration (OR=3.41, 95% CI=1.27–9.15) *(Table III)*.

Table II.

Frequency distribution of study participants by occupational history

Occupational history	**Total (N=80) n (%)**	**With LBP (N=52) n (%)**	**Without LBP (N=28) n (%)**	χ^2	**OR (95% CI)**
Professional category:					
Office worker	39 (48.8)	15 (28.8)	24 (85.7)		1.00
Plant worker	41 (51.3)	37 (71.2)	4 (14.3)	23.56	14.80 (4.38–49.97)*
Years of Experience:					
<17 years	36 (45.0)	19 (36.5)	17 (60.7)		1.00
≥17 years	44 (55.0)	33 (63.5)	11 (39.3)	4.29	2.68 (1.04–6.90)*
Working hours/day:					
<12 hs	19 (23.8)	5 (9.6)	14 (50.0)		1.00
≥12 hs	61 (76.3)	47 (90.4)	14 (50.0)	16.39	9.40 (2.88–30.67)*
Night shifts:					
Yes	30 (37.5)	24 (46.2)	6 (21.4)		3.14 (1.10–9.02)*
No	50 (62.5)	28 (53.8)	22 (78.6)	4.75	1.00
Ergonomics training:					
Yes	27 (33.8)	13 (25.0)	14 (50.0)		0.33 (0.13–0.88)*
No	53 (66.3)	39 (75.0)	14 (50.0)	5.09	1.00

* Statistically significant (p<0.05).

Table III

Participants' perceptions of job risk factors that may contribute to development of LBP (>7 on a scale of 0–10)

Job risk factor	Total (N=80) n (%)	With LBP (N=52) n (%)	Without LBP (N=28) n (%)	χ^2	OR (95% CI)
Working in the same positions for long periods	34 (42.5)	25 (48.1)	9 (32.1)	1.89	1.96 (0.75–5.11)
Lifting, or moving heavy materials or equipment	53 (66.3)	35 (67.3)	18 (64.3)	0.07	1.14 (0.44–3.01)
Improper work scheduling (overtime, irregular shifts and rest breaks)	49 (61.3)	37 (71.2)	12 (42.9)	6.14	3.29 (1.26–8.58)*
Working in awkward positions	50 (62.5)	37 (71.2)	13 (46.4)	4.75	2.85 (1.10–7.39)*
Inadequate ergonomics training	22 (27.5)	13 (25.0)	9 (32.1)	0.47	0.71 (0.26–1.94)
Repetitive movements	25 (31.3)	12 (23.1)	13 (46.4)	4.92	0.35 (0.13–0.93)
Whole body vibration	38 (47.5)	30 (57.7)	8 (28.6)	6.19	3.41 (1.27–9.15)*
Total score	40 (50.0)	28 (53.8)	12 (42.9)	0.88	1.56 (0.62–3.93)

* Statistically significant ($p<0.05$).

Analysing the job content, we measured the job strain score which was calculated using the difference between mean psychological job demands and mean decision latitude and found no significant difference between the two groups ($p>0.05$). Concerning physical work load, our study found a significant difference between the two groups, as 61.5% of the workers with LBP had high work load index (≥36.38 points) compared to the other group of workers without LBP (28.6%) *(Table IV)*.

Table IV.

Job content and physical work load evaluation among the studied participants

	Total (N=80)	With LBP (N=52)	Without LBP (N=28)	test	p-value
Job content (Mean±SD):				**t-test**	
Psychological Job demands	9.36±2.31	9.41±2.30	9.28±2.36	-0.217	0.829
Decision latitude	20.85±3.77	20.98±3.88	20.61±3.59	-0.421	0.675
Job strain score#	11.49±3.84	11.58±3.99	11.32±3.60	-0.283	0.778
Physical work load index:				**χ^2 test**	
Low (≤22.46 points)	15 (18.8%)	5 (9.6%)	10 (35.7%)		
Middle (22.47–36.37 points)	25 (31.2%)	15 (28.8%)	10 (35.7%)		
High (≥36.38 points)	40 (50.0%)	32 (61.5%)	8 (28.6%)	10.84	0.004*

#The job strain score was calculated using the difference between mean psychological job demands and mean decision latitude.

* Statistically significant (p<0.05).

DISCUSSION

This cross-sectional study was conducted among eighty workers (n=80) in Offshore Oil Company, Ras-Gharib city, Red sea Governorate, through the period from February 2016 to April 2017.

In our study, about two thirds of the participants (n=52, 65.0%) complained of LBP, and only 28 (35.0%) had a negative history of LBP. This prevalence rate is in accordance with previous studies (Wong et al., 2010; Aljeesh and Al Nawajha, 2011; Xu et al., 2012; Abo El-Soud et al. 2016). In contrast, a study in Norway found a lower prevalence (20.0%) (Morken et al., 2007), which might be due to higher level of automation as well as the healthy workers effect arising from the self-selection of these workers. In general, variable prevalence rates of LBP complaint among O&G industry workers may be accepted due to the different case definitions used in the various studies as regard to complaint duration or severity, or to the different quantity or quality of the actual tasks done by the workers under different studies.

Age is one of the most common factors in the development of LBP, with most studies finding the highest incidence in the third decade of life and overall prevalence increasing until age 60 to 65 years. In our study, LBP complaint was highly significant among those with older age (≥40 years old) (OR=7.56, CI=2.68–21.30). This can be explained on knowing that age of ≥40 years old coincide usually with the mid-career stage which is the stage of maximal physical activity at work and higher chance for LBP complaints development. Also, with the increase in ages, LBP will increase probably due to the wearing of the intervertebral discs in older population.

Our result is consistent with the results of Borayek et al. (2011) who stated that there was a high significant correlation between LBP complaint and advancing in age. However, this result disagrees with others who reported that age was of no importance when discussing musculoskeletal complaints generally or LBP complaints specifically (Tinubu et al., 2010; Aggarwal et al., 2013).

Increased prevalence of LBP was associated with patients of low educational status. Lower educational levels are a strong predictor of more prolonged episode duration and poorer outcomes (Patrick et al., 2016). Our study showed a significant relationship between the prevalence of LBP and basic education (OR=2.85). This result is consistent with most of the studies as Leclerc et al. (2009) that showed a highly significant relationship between basic education and prevalence of LBP (OR=1.17). On the other hand, Omidianidost et al. (2015) disagrees with our result; this study stated that prevalence of LBP had no significant relationship with education level. This difference may be due to different work technologies and conditions, and also may be due to the elevated ratio of workers with basic education/workers with higher education in our study.

According to special habits of participants, our study showed that prevalence of LBP among workers in O&G industry was significantly higher among smokers and caffeine consumers (ORs=5.15 and 4.34, respectively).

Regarding smoking, the result of our study is consistent with the results of other studies which stated that smoking is a very important risk factor for musculoskeletal disorders (MSDs) (Spies-Dorgelo et al., 2007; Leclerc et al., 2009; Borayek et al., 2011). In contrast to our results, Wong et al. (2010) found no significant relationship between LBP and smoking; this difference may be due to lower prevalence of smokers (4.5%) in this Malaysian study, while in our study, more than half of the workers (63.75%) were current smokers. Also, Choobineh et al. (2009) stated that smoking is a poor predictor for musculoskeletal complaints.

Concerning practicing regular exercise, the result of our study is consistent with the results of Bejia et al. (2005) who found that exercise practice had a protecting role against occurrence of LBP. On the contrary, other studies stated that there was no significant relationship between lack of practicing exercises and LBP (Alshagga et al., 2013; Bin Homaid et al., 2016). On the other hand, Omidianidost et al. (2015) found that there was a significant relationship between practicing regular exercise and occurrence of LBP, which means practicing regular exercise is an important risk factor for LBP.

Concerning caffeine consuming, the result of our study is consistent with the results of McPartland and Michell (1997) and Aggarwal et al. (2013) who stated that high consumption of caffeine increased urinary calcium and could have a detrimental effect on bones in the long run aggravating LBP. In contrary to these results, Alshagga et al. (2013) stated that caffeine helps to combat fatigue and drowsiness and alleviate pain without any significant relationship between consuming caffeine and LBP occurrence.

Our study showed that, the risk of LBP complaints in O&G field workers was significantly higher among those with body weight ≥80.0 kg and those with higher BMI (>30 kg/m^2) (ORs=2.60 and 4.40, respectively) .

These results are consistent with those of Spies-Dorgelo et al. (2007), who explained it by the associated increase of the spinal loading and momentum at the limbo-sacral joint during work activities. Also, Borayek et al. (2011) found that LBP complaints were significantly more frequent in workers with BMI≥30. On the other hand, some studies found that height, weight and BMI were poor predictors of MSDs (Choobineh et al., 2009; Aggarwal et al., 2013). In addition, Bin Homaid et al. (2016) found no significant relationship between LBP complaint and higher BMI.

From the results of this study, it was noticed that the highest prevalence of LBP complaints was found among plant workers compared to office personnel. These results can be explained by the job nature of each professional category. Plant workers usually deal with occurrence of sudden events that require rapid decision making and maximal coordination of the body movements to do multiple and more stressful tasks while working. While, office personnel were the least stressful department because of the simple work tasks, regular fixed duration of the work shift.

This is consistent with the study of Chen et al. (2008), in a Chinese oil company, and Morken et al. (2007), in Norway's offshore petroleum industry, who recorded that about 40.0% of all MSDs complaints were among plant workers, specially maintenance workers and particularly among mechanics, electricians and scaffolders and the lowest prevalence was among office and management personnel (17.0%). On the other hand, Omidianidost et al. (2015) and Choobineh et al. (2009) found that LBP prevalence was insignificantly higher among plant workers.

Regarding years of experience, our results revealed that there was a significant association between LBP complaints and increased years of experience (OR=2.68). It can be explained by knowing that, years of experience ≥17 years coincide usually with the mid-career stage, which is the period of maximal physical activity at work and so higher chance for LBP complaints development, other studies also reported similar results (Mohseni et al., 2006; Roquelaure et al., 2009). While on the other hand, Keriri (2013) and Wong et al. (2010) reported that years of experience were of no importance in terms of LBP complaints.

In our study, workplace/employment factors such as hours of work per day and work shift were found to be important risk factors for LBP occurrence. This is consistent with an Iranian study of Attarchi et al. (2014) who stated that the prevalence of LBP was higher among shift workers than among day workers (OR=2.8). Also, Alshagga et al. (2013) stated that the increased working hours/day was an important risk factor for LBP. On the other hand, other studies reported no significant effect (Bejia et al., 2005; Abo El-Soud et al., 2016).

Most of the workers with LBP (75.0%) didn't attend any ergonomic training before and this had a significant effect on increasing LBP prevalence. The incidence of LBP correlates with knowledge of back care ergonomics as reported by Occhipinti et al. (2005) and Sikiru and Hanifa. (2010). On the contrary, Bin Homaid et al. (2016) in Saudi Arabia found no significant relationship between lack of educational training and LBP complaint.

Our results showed significant association between LBP complaints and awkward posture, this is consistent with the observations of Swei-Pi and Shu-Yu. (2008) and Tinubu et al. (2010) who stated that one of the most perceived job risk factors was working in awkward position. This can be explained by the fact that working in an awkward posture may reduce capability of the spine to withstand the mechanical load in such twisted position. On the other hand, Bejia et al. (2005) and Occhipinti et al. (2005) found no significant association between prevalence of LBP and work posture.

Whole body vibration (WBV) has a significant effect on LBP, results of our study found to be consistent with that of Burstrom et al. (2015), who found significant association between exposure to WBV and LBP complaints (OR=2.17). This may be due to muscle fatigue after

WBV exposure; the muscle response to a sudden load has greater latency.

The results of our study showed significant relationship between LBP complaints and work scheduling as overtime, irregular shifts, infrequent rest breaks (OR=3.29). This is in consistence with Attarchi et al. (2014) who found the same results, while on the contrary, Occhipinti et al. (2005) found no significant correlation with not taking rest breaks when needed.

Regarding the job content evaluation among the studied participants according to the Job Content Questionnaire (JCQ), our study found no significant difference between the two groups in either domains of JCQ and job strain score, which is consistent with Hoogendoorn et al. (2002) and Morken et al. (2007). On the other hand, Choobineh et al. (2009) and Aggarwal et al. (2013) found that high perceived psychological demands were important risk factors of LBP. This difference may be attributed to the varied psychological and physical conditions and loads in the working environment in the different studies.

Regarding physical work load evaluation, our study results showed that there was a highly significant difference between workers exposed to low physical workload and those exposed to high workload as regards the physical work load index and its total score ($p<0.01$). These study findings are in accordance to those found by previous studies of Morken et al. (2007) and Aljeesh and Al Nawajha (2011), who stated that high physical load was an important risk factor for LBP complaint.

Our study had some limitations as like all other cross sectional or self-reported studies, it is possible that the respondents might have given vague answers or exaggerated their LBP complaints also, it was also hard to compare these results to the results of previous studies due to the limited researches that has been conducted in this area. It is important to plan to a prospective cohort study design with larger sample size in the future to provide more sound research evidence on LBP among workers in Oil & Gas field.

CONCLUSION

The present study provides an important body of information concerning prevalence of LBP in the O&G industry. Accordingly, it was concluded that working in O&G industry is associated with an increased risk of LBP. Lifting or moving heavy materials or equipment and working in awkward positions were the most common perceived job risk factors. So, we recommend training programmes for back care ergonomics and stress management to be incorporated into ongoing OHS training programme0s, and should be provided, repeated periodically and supported by feasible incentives. Also, modifying the work circumstances and process nature to match the capabilities of the workers and avoiding high physical load works. Enhancing sports activities and designing programmes to encourage weight reduction will be useful.

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