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Prevalence of Risk Factors and Work-Related Musculoskeletal Disorders among the Study Participants Working at an Egyptian Oil and Gas Company

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Abstract

Background: Work-related musculoskeletal disorders (WMSDs) have a significant impact on the workplace and the implications have a serious impact on workers and organizations. WMSDs can result from various risk factors including biomechanical, environmental, organizational and psychological risk factors. It is hypothesized that risk factors can affect study participants' body regions at different disciplines and can lead to chronic and acute pain. Aim of the study: To assess prevalence of biomechanical, environmental, organizational, psychological risk factors and associated WMSDs. Subjects & methods: The research was done through an analytical cross-sectional study on employees from different disciplines working at an Egyptian oil and gas company at Cairo office and site, the number of participants was 469 individuals, and the research tools included standard Nordic questionnaire and checklist for risk factors assessment. Results: The current study found that WMSDs pains complaints were most prevalent at lower back, neck, hand and one or both knees respectively and WMSDs complaints prevented employees from work were at lower back, hand, upper back, neck and knees. The most prevalent biomechanical risk was static posture, sit for periods of more than 30 minutes, perform task fast, environmental risk was in adequate lighting, inadequate heat, inadequate room to change position, organizational risk was inadequate schedule, work overtime and psychological factor was improper relationship with leaders, inadequate work deadline and un satisfaction with work at different disciplines. Conclusion: biomechanical, organizational, environmental and psychological were the risk factors for WMSDs prevalence among employees and are statistically significant.

Keywords: Biomechanical, environmental, organization, psychological and WMSDs.

Introduction

Work related musculoskeletal disorder (WMSDs) is an injury to the muscles, tendons, ligaments, nerves, joints, cartilage, bones, or blood vessels in the arms, legs, head, neck, or back caused by work tasks such as lifting, pushing and pulling that causes significant harm to people's health, serious absenteeism, economic losses, impact on remuneration, increased health costs, decrease productivity and quality of life **(Yao et al., 2019)**. The prevalence of WMSDs had a serious implication on workers and employees at the world due to their exposure to a lot of occupational hazards such as inadequate postures, improper handling of materials and occupational stress in the workplace which are main cause for morbidity, disabilities and most work-related time lost among many workers **(Barreto et al., 2017)**. The national institute of occupational safety and health (NIOSH) declared strong evidence on the association of physical risk factors such as static posture, awkward posture, force, vibration, temperature and job tasks with the development of work related musculoskeletal disorders pain **(NIOSH, 2021)**.Computer work has recently increased, and office work is the most rapidly growing occupation which leads to increase work related musculoskeletal disorders and has been linked with musculoskeletal complaints. There are several factors associated with computer workstations can contribute to WMSDs such as poor ergonomics which include inadequate chair and desk design, improper keyboard and mouse placement and incorrect monitor height which can lead to discomfort and pain over time, repetitive movements like repetitive hand movements, typing and using a mouse extensively which can lead to strain the muscles and tendons in the hands and arms leading to conditions like carpal tunnel syndrome. Prolonged sitting for long periods without proper support can lead to lower back pain and negatively impact posture leading to various musculoskeletal disorder problems. Screen and document placements are not placed at eye level which leads to employees may have to constantly bend their necks leading to neck and shoulder strain. Environment factors such as lighting, noise levels and overall workspace design can lead to impact an employee's comfort and well-being also employees work with computers include a range of various physical work environment factors and interaction between them such as the interaction between the workplace, the devices , the speed of data entry or the interface between the work posture and the objects being displayed like the screen, documents, etc. and the content of work **(Elkhateeb et al., 2018 and Ono et al., 2020)**. Forward head posture (FHP) is an epidemic that has become more prevalent in modern times as work related musculoskeletal disorders due to several factors such as sleeping with head elevated too high, access and simultaneously longer extending using of computer and smart phone recently and changes may be accompanied by a poor posture and the resultant neck pain, lack of the developed back muscle strength **(Lotfian et al., 2015 and Szczygieł et al., 2020)**. Low back pain (LBP) is one of the common health problems among full time office employees that cause absenteeism from work and safety at work is important for employees with low back pain (LBP) and good job design the job to fit the worker (**Edwin et al., 2023; Hossain et al., 2020 and Ishimaru et al., 2021)**.

Aim of work

To study the prevalence of biomechanical, environmental, organizational, psychological risk factors and work-related musculoskeletal disorders among the study participants working at an Egyptian oil and gas company

Material and methods

Research design: Analytical cross-sectional study.

Sampling technique: Simple Random Sample technique

Period and place of study: The study was conducted from November 2022 to December 2023 among employees working at different divisions and departments at Engineering for petroleum and process industries organization (Enppi).

Study population: The study was conducted at an Egyptian oil and gas company (Engineering for petroleum and process industries –ENPPI), it includes Administrative work including (administration , financial , administration buildings affairs, human resources, public relation, information technology, secretary, business development), Technical & Professional work including (process, piping, civil, mechanical , electrical, instrumentation and telecommunication, procurement, project management, proposal and contracts, cost, engineering management, planning , Pre-commissioning & commissioning, document control, printing and graphic , graphic, QHSE), Construction including (construction, health, safety and environment, electrical & installation, site material control, site administrator), Maintenance, Transportation). Sample size was calculated in light of previous study performed by Steven K Thompson and according to the following equation: Sample size (n) = [DEFF*Np (1-p)]/ [(d2/Z2α/2*(N-1) + p*(1-p)].Where n is the required sample size, N is the total number of workers in study setting (3143 worker). $Z_{\propto/2}$Denotes the critical value that divides the central 95% of the Z distribution from the 5% in the tail) and equals 1.96, P is the prevalence of MSDs among workers and the estimated sample employees' size was 133 but it was increased 469, DEFF is the design effect (1.0) and d equals the absolute precision level of 5%.

Study method: Data was collected by a questionnaire and checklist; the participants were asked to fill and complete questionnaire via email and written hard copy for maintenance and transportation employees participated.

I. **Questionnaire:** It is English standard Nordic questionnaire **(Kourinka et al., 1978)** was translated to Arabic and used for assessment of general musculoskeletal discomfort of body regions. It includes data on demographic characteristics such as age and gender, occupational history as job position, duration of employment and working hours and presence of musculoskeletal complaints at different body regions.

II. **Checklist :** It is a comprehensive checklist based on checklists extracted from NIOSH, computer work station checklist, DSC workstation checklist, hand tools checklist, material handling checklist, office workstation checklist, WMSDs Hazard identification checklist and task analysis checklist and include questions on work that

could contribute to musculoskeletal symptoms among participants including biomechanical, organization factors, environmental, psychological factors, task hazard analysis, computer workstation, office chair design, keyboard design, mouse, display screen equipment, handling materials, hand tools, office workstation and task design and it was based on participants responded with Yes, No and Not applicable.

Consent: Written informed consent were taken from all participants involving a brief explanation about the importance and the aim of this study, explaining to them the purpose and procedures of the study, the confidentiality of the participant's data regarding that the questionnaire, the right to refuse participation and end the meeting at any time without giving any reasons and informed them that all collected data was used for this current research only.

Ethical approval: Two official approvals were obtained before field work from faculty's research ethics committee (REC) and ENPPI-Company before starting data collection.

Data management and analysis: Data analyses were performed with the statistical package for social science SPSS-22. Descriptive statistics were used for describing and summarizing data as appropriate (mean and standard deviation for continuous variables, and frequency and percentage for categorical variables). Chi squared test ($\chi 2$) was used to test the significance of differences of qualitative variable. P value was set at <0.05 for statistically significant results.

Results

This study included 469 workers in Enppi at different sites and office and all of them were eligible and agreed to take part in the survey.

Table 1. Distribution of the study population according to personal and job characteristics (No=469).

	Mean ±SD
Body Mass Index (BMI)	28.98 ±5.24
Age	40.15 ±8.24
Working Hours	49.92 ±12.05
Working Years	15.49 ±7.71

Data expressed as mean and standard deviation $\bar{x}$ ± (SD) or No. (%).

The age of participants ranged from 24: 59 years with a mean of 40.15 ±8.24. The years of working in current job ranged from 3: 38 years with a mean of 15.49 ±7.71. Working hours per week in current job ranged from 40: 90 hours with a mean of 49.92 ±12.05 and body mass index (BMI) with a mean of 28.983 ±5.24 (Kg/m²) (Table 1).

Distribution of the study population according to gender, males represented 86.6% compared to females 13.4% (Fig. 1). Prevalence of work-related musculoskeletal complaints suffering from WMSDs pains last 12 months among the study participants (No=469) (Fig. 2-1). The most prevalent site of complaint reported by employees suffering from MSDs pain for the last 12 months was lower back followed by neck, wrist /hand, and knees 53.9 %, 51.2%, 38% and 36.7%, respectively.

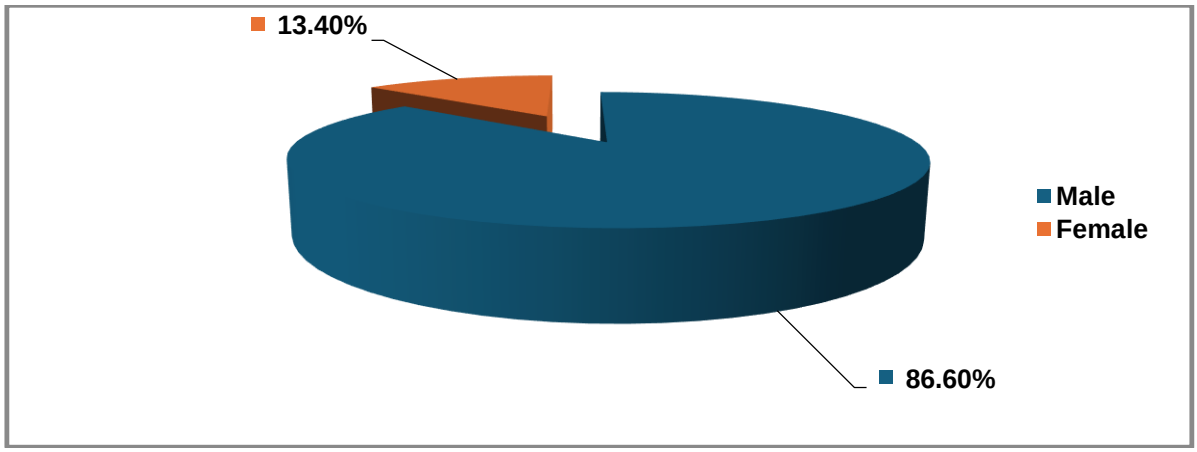

Fig.1. Distribution of the study population according to gender

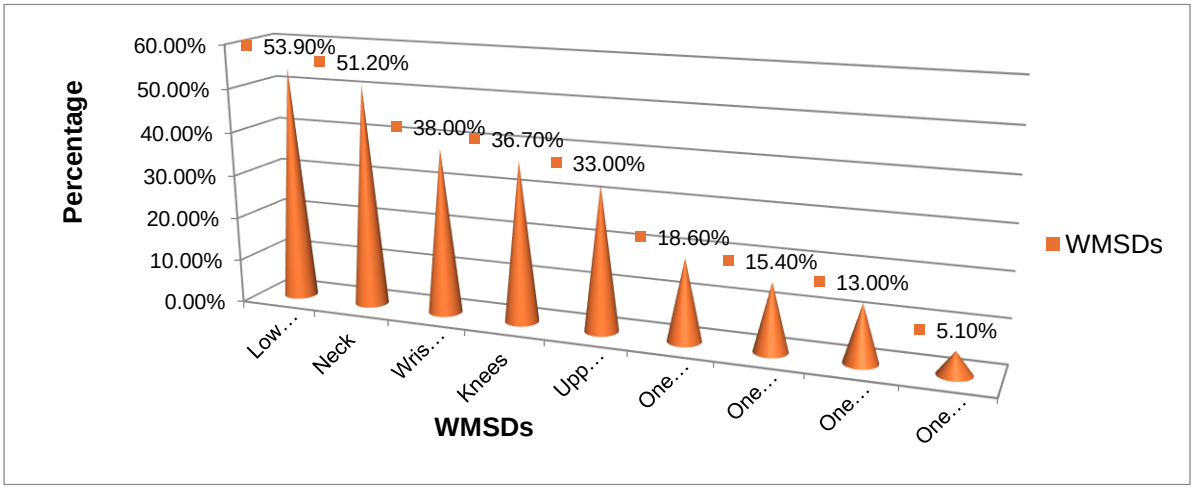

Fig. 2-1. The most prevalent site of complaint reported by employees suffering from MSD's pains complaints for last 12 months

Prevalence of work-related musculoskeletal complaints reported prevent the employees from doing normal work at home any way because of the trouble any time during the last 12 months (No=469) (Fig. 2-2). The most prevalent sites reported prevent the employees from doing normal work at home any way because of the trouble any time

during the last 12 months were lower back, wrist /hand, upper back, neck 40.5%, 36.5%, 32.6 and 32.6%, respectively.

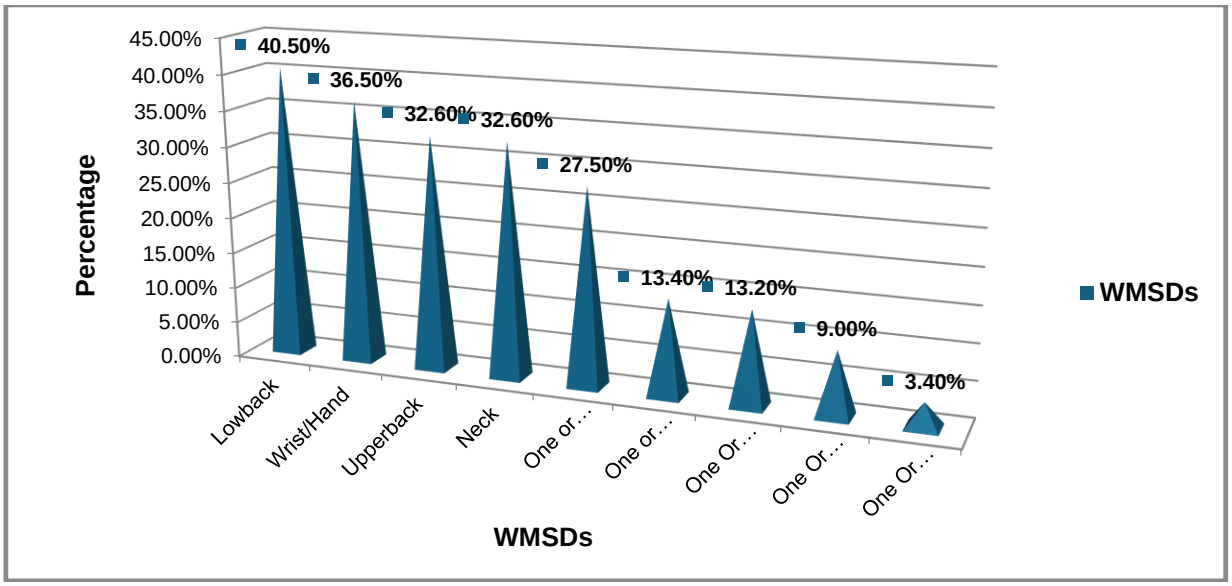

Fig. 2-2. The most prevalent sites of complaints reported prevent the employees from doing normal work at home any way because of the trouble any time during the last 12 months

As shown in Table 2, most prevalent biomechanical risk factors at administration was static posture followed by sit for periods of more than 30 minutes without the opportunity to stand or move, Perform task very fast in short time periods, technical at use electronic input devices for continuous periods of more than 30 minutes followed static posture, Sit for periods of more than 30 minutes without the opportunity to stand or move , construction at use electronic input devices for continuous periods of more than 30 minutes followed by static posture, Sit for periods of more than 30 minutes without the opportunity to stand or move around freely, maintenance at and exert force with their hands for gripping and pushing followed by work with arm over shoulders, work with body away need to bend or stretch their arm to reach, transportation at static posture and sit for periods of more than 30 minutes without the opportunity to stand or move around freely followed by work with body away need to bend or stretch their arm to reach and statistically significant.

As shown in Table 3, most prevalent environmental risk factors at administration was in adequate lighting followed by inadequate and comfortable levels of heat, inadequate room to change position and vary movement, technical at in adequate lighting followed by inadequate and comfortable levels of heat, construction at inadequate lighting followed by inadequate level of comfortable heat , inadequate ventilation, maintenance at inadequate maintenance periodically, in adequate room to change position and inadequate lighting,

transportation at inadequate maintenance periodically followed exposure to vibration, inadequate ventilation and statistically significant.

Table 2. Prevalence of biomechanical risk factor among disciplines (No=469).

Biomechanical Risk Factors	**Administration**	**Technical**	**Construction**	**Maintenance**	**Transportation**	**P-Value**
	NO. (%) N=226	**NO. (%) N=1091**	**NO. (%) N=452**	**NO. (%) N=51**	**NO. (%) N=141**	
Static posture.	42 (18.6)	245(22.5)	82(18.1)	5 (9.8)	26 (18.4)	**(0.000) ***
Bending or twisting the back in awkward position.	13(5.8)	67(6.1)	32(7.1)	3(5.9)	15(10.6)	**(0.000) ***
Sit for periods of more than 30 minutes without the opportunity to stand or move around freely.	37(16.4)	211(19.3)	51(11.3)	3(5.9)	26(18.4)	**(0.000) ***
Work with arm over shoulders.	6(2.7)	16(1.5)	17(3.8)	6(11.8)	4(2.8)	**(0.000) ***
Work with body away need to bend or stretch their arm to reach.	19(8.4)	57(5.2)	42(9.3)	6(11.8)	19(13.5)	**(0.000) ***
Carry, lift or move heavy objects (equipment /materials).	8(3.5)	19(1.7)	12(2.7)	5(9.8)	1(1.0)	**(0.000) ***
Lift / lower objects between floor and waist height or above shoulder height.	6(2.7)	34(3.1)	17(3.8)	4(7.8)	8(5.7)	**(0.000) ***
Lift, lower, or carry objects weighing more than 50 lbs. (23 kg).	6(2.7)	19(1.7)	18(4.0)	4(7.8)	1(1.0)	**(0.000) ***
Perform task very fast and in short time periods.	28(12.4)	128(11.7)	56(12.4)	5(9.8)	4(2.8)	**(0.000) ***
Handling material wrong with non anatomical shape (weight, ape,.etc).	3(1.3)	19(1.7)	7(1.5)	0(0.0)	3(2.1)	**(0.018) ***
Exert force with their hands (e.g., gripping, pulling, and pinching).	11(4.9)	24(2.2)	22(4.9)	7(13.7)	11(7.8)	**(0.000) ***
Use electronic input devices (e.g., keyboards, mouse, joysticks, and track balls) for continuous periods of more than 30 minutes.	47(20.8)	252(23.1)	96(21.2)	3(5.9)	13(9.2)	**(0.000) ***

* Statistically significant at 95% level of confidence, Chi-square test was used.

Table 3. Prevalence of environmental risk factors among disciplines (No=469).

Environmental Risk Factors	Administration NO. (%) N=284	Technical NO. (%) N=1358	Construction NO. (%) N=687	Maintenance NO. (%) N=70	Transportation NO. (%) N=153	P-Value
Suitable lighting room to be comfortable.	42(14.8)	216(15.9)	101(14.7)	10(14.3)	17(11.1)	**(0.000)***
Exposure to vibration.	3(1.1)	17(1.3)	17(.5)	2(2.9)	22(14.4)	**(0.000)***
Adequate workplace with furniture and equipment (difficulty for mobility)	14(4.9)	80(5.9)	20(2.9)	1(1.4)	1(0.7)	**(0.000)***
Equipment is maintained periodically.	33 (11.6)	117(8.6)	77(11.2)	10(14.3)	25(16.3)	**(0.000)***
Adequate room to change position and vary movement.	36(12.7)	177 (13.0)	101(14.7)	10(14.3)	15 (9.8)	**(0.000)***
Workstation is adequate lighting and comfortable for the tasks, and does not influence posture e.g. cause peering, leaning or squinting.	34 (12.0)	202 (14.9)	99 (14.4)	10 (14.3)	17 (11.1)	**(0.000)***
Adequate ventilation.	34(12.0)	149(11.0)	94(13.7)	9(17.9)	19(12.4)	**(0.000)***
Presence of tripping hazards e.g. cabling mats, poor housekeeping in the immediate environment.	18 (6.3)	74(5.4)	25(3.6)	4(5.7)	4(2.6)	**(0.000)***
Adequate and comfortable levels of heat.	37 (13)	177 (13.0)	75 (10.9)	7 (10.0)	17 (11.1)	**(0.434)**
Adequate and comfortable levels of noise/ sound.	33 (11.6)	149 (11.0)	78 (11.4)	7 (10.0)	16 (10.5)	**(0.012) ***

* Statistically significant at 95% level of confidence, Chi-square test was used.

As shown in Table 4, the most prevalent organizational risk factor at administration, maintenance and technical were inadequate work schedule followed by work overtime, perform task repetitively, construction at perform task repetitively followed by work overtime, inadequate work schedule, transportation at perform task repetitively followed by inadequate work schedule, work overtime, unequal distribution of work.

Table 4. Prevalence of organizational risk factor among disciplines (No=469).

Organizational Risk Factors	Administration NO. (%) N=214	Technical NO. (%) N=1079	Construction NO. (%) N=498	Maintenance NO. (%) N=46	Transportation NO. (%) N=123	P-Value
Work schedule is suitable	47(22)	229(21.2)	81(16.3)	10(21.7)	19(15.4)	**(0.09)**
Work overtime.	28(13.1)	212(19.6)	97(19.5)	9(19.6)	18(14.6)	**(0.000)***
Irregular work shift	6(2.8)	30(2.8)	36(7.2)	1(2.2)	6(4.9)	**(0.000)***
Tasks are distributed unequal.	23(10.7)	98(9.1)	20(4.0)	5(10.9)	18(14.6)	**(0.000)***
The same task is performed repetitively.	40(18.7)	203(18.8)	89(17.9)	8(17.4)	26(21.1)	**(0.059)**
Work is designed to get regular rest breaks; Take postural breaks every 30 minutes.	23(10.7)	106(9.8)	56(11.2)	6 (13.0)	9(7.3)	**(0.000)***
Sufficient number of workers at workplace /job.	31(14.5)	152(14.1)	69(13.8)	3(6.5)	17(13.8)	**(0.215)**
Training on the proper postures, proper work methods, recognizing signs and symptoms of potential WMSDs problems, when and how to adjust their workstations to avoid musculoskeletal discomfort.	16(7.5)	49(4.5)	50(10.0)	4(8.7)	10(8.1)	**(0.000)***

* Statistically significant at 95% level of confidence, Chi-square test was used.

As shown in Table 5, most prevalent psychological risk factors at administration was improper relationship with coworkers or leaders followed by unachievable work deadline, un satisfaction with work, technical at improper relationship with coworkers or leaders followed by work under time pressure, un satisfaction with work, construction at improper relationship with coworkers or leaders followed by organization hasn't decision making power or do job control, un satisfaction with work, maintenance at improper relationship with coworkers or leaders and Un satisfaction with work, transportation at organization hasn't decision making power or do job control followed by improper relationship with coworkers or leaders, un satisfaction of work.

Table 5. Prevalence of psychological risk factor among disciplines (No=469).

Psychological Risk Factors	Administration NO. (%) N=336	Technical NO. (%) N=1855	Construction NO. (%) N=787	Maintenance NO. (%) N=66	Transportation NO. (%) N=137	P-Value
Continue work even they have pain or injury.	30(8.9)	186(10.0)	65(8.3)	3(4.5)	11(8.0)	**(0.008) ***
Work under time pressure.	33(9.8)	245(13.2)	93(11.8)	4(6.1)	11(8.0)	**(0.000)***
Overloading of different functions.	21(6.3)	168(9.1)	52(6.6)	2(3.0)	3(2.2)	**(0.000)***
Work under pressure from leadership.	15(4.5)	117(6.3)	34(4.3)	1(1.5)	6(4.4)	**(0.009) ***
Improper relationship with coworkers or leaders.	46(13.7)	254(13.7)	107(13.6)	10(15.2)	21(15.3)	**(0.04) ***
Organization hasn't decision making power or do job control.	39(11.6)	213(11.5)	96(12.2)	9(13.6)	22(16.1)	**(0.165)**
Un satisfaction with work.	41(12.2)	216(11.6)	94(11.9)	10(15.2)	20(14.6)	**(0.015) ***
Organization performs recognition for well job.	29 (8.6)	175 (9.4)	87 (11.1)	9 (13.6)	13 (9.5)	**(0.000)***
Work deadlines realistic, achievable and there is sufficient control over the work place and workload.	43 (12.8)	162 (8.7)	70 (8.9)	9 (13.6)	14 (10.2)	**(0.000)***
Workplace culture is positive, respectful and supportive.	39(11.6)	219(11.8)	89(11.3)	9(13.6)	16(11.7)	**(0.009) ***

* Statistically significant at 95% level of confidence, Chi-square test was used.

Discussion

Four hundred and sixty-nine employees were included 86.6% were males and 13.4% were females. The mean age was 40.15 ±8.25 years and ranged from 24 to 59 years. The mean body mass index was 28.983 ± 5.24 kg/m². The mean working hours per week were 49.92 ±12.05 hours and ranged from 40 to 90 hours.

It was found that employees reported MSDs pains complaints for last 12 months were at lower back followed by neck, wrist / hand and knees and for employees prevented from their doing normal work at home any way because of the trouble any time during the last 12 months were at lower back, wrist /hand, upper back and neck. In accordance with a

study conducted by **Elkhateeb et al. (2018)**, lower back, neck complaints and upper musculoskeletal complaints. In accordance with a study conducted by **Mozafari et al. (2014)**, the most common musculoskeletal problems were in the low back and neck regions. On contrast with study conducted by **El Hosseini et al. (2019)**, neck and shoulder pain were the most prevalent followed by low back and wrist pain.

It was found that WMSDs and all biomechanical risk factors are statistically significant. In addition to it was found that most prevalent biomechanical risk factors at administration was static posture followed by sit for periods of more than 30 minutes without the opportunity to stand or move, Perform task very fast in short time periods , technical at use electronic input devices for continuous periods of more than 30 minutes followed static posture, Sit for periods of more than 30 minutes without the opportunity to stand or move , construction at use electronic input devices for continuous periods of more than 30 minutes followed by static posture, sit for periods of more than 30 minutes without the opportunity to stand or move around freely, maintenance at and exert force with their hands for gripping and pushing followed by work with arm over shoulders, work with body away need to bend or stretch their arm to reach, transportation at static posture and sit for periods of more than 30 minutes without the opportunity to stand or move around freely followed by work with body away need to bend or stretch their arm to reach and statistically significant .In accordance with a study conducted by **Kalinienė et al. (2013)**, working for longer than 2 h without taking a break as well as with higher ergonomic risk score and had the strongest associations with neck complaints. In accordance with a study conducted by **Barreto et al. (2017)**, occupational risk factors perceived as the most problematic ones were bending or twisting the back in an awkward way, continuing to work when injured or hurt and working in the same position for long periods. In accordance with a study conducted by **Elkhateeb et al. (2018)**, musculoskeletal complaints was observed among computer office workers due to poor ergonomic practices in their workplace, being in the same position for long period, doing repetitive tasks and lack of regular break.

It was found that WMSDs and environmental risk factor are statistically significant and adequate/ comfortable levels of heat is statistical insignificant. In addition to it was found that most prevalent environmental risk factors at administration was in adequate lighting followed by inadequate and comfortable levels of heat, inadequate room to change position and vary movement , technical at in adequate lighting followed by inadequate and comfortable levels of heat, construction at inadequate lighting followed by inadequate level of comfortable heat , inadequate ventilation, maintenance at inadequate maintenance periodically for employees suffered from WMSDs, in adequate room to change position and inadequate lighting, transportation at inadequate maintenance periodically followed exposure to vibration, inadequate ventilation and statistically significant. No study reported that factor.

It was found that WMSDs and organizational risk factor are statistically significant except adequate work schedule, enough workers for job and repetitive same task are statistical insignificant. The most prevalent organizational risk factor at administration,

maintenance and technical were inadequate work schedule followed by work overtime, perform task repetitively, construction at perform task repetitively followed by work overtime, inadequate work schedule, transportation at perform task repetitively followed by inadequate work schedule, work overtime, unequal distribution of work. In accordance with a study conducted by **Kalinienė et al. (2013)**, working for longer than 2 h without taking a break as well as with higher ergonomic risk score had the strongest associations with neck complaints. In addition to it was found that most prevalent organizational risk factors at administration, maintenance and technical were inadequate work schedule followed by work overtime, perform task repetitively, construction at perform task repetitively followed by work overtime, inadequate work schedule, transportation at perform task repetitively followed by inadequate work schedule, work overtime, unequal distribution of work and statistically significant. In accordance with a study conducted by **Elkhateeb et al. (2018)**, WMSDs complaints was observed among computer office workers due to poor ergonomic practices in their workplace, being in the same position for long period, doing repetitive tasks and lack of regular break.

It was found that WMSDs and psychological risk factor are statistically significant except organization decision making power to do job control is statistically insignificant. The most prevalent psychological risk factors at administration was improper relationship with coworkers or leaders followed by unachievable work deadline , un satisfaction with work, technical at improper relationship with coworkers or leaders followed by work under time pressure, un satisfaction with work, construction at improper relationship with coworkers or leaders followed by organization hasn't decision making power or do job control, un satisfaction with work, maintenance at improper relationship with coworkers or leaders and Un satisfaction with work, transportation at organization hasn't decision making power or do job control followed by improper relationship with coworkers or leaders, un satisfaction of work. In accordance with a study conducted by **El Hosseini et al. (2019)**, a psychological factor as poor job control was significantly associated with the development of MSDs while high work demand didn't.

Conclusion

Lower back and neck complaints were most prevalent followed by hand and knees among oil and gas study participants had pain for last 12 months in-addition to lower back and hand were most prevalent followed by upper back and neck for studied employees who prevented from doing their normal work at home any way last 12 months and biomechanical, environmental, organizational and psychological were risk factors for WMSDs complaints and were statistically significant.

Biomechanical risk factor prevalence at administration was static posture followed by sit for periods without the opportunity to stand or move, perform task very fast in short time periods, technical at use electronic input devices for continuous periods followed static posture, sit for periods without the opportunity to stand or move, construction at use electronic input devices for continuous periods followed by static posture, sit for periods without the opportunity to stand or move around freely, maintenance at and exert for

gripping and pushing followed by work with arm over shoulders, bend or stretch their arm to reach, transportation at static posture and sit for periods without the opportunity to stand or move around freely followed by stretch their arm to reach.

Environmental risk factor prevalence at administration was in adequate lighting followed by inadequate and comfortable levels of heat, inadequate room to change position and vary movement, technical at in adequate lighting followed by inadequate and comfortable levels of heat, construction at inadequate lighting followed by inadequate level of comfortable heat, inadequate ventilation, maintenance at inadequate maintenance, in adequate room to change position and inadequate lighting, transportation at inadequate maintenance followed exposure to vibration, inadequate ventilation.

Organizational risk factors prevalence at administration, maintenance and technical were inadequate work schedule followed by work overtime, perform task repetitively, construction at perform task repetitively followed by work overtime, inadequate work schedule, transportation at perform task repetitively followed by inadequate work schedule, work overtime, unequal distribution of work.

Psychological risk factors prevalence at administration was improper relationship with coworkers or leaders followed by unachievable work deadline, un satisfaction with work, technical at improper relationship with coworkers or leaders followed by work under time pressure, un satisfaction with work, construction at improper relationship with coworkers or leaders followed by organization hasn't decision making power or do job control, un satisfaction with work, maintenance at improper relationship with coworkers or leaders and un satisfaction with work, transportation at organization hasn't decision making power or do job control followed by improper relationship with coworkers or leaders, un satisfaction of work.

Acknowledgment

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Recommendations

- **Engineering control**
  - Change all company office chairs to be ergonomically designed to minimize all WMSDs injuries.
  - Redesign workplace to provide proper ventilation and air circulation.
  - Redesign and arrange workstation and furniture for safe mobility and accessibility to avoid tripping and environmental hazards.
  - All workstations set-up shall be tilted and designed to fit the worker.
  - Wooden inclined pieces shall be provided under the feet of all employees for thigh, feet and knees relaxation.
  - Only designed and adequate keyboard which can be tilted and adjusted to be used to make wrists and upper arms are straight and relaxed.

- Planning and project control disciplines shall be developed and designed in order to make project schedule achievable to complete all projects and tasks within time schedule milestone.
- Re-design work methods and replacing manual handling to be through mechanical lifting as applicable.
- Only designed and adequate mouse to cope posture to be provided.
- Display screens shall be provided with reflective and protective shields to prevent any glare or reflection.
- Review and modify PC screen to be on a lower level than eye level by angle 30 degree.
- Change fixed PC screen with adjustable one.
- Modify and re-design lighting for all office and workstations inorder to be suitable for the type of activity and comply with Egyptian law 12/2003.

- **Administrative control**
  - Noise monitoring plan shall be developed for all company buildings and site and noise levels measurements using sound level meter shall be conducted on regular basis to ensure appropriate noise levels as per laws Egyptian law 12/2003 and regulations to avoid any injury or deafness and in case of non-compliance , redesign to ensure compliance .
  - Heat stress management monitoring plan shall be developed and heat stress index measurements using WBGT device to ensure appropriate levels as per Egyptian law 12/2003 and regulations to avoid any injury, heat exhaustion, heat cramps, overcome and in case of non-compliance , redesign to ensure compliance .
  - Monitoring and follow up implementation of company preventive maintenance program (PMP) for all workstations and chairs and inspection shall be conducted on regular basis.
  - Illuminations monitoring plan shall be developed for all company buildings and illumination intensity using Luxmeter device shall be conducted on regular basis to ensure appropriate illuminations as per Egyptian law 12/2003 and law 4 for 1994 and it's modification 9 for 2009 EEAA and regulations to avoid eye strain and diseases and in case of non-compliance, redesign the lighting/illumination to ensure compliance.
  - Training program for all employees on early ergonomic hazards and WMSDs recognition symptoms, education program to user on how to adopt suitable postures while working to prevent hands bent up at the wrist, wrists straight and upper arms relaxed and no overstretching the fingers during typing and encourage employees for feedback and reporting for any unsafe condition related to ergonomics.
  - Training for administration building affairs employees on safe manual and mechanical handling techniques.
  - Review clearance and access at workspace to ensure safe accessibility and mobility.

- Change work methods and rest breaks to avoid using electronic input devices for continuous periods of more than 30 minutes without break, avoid working with same position for long periods and standing and moving.
- Stop work if you have pain or injury and report to the medical& HSE department for evaluation and assessment.
- Adequate resources and manpower shall be managed and provided as per forecast workload to avoid overloading of different functions and avoid work under time pressure.
- Measure employee's satisfaction on their leader's behavior and attitude by a confidential questionnaire, reporting and feedback checklist related to work under pressure shall be reported by employees and to be analyzed and submitted to top management on quarterly basis for evaluation.
- A lifestyle and health plan shall be activated for all employees to lose weight and keep their live healthy.
- Develop policy for repairing and changing and maintaining chairs as per preventive maintenance program.
- Minimize working hours and multi tasks for all employees.
- Conduct periodical medical checks for early identifying WMSDs for all employees and setting a periodically medical measures action plan.
- Enforce policy for construction and transportation to have authority for decision making to do control for job and apply procedures.
- Enforce procedures in place for drivers and passengers break time 15 minutes every 2 hours driving.
- Company top management to rectify construction, administration, maintenance and technical disciplines management to change attitude to satisfy employees with work.

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