



# PREVALENCE AND PATTERN OF WORK-RELATED DISORDER AMONG OIL AND GAS WORKERS IN KADUNA REFINERY, NIGERIA.

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## ABSTRACT

This study examined the frequency and distribution of musculoskeletal problems among Kaduna Refining and Petrochemicals Company Limited (KRPC) engineers, desk workers, security. Data for the study were gathered using a modified online version of the Nordic musculoskeletal questionnaire. The prevalence and patterns of musculoskeletal disorder (MSD) were assessed and data from a survey given to KRPC employees was analyzed using SPSS. According to the survey, there were 62.4% of MSD cases among KRPC employees overall over 12 months. The prevalence of MSD was highest for lower back (%), followed by upper back (%) and the wrist (%). Years of experience and MSD were significantly associated ( $P > 0.05$ ). Employees with 16 to 25 years of work experience had a very high prevalence of MSD (84.9%). The power plant and quality control (PPQ and C) departments as well as the maintenance department had the highest rates of MSD. The findings can be used by KRPC management and any other refinery to address MSD problems among its employees and to close a gap in the body of knowledge regarding how MSD affects refinery workers in general.

**Keywords:** Kaduna, Lower back, Musculoskeletal disorders, Prevalence, Upper back

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## INTRODUCTION

According to Bevan (2015), with the current and projected population growth, an increase in average living age, and a decrease in mortality rate due to advancements in health care, the global population is now living longer. The primary concern is that people are becoming more susceptible to non-communicable diseases such as musculoskeletal disorder (MSD) (March *et al.*, 2014). According to the World Health Organization, MSDs are the second leading cause of disability worldwide and must be studied and resolved (Luan *et al.*, 2018). These conditions affect people of all ages, one in every five people, causing them to live with painful or disabling musculoskeletal conditions (World Health Organization, 2018).

Occupational Safety and Health Administration (OSHA) surveys from 2000 revealed that different occupational safety and health professionals refer to musculoskeletal disorders (MSD) by different names, including occupational disease, cumulative trauma disorders, repeated trauma, repetitive stress injuries, and occupational overexertion syndrome (Ge *et al.*, 2018.). MSD are common conditions that affect the entire body's muscles, tendons, ligaments, joints, cartilage, bones, and nerves as a result of an employee being exposed to prolonged awkward body position, excessive repetition, and heavy lifting (OSHA, 2000; Costa and Vieira, 2010; Ge *et al.*, 2018; HSE, 2023). MSD account for 17.1% of all reported cases of occupational health injury worldwide, as per the Global Burden of Disease study (GBD, 2017). On the incidence and expense of MSD in the oil and gas sector in Africa, there is not much-published information. However, according to Wanyoni and Frantz's (2015) systematic analysis of the literature, MSD affects a sizable portion of the population in Africa and has a prevalence rate ranging from 15% to 93.6%. The low back region is the most commonly affected body portion, with incidence rates ranging from 13% for administrative personnel in South Africa to 92% for farmers in Ghana. According to Louw *et al.* (2007) and Morris *et al.* (2018), low back pain is the most concerning type of MSD and is becoming more prevalent across the continent. Health care has the highest incidence rate (24%), followed by industrial work (20%) and with 2% apiece, the music business and fishing among Africa's least studied fields (Wanyoni and Frantz, 2015).

Oil refining is the high-temperature separation of petroleum crude into hydrocarbon sub-fractions like light hydrocarbon (flammable gas and liquid) (American Petroleum Institute, 2019). The need to ensure a safe working environment through effective health and safety management procedures has arisen as a result of the development of petroleum refining from a straightforward distillation process to today's high-tech process (Kumar *et al.*, 2012). Workers perform a lot of technical and physical effort due to the intricacy of the refining process, especially in poor nations where the process is not fully automated, which results in a variety of MSD (Mohammadi *et al.*, 2018).

Recent research has demonstrated that oil and gas employees are at risk for ergonomic injuries due to repetitive motions, uncomfortable body postures, bending, lifting heavy objects, turning valves, reaching overhead, climbing, lowering, stooping, and prolonged standing (OSHA, 2019; Kim, 2017). There are few publications describing the prevalence and pattern of MSD in the oil refining industries, despite being a common occupational illness resulting into loss of productivity and health care costs. The majority of studies that are currently available focus on oil field workers who are engaged in exploration activities on either onshore or offshore oil rigs (Sadeghian *et al.*, 2012).

There is no study on the prevalence and pattern of MSD in refinery workers, despite the fact that the oil industry in Nigeria is the country's main source of income. The majority of MSD studies in Nigeria focused on other occupations like nursing, physiotherapy, office workers, and butchers (Tinubu *et al.*, 2010; Maduagwu, *et al.*, 2014). By identifying

the prevalence and pattern of MSD among oil refinery workers, this study aims to close a gap in the literature (KRPC).

## **MATERIALS AND METHODS**

### **RESEARCH DESIGN**

A quantitative research approach was employed to gather data (ONS, 2012; Tehrani *et al.*, 2015).

### **STUDY AREA**

The Kaduna Refining and Petrochemical Company is a 2.89 square kilometer facility that is situated in the Chikun Local Government Area of Kaduna State, Nigeria, with coordinates of latitude 10.41159 and longitude 7.4906 (Nigerian National Petroleum Corporation, 2019). It was put into operation in 1980 and has a production capacity of 110,000 barrel per day.

### **SAMPLING TECHNIQUES**

A purposive sampling was used in this study to choose 302 participants. This method is frequently used when working with groups of interest (CIRT, 2012). The study was carried out across seven departments which are the production, engineering and technical services, maintenance, power plant and utility, fire and safety, quality control (QC), production planning and linear alkyl benzene (LAB). 125 responses were received amounting to a response rate of 41.4%. Male respondents made up 90.4% of the sample, with female respondents making up the remaining 9.6%, as shown in table 1. The researchers discovered that the average age of the workers was 35.14 years, with a standard deviation of 0.67 (35.14±0.67). The highest age group is between 26 – 35 (44%) and the least is between the ages of 46 – 55 (8%). In terms of years of experience, employees with six to ten years of experience account for 33.6% of respondents while those with sixteen to twenty years of experience accounts for 11.2%

### **DATA COLLECTION INSTRUMENT AND ADMINISTRATION**

The online survey previously known as Bristol Online Survey (BOS) (Jisc, 2019) was used to upload the modified version of the Nordic musculoskeletal questionnaire (NMQ) (Pugh *et al.*, 2015). It is a standardized instrument popularly used in Europe used to collect data on the prevalence and pattern of MSD (Baron *et al.*, 1996). Emails and departmental WhatsApp groups were used to deliver the online survey link sent to the organization's saturation was ensured when there was repeated pattern from the responses after collecting more than 70% of the data. The Nordic musculoskeletal questionnaire was used to assess pain in neck, shoulder, elbow, wrist/hand, lower back, one or both hips/thighs, one or both knees, and one or both ankles in last twelve months using reliability (internal consistency and test-retest reliability) and validity (face validity, content validity, and construct validity) questions.

### **DATA ANALYSIS**

SPSS (version 26) was used to analyze the information collected. Descriptive analysis (such as cross-tabulating MSD occurrence with job demand, comparing MSD prevalence by age group, and looking at the distribution of MSD types) was used to identify the distribution and pattern of MSDs among the seven departments of KRPC. Inferential analysis (Chi-square test) was used to establish associations and influence between body parts and MSDs as well as relationships between nature of the work, the departments, age, years of experience and MSDs prevalence.

## RESULTS

Over the last year, a work-related musculoskeletal disorders (WMSD) of 75.2 % was reported in the lower back, shoulder (56%), wrist/hand (64.8%), hips/thigh (64.8%), and knees (64.8%) in table 1. Results of the association between body regions and MSDs from table 2 shows that an average prevalence rate of 90.91% for WMSDs was recorded in the shoulder, wrist/hand, hips/thigh, and knees. This value showed that WMSDs are statistically significant (P 0.05) in workers between the ages of 16 and 25 in table 3. While table 4 indicates that the upper extremities of workers with 16 to 20 years of work experience have the highest prevalence rate of WMSDs. Knee pain is most prevalent among workers with over 21 years of experience, particularly impacting the lower extremities. Based on the department of the respondents, employees from the maintenance department reported a high rate of pain in the upper extremities while employees in the power plant and utility (PPU) department experienced high upper and lower back pain, while those in the PP and QC departments experience high pain in the elbow, wrist, hand, and lower extremities. The highest prevalence in lower back pain is attributed to employees whose daily routine involves heavy lifting and repetitive work.

**Table 1:** Prevalence of MSD on various body regions

<b>BODY REGION PAIN</b>	<b>FREQUENCY</b>	<b>PERCENTAGE (%)</b>
<b>NECK</b>		
Never	49	39.2
Last year	76	60.8
Total	125	100.0
<b>SHOULDER</b>		
Never	55	44.0
Last year	70	56
Total	125	100.0
<b>ELBOW</b>		
Never	63	50.4
Last year	62	49.6
Total	125	100.0
<b>WRIST/HAND</b>		
Never	44	35.2
Last year	81	64.8
Total	125	100.0
<b>LOWER BACK</b>		
Never	31	24.8
Last year	94	75.2
Total	125	100.0
<b>ONE OR BOTH HIPS/THIGHS</b>		
Never	49	39.2
Last year	76	61.8
Total	125	100.0
<b>ONE OR BOTH KNEES</b>		
Never	48	38.4
Last year	77	64.8
Total	125	100
<b>ONE OR BOTH FEET/ANKLES</b>		
Last year	73	58.4
Total	125	100

**Table 2:** Distribution of musculoskeletal discomfort in various body regions during the past 12 months on the basis of age of respondents.

Part of the body	16-25 year	26-35 years	36-45 years	46-55 years	p-value
	Percentage (n = 11)	Percentage (n = 55)	Percentage (n = 49)	Percentage (n = 10)	P- value
Neck	72.72	63.63	44.9	70.0	0.350
Shoulder	90.91	60.0	48.97	60.0	0.193
Elbow	81.81	60.0	61.22	50.0	0.020*
Wrist/hand	90.91	70.91	48.98	80.0	0.044*
Upper back	90.91	81.82	46.94	60.0	0.007*
Lower back	81.82	87.27	61.22	70.0	0.022*
Hips/thigh	90.91	63.64	44.90	80.0	0.141
Knees	90.91	58.18	46.94	80.0	0.005*
Ankle/feet	81.82	56.36	48.98	70.0	0.306

**Table 3:** Distribution of musculoskeletal discomfort in various body regions during the past 12 months on the basis of years of experience of respondents.

Part of the body	0 - 5 year	6-10 years	11-15 years	16-20 years	21 > years	p-value
	Percentage (n =20)	Percentage (n = 42)	Percentage (n = 31)	Percentage (n = 14)	Percentage (n= 18)	P- value
Neck	75.0	45.23	51.6	100	55.6	0.004
Shoulder	70.0	52.4	41.9	85.7	66.7	0.006
Elbow	60.0	45.2	35.5	100.0	55.6	0.009
Wrist/hand	75.0	52.4	58.1	85.7	66.7	0.006
Upper back	75.0	66.7	51.6	78.6	61.1	0.026
Lower back	80.0	71.4	67.7	100.0	72.2	0.392
Hips/thigh	65.0	50.0	51.6	78.6	61.1	0.021
Knees	65.0	42.9	54.8	64.3	97.8	0.012
Ankle/feet	55.0	47.6	45.2	71.4	66.7	0.007

**Table 4:** Distribution of musculoskeletal discomfort in various body region in the past 12 months on the basis of department of respondents.

Part of the body	Production	PPQ & C	ETSD	PPU	Maintenance	Fire & safety	P value
	Percentage % (n =39)	Percentage (n = 9)	Percentage (n = 6)	Percentage (n =23)	Percentage (n= 20)	Percentage (n=28)	
Neck	43.6	66.7	33.3	69.7	70.0	60.7	0.031
Shoulder	43.6	66.7	33.3	65.2	75.0	64.3	0.078
Elbow	35.9	77.8	50.0	65.2	60.0	53.6	0.394
Wrist/hand	53.8	77.8	50.0	73.9	70.0	67.9	0.072
Upper back	61.5	66.7	50.0	78.3	70.0	67.9	0.736
Lower back	71.8	88.9	66.7	82.6	75.0	71.4	0.065
Hips/thigh	43.6	77.8	33.3	73.9	60.0	71.4	0.004
Knees	41.0	88.9	50.0	73.9	60.0	60.7	0.003
Ankle/feet	41.0	88.9	78.3	57	55.0	57.1	0.003

**Table 5:** Distribution of musculoskeletal discomfort in various body region in the past 12 months on the basis of nature of jobs of respondents.

Part of the body	Heavy lifting Percentage (n =16)	Sedentary Percentage (n = 5)	Repetitive Percentage (n = 27)	Process monitoring Percentage (n = 77)	P value
Neck	68.8	40.0	88.9	45.5	0.001
Shoulder	87.5	60.0	77.8	45.5	0.002
Elbow	87.5	80.0	81.5	33.8	0.000
Wrist/hand	62.5	60.0	88.9	50.6	0.003
Upper back	93.8	80.0	81.5	55.5	0.021
Lower back	93.8	60.0	88.9	71.4	0.004
Hips/thigh	87.5	60.0	85.2	45.5	0.000
Knees	81.3	20.0	81.5	45.5	0.000
Ankle/feet	87.5	60.0	77.8	42.9	0.000

## DISCUSSION

The findings indicate that there are more male employees (90.4%) than female employees at KRPC. This demonstrates unequivocally that KRPC's chosen departments are predominately male. The fact that there are fewer female workers is probably due to the high workload and demanding workplace, both of which can be bad for a worker's physical and mental health. Ge *et al.* (2018) found a larger percentage of male employees in a research that was identical to theirs on the status of MSD among oil workers in Xinjiang *et al.* (2018) stated that just 20% of women worldwide work in the oil and gas sector.

The result also indicates that the majority of the workers were between the ages of 25 and 54 due to the demanding environment of the petroleum refining industry (Tuzemen, 2018). The European Chiropractors' Union (2019), who reported that the average age of personnel from 135 operational refineries in the United States was 43.1 years, supports this finding.

Out of the 125 responders, 76 (60.8%) reported having neck pain in the previous year. A similar study conducted by Tinibu *et al.* (2010) found a 28.0% prevalence of neck pain among nurses in Ibadan. Hossain *et al.* (2018) revealed that among Bangladeshi readymade garment workers, the neck had the highest prevalence of WMSDs at 23.7%. In the last year, 62 respondents (49.6%) and 70 respondents (58.4%) reported having elbow and shoulder discomfort, respectively. This research suggests that neck, shoulder, and elbow discomfort are widespread issues among oil refinery employees. This is in line with the findings of Abu Salem *et al.* (2017), where it was found that WMSD among natural gas field workers most frequently affects the neck, shoulder, and elbow. According to Ge *et al.* (2018), the neck and shoulder are the body parts with the highest prevalence rate of 78.01 among oil and gas workers in China. This disorders usually occur when the soft tissues, muscles, tendons nerves and ligaments along the circulatory systems are strained as a result of works in wrong positions according to HSE (2019). Because these workers are involved in involve highly repetitive and forceful movement in an awkward posture, hence the high occurrence of this disorder (Bevan, 2015).

This study shows that the lower back region of the body had the highest prevalence (75.2%) of MSDs over the previous twelve months, with 37.6% of people experiencing moderate to severe pain. Just like studies conducted in Egypt (Abu

Salema *et al.*, 2017), Norway (Morken *et al.*, 2007) and Iran (Sadeghian *et al.*, 2012) all reported significant prevalence rate of 30.5%, 62% and 20% respectively for lower back pain. Regarding wrist/hand pain, 64.8% of workers reported having it over the previous 12 months. The responds show that when workers do a lot of manual handling and heavy lifting, they risk the possibility of having pains in this region of the body. The frequent flexion, extension, and radial motion of the wrist caused by manual control valve adjustment is to blame for the high prevalence of wrist discomfort. Research has shown that the causal factors of LLD are physical factors such as: kneeling, jumping from height, climbing stairs/ ladder, slip and trip hazard, heavy lifting (Cheng *et al.*, 2016).

In the last 12 months, 61.8% of respondents said they had hip or thigh pain. The frequent ascent and descent of ladders attached to columns to monitor process variables and flight of steers to manually operate valves are the most likely causes of the high prevalence of hip/thigh and knee discomfort among the workforce. 61.6% of the respondents reported having experienced knee pain over the past one year. The prevalence of ankle/foot discomfort among KRPC personnel was considerable (58.4%) in the last year. The findings of this study are consistent with earlier research by Mohammadi *et al.* (2018), who found a 42.5% prevalence of knee pain and a 10% prevalence of hip pain. According to Sadeghian *et al.* (2012), 71% of people experience knee discomfort and 10% experience thigh pain. Therefore, the finding of this research shows that the when workers undergo tasks that subjects them to different types of biomechanical risk as a repetitive motion and operations that requires a remarkable degree of strength, they may likely experience pain in those regions of the body.

According to table 3, there was a high rate of musculoskeletal discomfort in the shoulder, wrist/hand, upper back, hips/thigh, and knees among employees between the ages of 16 and 25 (90.91%). The findings of Mohammadi *et al.* (2018), who showed a low prevalence rate in the same body regions in the 20–27 age range are in contradiction to this conclusion. This pattern may be explained by the fact that the refinery has been in operation since 1975 without making any reasonable adjustments to its operating procedures to conform to the requirements of the contemporary refining process. As a result, untrained new employees are exposed to an antiquated refining process that necessitates heavy lifting and continuous manual valve twisting (Agrawal *et al.*, 2014).

The power, plant, and quality control (PP and QC) department, employees have the highest prevalence of musculoskeletal discomfort across the nine body regions (Table 4). It is almost clear that the PP and QC department's workstations are poorly built from an ergonomic standpoint or that employees there are sitting incorrectly. Due to the department's responsibilities for performing a wide range of laboratory analyses on crude oil and refined petroleum products to assess their fitness for processing or consumption, there is a significant prevalence of musculoskeletal discomfort in this department.

In all eight body regions, workers with job experience between 16 and 20 years had the highest prevalence of WMSD. The years of employment, which is a common phenomenon, were blamed for the increased prevalence of MSD among this group of workers (Tinibu *et al.*, 2010). Workers at Iranian oil refineries with 12 years or more of experience have reported experiencing WMSD in a pattern that is similar to this (Mohammadi *et al.*, 2018). The main cause of the high prevalence rate of musculoskeletal discomfort among workers with 0 - 5 years of work experience according to

Maduagwu *et al.* (2014), is a lack of professional expertise and working experience. A related study also discovered that new hires had a high prevalence of MSD, which can be attributed to inexperience (Heikkinen, 2001).

## CONCLUSION

The prevalence of MSD of the lower back, upper back, and wrist disorder was the most prevalent musculoskeletal discomfort among staff at KRPC due to the nature of the jobs. The study comes to the conclusion that workers with 16 to 20 years of experience, PP and QC employees in the refinery, and newly hired operations staff are most likely to suffer from MSD due to the state of the operating machinery. The management of KRPC must modernize the refinery's working environment so that the process of refining will be extensively automated and computerized. There is a need for additional research that would highlight the reporting of MSD cases and estimate the financial impact of treatment and lost work time.

## COMPETING INTERESTS

The authors declare that they have no competing interests

## REFERENCES

- Abu Salema, M. A., Mahrous O. A., Kasemy Z. A., Allam H. K. and Mohsem M. (2017). Prevalence and Risk Factors of Musculoskeletal Disorders Among Natural Gas Field Workers. *Egyptian Journal of Occupational Medicine*, **41**(1): 19-33.
- Agrawal, P. R., Maiya, A. G., Kamath, V. and Kamath, A. (2014). Work Related Musculoskeletal Disorders among Medical Laboratory Professionals: A Narrative Review. *International Journal of Research in Medical Sciences*, **2**(4): 1262-1266. 10.5455/2320-6012.ijrms20141105
- American Petroleum Institute [API], (2019). *Petroleum Refining Industry Job Descriptions, Careers in the Petroleum Refining Industry, Salary, Employment*. Retrieved on 1st Mar, 2024 from <https://careers.stateuniversity.com/pages/601/Petroleum-Refining-Industry.html>
- Baron, S., Hales, T. and Hurrell, J. (1996). Evaluation of symptom surveys for occupational musculoskeletal disorders. *American Journal of Industrial Medicine*, **29**(6): 609–617. [https://doi.org/10.1002/\(SICI\)1097-0274\(199606\)29:6<609::AID-AJIM5>3.0.CO;2-E](https://doi.org/10.1002/(SICI)1097-0274(199606)29:6<609::AID-AJIM5>3.0.CO;2-E)
- Bevan, S. (2015). Economic impact of musculoskeletal disorders (MSDs) on work in Europe. Best Practice and Research. *Clinical Rheumatology*, **29**(3): 356–373. <https://doi.org/10.1016/j.berh.2015.08.002>
- Center for Innovation in Research and Teaching [CIRT], (2012). *Qualitative Sampling Methods*. Retrieved on 21st Dec, 2023 from [https://cirt.gcu.edu/research/developmentresources/research\\_ready/qualitative/sampling](https://cirt.gcu.edu/research/developmentresources/research_ready/qualitative/sampling)
- Cheng, HY.K., Wong, MT., Yu, YC. et al. (2016). Work-related musculoskeletal disorders and ergonomic risk factors in special education teachers and teacher's aides. *BMC Public Health* **16**: 137. <https://doi.org/10.1186/s12889-016-2777-7>.
- Clark, S. and Horton, R. (2018). Low back pain: a major global challenge. *Lancet* (London, England), 391(10137), 2302. [https://doi.org/10.1016/S0140-6736\(18\)30725-6](https://doi.org/10.1016/S0140-6736(18)30725-6)
- Costa, B. R. and Vieira, E. R. (2010). Risk factors for work-related musculoskeletal disorders: A systematic review of recent longitudinal studies. *American Journal of Industrial Medicine*, **53**(3): 285–323. <https://doi.org/10.1002/ajim.20750>
- European Chiropractors' Union [ECU], (2019). Musculoskeletal (MSK) conditions and Back Pain in Europe and the Role of Chiropractors. Retrieved on 21st Feb, 2024 from <https://www.chiropractic-ecu.org/musculoskeletal-msk-conditions-and-back-pain-in-europe-and-the-role-of-chiropractors/>
- Fan, X. and Straube, S. (2016). *Reporting on Work-Related Low Back Pain: Data Sources, Discrepancies and the Art of Discovering Truths, Pain Management*, **6**(6): 553-559.
- GBD, (2017). Global, Regional, and National Incidence, Prevalence, and Years Lived with Disability for 328 Diseases and Injuries for 195 Countries, 1990–2016: A Systematic Analysis for the Global Burden of Disease Study 2016. *Global Health Metrics*, **390**(10100): 1211-1259.



- Ge, H., Sun, X., Liu, J. and Zhang, C. (2018). The Status of Musculoskeletal Disorders and Its Influence on the Working Ability of Oil Workers in Xinjiang, China. *International Journal of Environmental Research and Public Health*, **15**(5): 842. <https://doi.org/10.3390/ijerph15050842>
- Global Energy Observatory, (2019). *Identifiers for Crude Oil Refineries*. Retrieved on 1st Feb, 2024 from <http://globalenergyobservatory.org/geoid/6731>
- Herquelot, E., Guéguen, A., Roquelaure, Y., Bodin, J., Sérazin, C., Ha, C., Leclerc, A., Goldberg, M., Zins, M. and Descatha, A. (2013). Work-related risk factors for incidence of lateral epicondylitis in a large working population. *Scandinavian Journal of Work, Environment and Health*, **39**(6): 578–588. <https://doi.org/10.5271/sjweh.3380>
- HSE, (2023). *Work Related Musculoskeletal Disorders in Great Britain (WRMSDs)*, Merseyside: Health and Safety Executives. Retrieved on 31st Jan, 2024 from <https://www.hse.gov.uk/statistics/assets/docs/msd.pdf>
- JISC, (2019). *online Surveys (formerly BOS)*. Retrieved on 31st Jan, 2024 from <https://www.onlinesurveys.ac.uk/>
- Kim, Y. M. and Cho, S. I. (2017). Work-Life Imbalance and Musculoskeletal Disorders among South Korean Workers. *International Journal of Environmental Research and Public Health*, **14**(11): 1331. <https://doi.org/10.3390/ijerph14111331>
- March, L., Smith, E. U., Hoy, D. G., Cross, M. J., Sanchez-Riera, L., Blyth, F., Buchbinder, R., Vos, T. and Woolf, A. D. (2014). Burden of disability due to musculoskeletal (MSK) disorders. Best practice & research. *Clinical Rheumatology*, **28**(3): 353–366. <https://doi.org/10.1016/j.berh.2014.08.002>
- Morken, T., Mehlum, I. S. and Moen, B. E. (2007). Work-related musculoskeletal disorders in Norway's offshore petroleum industry. *Occupational Medicine (Oxford, England)*, **57**(2): 112–117. <https://doi.org/10.1093/occmed/kql154>
- Mohammadi, G., Agharezaei, S., Nasab, M. E. and Mohammadi, P. (2018). Study of Musculoskeletal Disorders Risk Factors Among Oil Refinery Staff of Iran by Using RULA and REBA Methods. *Scientific Journal of Musculoskeletal Disorders*, **2**(1): 001-006.
- NNPC, (2019). *Kaduna Refining and Petrochemical Company*. Retrieved on 31st Jan, 2024 from <http://nnpcgroup-test.nnpcgroup.com/Refining/Pages/KRPC.aspx>
- Ogbuigwe, A. (2018). Refining in Nigeria: history, challenges and prospects. *Applied Petrochemical Research* **8**: 181–192 <https://doi.org/10.1007/s13203-018-0211-z>
- Pugh, J. D., Gelder, L., Williams, A. M., Twigg, D. E., Wilkinson, A. M. and Blazeovich, A. J. (2015). Validity and reliability of an online extended version of the Nordic Musculoskeletal Questionnaire (NMQ-E2) to measure nurses' fitness. *Journal of Clinical Nursing*, **24**(23-24): 3550–3563. <https://doi.org/10.1111/jocn.12971>
- Rahman, M. S., (2017). The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and methods in language "testing and Assessment" Research: A literature Review. *Journal of Education and Learning*, **6**(1): 102-112. <http://dx.doi.org/10.5539/jel.v6n1p102>
- Sadeghian, F., Sadeghian, A., Raei, M. and Kasaeian, A. (2012). Musculoskeletal Disorders among Oil Field Workers: Influences of Health Beliefs, Mental Health and Somatization Tendency. *Journal of Medical Science*, **12**(4): 114-120. 10.3923/jms.2012.114.120
- Teherani, A., Martimianakis, T., Stenfors-Hayes, T., Wadhwa, A. and Varpio, L. (2015). Choosing a Qualitative Research Approach. *Journal of Graduate Medical Education*, **7**(4): 669–670. <https://doi.org/10.4300/JGME-D-15-00414>.
- Tinubu, B. M., Mbada, C. E., Opeyemi, A. L. and Fabunmi, A. A. (2010). Work-Related Musculoskeletal Disorders among Nurses in Ibadan, South-west Nigeria: A Cross-sectional Survey. *BMC Musculoskeletal Disorders*, **11**(12): 1471-2474. <https://doi.org/10.1186/1471-2474-11-12>
- Tüzemen, D. (2018). *Why Are Prime-Age Men Vanishing from the Labor Force?* Kansas City: Federal Reserve Bank of Kansas City. Econ Papers. Retrieved on 1st May, 2023 <https://www.kansascityfed.org/Economic%20Review/documents/653/2018-Why%20Are%20Prime-Age%20Men%20Vanishing%20from%20the%20Labor%20Force%3F.pdf>
- Vander Stoep, S. W. and Johnson, D. D. (2009). *Research methods for Everyday Life: Blending Qualitative and quantitative Approaches*. San Francisco: Jossey-Bass.
- Wanyoni, N. N. and Frantz, J. (2015). Prevalence of work-related Musculoskeletal Disorder in Africa: A systematic review. *Physiotherapy*, e1604-e1605.
- W.H.O, (2018). *Musculoskeletal Conditions*. Retrieved on 31st Nov, 2023 from <https://www.who.int/mediacentre/factsheets/musculoskeletal/en/>