Innovations

Work-related musculoskeletal disorders and ergonomic hazards among Cameroonian metallurgists

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Abstract

The aim of this cross-sectional study was to determine the prevalence of musculoskeletal disorders (MSDs), ergonomic hazards, and their relationship among Cameroonian metallurgists, taking the city of Douala as an example. A structured questionnaire was self- administered to 80 metallurgists in three of the five urban municipalities that constitute the city of Douala. Both descriptive and inferential statistics were performed to summarize and organize the data, and to explore the relationship between MSDs and potential risk factors, respectively. We found that the prevalence rate of MSDs was 85.4% in the previous 12 months and 53.8% in the previous 7 days. Majority, 76 (95%), of the metallurgists were youths between 20 and 42 years (mean = 32.7, SD = 8.8) old. Disorders in the upper back (52.2%), lower back (50.2%), and shoulders (46.45%) were the most commonly reported symptoms. Those who reported symptoms of MSDs did differ by sex, $X^2(1, N=80) = 9.21, P=.000)$, age category, $X^2(1, N=80) = 8.74, P=.000)$, and educational level, $X^2(1, N=80) =7.71, P =.000)$. Multivariate logistic regression analysis predicted that Metallurgists who regularly lifted, pushed, and pulled loads greater than 20 kg without assistance from colleagues or assistive tools were 4.85-fold more exposed to the risk of MSD than those who did not (AOR: 4.85, 95% CI: 2.65-8.87). Similarly, workers whose activities frequently involved repetitive motions were 4.29 times more likely to develop WMSDs than those whose tasks did not involve repetitive motions (AOR: 4.29, 95% CI (1.78–10.2). Our study shows that though similar studies have been carried out in relation to the epidemiology of musculoskeletal disorders worldwide, there is yet a dearth of studies on how this syndrome affects people of different occupational background. Further studies on the epidemiology of musculoskeletal disorders, especially the impact on the psychosocial safety climate of workplaces are recommended.

***Keywords**: Risk factors, musculoskeletal disorders, Nordic Musculoskeletal Questionnaire*

1. Introduction

All over the world, workers from different occupational backgrounds are exposed to varying types of physical conditions that may pose a risk of injury to the musculoskeletal system due to poor ergonomics. These hazards include awkward or static postures, high forces, repetitive motion, or short intervals between activities. This syndrome accounts for more than 48% of all work-related disorders (Backhans et al. 2015), making them a significant occupational health problem in all professions. The prevalence varies by activity (Westergren, Ludvigsen, and Lindberg 2019), and it affects both adolescents (Guessogo et al. 2020) and adults (Wintergreen et al. 2019). Continuous exposure to the risk of injury causes an inflammatory response, followed by pains and loss of motor functions (Barbe and Barr 2006). The economically active population's exposure could have both economic and social consequences, such as early retirement (Palmer et al. 1999; Inoue et al. 2008), worker disability (Kahraman et al. 2016), productivity loss (Moraru and Băbuţ , 2016). The syndrome is likely to increase as industrialization accelerates, particularly in developing countries like Cameroon, as they strive to meet a slew of development targets. For these reasons, this study was designed to systematically characterize and model the prevalence of MSDs among metallurgical workers and to investigate the risk factors that influence this prevalence.

A review of literature on MSDs shows that a variety of ergonomic tools have been developed to aid in the identification of MSD risk factors and the assessment of risk on workstations. Of common use are observational techniques such as the Ovako Working Posture Analysis System, OWAS (Karhu et al. 1977), and the associated software WinOWAS (Tiilikainen 1996), the Rapid Upper Limb Assessment (RULA) (McAnarney, and (Corlett 1993), and the Rapid Entire Body Assessment (REBA)(Hignett 2000). Though these techniques are inexpensive, easy to use, flexible, and do not interfere with workers' tasks or the jobs being performed (Gómez-Galán 2017), they do not consider the effects of recovery, duration, vibration, environmental conditions, and psychosocial and individual factors, which have been known to affect the occurrences of MSDs (Kee et al. 2013; and Chiassonet al. 2012).

Away from the above direct methods are indirect methods such as Michigan (Lifshitz and Armstrong 1986), the Standardised Nordic Questionnaires, NMQ (Kuorinka et al. 1987), Keyserling (1993), and the Quick Exposure Check Method (David et al.2008), etc. However, the complexity, the statistical treatment of data, and the need to administer questionnaires to a representative portion of workers under study are the main disadvantages.

The drawbacks of all the foregoing approaches suggest that, while it may generally be true that several methods could be available for going about a given phenomenon, these approaches differ, inter alia, in the accuracy of the recording and assessment (Punnet and Wegman 2004). However, because of its repeatability, sensitivity, and usefulness as a screening and surveillance tool, and its multiple applications in the assessment of musculoskeletal problems in a variety of occupational groups such as car drivers (Porter and Gyi 2002), whisky industry workers (Macdonald and Waclawski 2006), nurses (Smith 2004), and forestry workers (Briggs et al. 2016), the standardised Nordic musculoskeletaf questionnaire (NMD) was found to be a useful supplement for this study, aimed at, assessing the prevalence of MSDs among metallurgists in small-scale manufacturing enterprises, and to investigate their relationships with sociodemographic, ergonomic and psychosocial related characteristics of the workers.

2. Materials and Methods

2.1 Survey Design and Sampling

The sample points for this cross-sectional study were small-scale metal workers' garages in the city of Douala. We decided to limit the survey to three of the five urban municipalities because the majority of these businesses are located there. In the absence of statistics on the total number of employees working in this sector, the sample size was determined using the Cochran (1963) model (Equation 1) with a margin of error of +/- 10% based on the 30% expected global prevalence rate of MSD (Briggs et al. 2015).

$$S = z^2 * \frac{pq}{M^2} \quad (1)$$

Where:

S = sample size for infinite population

Z = Z- score

P = population proportion (assumed as 30% or 0.3)

M = Margin of error

In this study, we used Z = 1.960, P = 0.3, and M = 10% to have S ~ 81. Assuming a non-response rate of 10% (8.87 ~ 9), the minimum sample size is, therefore, rounded up to 90 respondents. Respondents had to have worked in the metallurgical industry within the previous 12 months. Cutting and bending metal tubes, assembling, welding, calibrating, and packaging for the production of doors and windows were all part of the job.

2.2 Survey Design and Sampling

A structured questionnaire complimented by the standard Nordic musculoskeletal questionnaire was used. The questionnaire was divided into three sections:

In the first part, sociodemographic variables such as the respondent's age (years), marital status, weight (kg), height (meters), sex, educational level, self-reported hand dominance, smoking habits, and practice of regular physical activities (whether the participant regularly practices aerobic activity or resistance training) were recorded. Self-reported body mass (kg) and height (m) were used to calculate the body mass index (kg/m^2), which was then used to categorize respondents into three groups using the World Health Organization (WHO) classification system (WHO, 2000). For physical activity classification, the updated WHO guidelines * Fiona, 2020) were used.

The questionnaire's work-related characteristics section included questions about company experience (in months), workload (push and/or lift loads above 10 kg), repetitive work (perform repetitive and stereotyped motions at work), work pause (perform short rest breaks at work), and vibration exposure (use of vibrating tools). A four-point Likert-type scale with ratings of 'never,' 'rarely,' 'often,' and 'always' was used to classify physical workload, repetitiveness, and vibration exposure perceived by the workers. Answers such as 'never' or 'rarely' were classified as 'no,' while answers such as 'often' and 'always' were classified as 'yes.'

In the third section of the questionnaire, the Standardized Nordic Questionnaire was used to collect data on musculoskeletal symptoms. NMQ includes questions about overall body problems as well as questions about specific body parts (wrist, upper and lower arms, neck, trunk, and legs). A body "map" was also used to make it easier for workers to pinpoint their problems in each body area. The questionnaires' reliability had been demonstrated to be acceptable in different studies since 1987, for example (Kuorinka 1987; Wicaksono 2019).

2.3 Data Collection

Data were collected between March and May of 2022. We gathered both primary and secondary data. Secondary data was gathered through document analysis to comprehend the current state-of-the-art literature regarding MSDs and the most effective approaches in place. The specially designed questionnaire was used to collect primary data. We used a face-to-face interview strategy with the employees to ensure that we observed and triangulated every response. First, we conducted a pretest on 10 enterprises in the city to uncover any misinterpretation of the questions. Following this was the questionnaire administration proper. For each enterprise, a worker was selected (mostly the head of the enterprise), and a questionnaire was administered. Only small-scale metallurgical enterprises were chosen because they account for more than 90% of the market share and are easily accessible. Participants in the study had to have worked in the metallurgical industry within the previous 12 months. Participants on sick leave due to musculoskeletal issues were excluded from the study. There were 80 qualified workers in the study sample. Cutting and bending metal tubes, assembling, welding, calibrating, and packaging for the production of doors and windows were all part of the job.

2.4 Data analysis

To summarize the characteristics of the sample population, descriptive statistics were used. Chi-square tests of independence were performed to detect the relationship between MSD symptoms and selected demographic and work-related factors. Lastly, a supervised learning algorithm, the binary logistic regression model (Cox, 1958), was used to estimate or predict the impact of sociodemographic and work-related factors on the occurrence of musculoskeletal complaints. The dependent variable, MSD is designed as a dichotomous dummy (whether the respondent contracted MSD or not). The model is (Equation 2).

$$Logit(p(x)) = \ln\left(\frac{p(x)}{1-p(x)}\right) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \cdots . \beta_n X_n + \varepsilon \qquad (2)$$

$where:$

$\beta_0; \beta_1; \cdots; \beta_n$ = the regression coefficients;

$X_1;\ X_2; \cdots; X_n$ = the independent variables

P = the probability that the event occurs (MSD =1)

$\frac{p}{1-p}$ = odd ratio; $0 \leq p \leq 1$; *(p = p(x))*

$\ln\left(\frac{p(x)}{1-p(x)}\right)$ = log of the odd ratio; $0 \leq odd \leq +\infty$

As p(x) → 0, $Logit(p(x))$ →-∞, and as p(x) →1, $Logit(p(x))$→-+∞

The transformation from odds to log of odds is the log transformation, and this is a monotonic transformation. That is, the greater the odds, the greater the log of odds and vice versa. Logit (p) can be back-transformed to p by the following formula:

$$p = \frac{1}{1+e^{-logit(p)}} \quad (3)$$

The transformation from probability to odds is a monotonic transformation as well, meaning the odds increase as the probability increases or vice versa.

The transformation from probability to odds is a monotonic transformation as well, meaning the odds increase as the probability increases or vice versa. The independent variable was double-checked for multicollinearity. To evaluate the model fitness, the Hosmer-Lemeshow goodness of fit test was used. The "Enter" method was then used to run the adjusted logistic regression model. In the multivariate analysis, only significant potential risk factors (p<0.03) in the univariate analysis were included.

Odds ratios (ORs, Equation 3) were used to compare the relative odds of the outcome of interest, MSDs (Dependent variable) occurring given exposure to the variable of interest. The dependent variable is whether the worker had been exposed to MSDs within the last 12 months or the last 7 days (Yes=1). As independent variables in the final adjusted model for musculoskeletal symptoms, company experience, sleep disorders, general health state, and work pause were included. These analyses were performed separately for each of the following locations: neck, upper limb, upper/lower back, and lower limb (Yes = 1) (Table 1):

Table 1: Sample crosstab used in ORs modelling

Exposed to MSDs?	Sociodemographic/work-related variables		Total
	Yes (1)	No (0)	
Yes (1)	(a)	(b)	**(a+b)**
No (0)	(c)	(d)	**(c+d)**
Total	**(a+c)**	**(b+d)**	**(a+b+c+d)**

The odds ratio is calculated to compare the odds across groups (Equation 4)

$$OR = \frac{a/c}{b/d} = \frac{ad}{bc} \quad (4)$$

$$OR = \begin{cases} > 1, \text{Exposure associated with higher odds of outcome} \\ = 1, \text{Exposure does not affect odds of outcome} \\ < 1, \text{Exposure associated with lower odds of an outcome} \end{cases}$$

Data were computerized and analyzed using the SPSS 20 software (SSPS Inc., Chicago, Illinois, USA) and Microsoft Excel for windows 10.

3. Results and Discussion

3.1 General characteristics of metallurgists in the city of Douala

Eighty filled questionnaires were analyzed. There were 72 (90%) males and 08 (10%) females.The age range was 20 to 42 years (Mean = 32.7, SD=8.8), with the majority, 76 (95%), being young. With regard to qualifications, it was revealed that, 29(36%) were primary school graduates; 53(66.3%) had 2 to 4 years of work experience; and 28(35%) were married (Table 1).

Table 1. Demography of the study population

Variable	Description	N (%)
Sex	Female	8(10)
	Male	72(90)
Age (years)	20–30	60(75)
	30–40	16(20)
	40+	4(5)
Marital status	Single	32(48)
	Married	28(35)
	Others	20(25)
Education level	Primary	36 (45)
	Secondary	29(36.25)
	Post-secondary	15(18.75)

Education is one of the most important factors influencing overall enterprise performance. The link between educational level and management techniques is understandable given that metallurgical activity management is a long-term phenomenon that can only be grasped and understood with time and practical experience. Furthermore, literacy allows access to modern/strategic management information that non-literates do not normally have. Individuals may be less exposed to MSDs if they can complete their education before beginning work, have enough experience before performing certain tasks, and have less potential stress in their working lives resulting from their marital environment, among other factors.

Gender is used to determine the contribution of males and females in manufacturing industries as such. This data could help decision-makers consider the significance of gender participation in safety and ergonomics plans. It also assists decision-makers in determining the type of motivation to be assigned per gender. Because the results show that male participation is higher than female participation, management could focus more on female employee motivation and engagement. With an age range of 20–30 years, the majority of workers in this sector are in their prime working years. Overall, males appear to dominate human resources in this sector across all age groups in this region.

The purpose of using marital status in our research is to know how much respondents are supporting their families and how much they are not. Therefore, most people first try to get a good job, secure it, and then get married. The results show that 28 (35%) of the participants were married, and 32 (48%) were single. These figures indicate that a reasonable fraction of the employees support their families, which is a moral right. Therefore, management should provide opportunities to all those employees to retain them for a long time through motivation and engagement.

3.2 Social characteristics of the Respondents

Twenty-eight (35%) of the workers smoke, and 48 (60%) drink alcohol. In terms of physical activities, 42 (52.5%) exercised regularly. Only 8% of those polled admitted to having a history of systemic illness (Fig. 1).

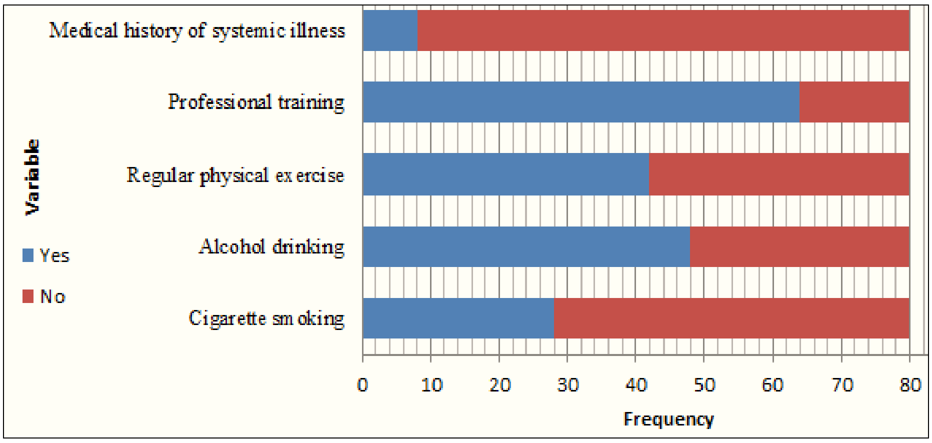

Fig 1: Personal characteristics of metallurgical workers in the city of Douala, Cameroon

Methods such as providing good professional training to young employees, regular physical exercises, a medical history of systematic illnesses, maintaining a healthy work-life balance, and supporting employees in their efforts to give up various bad habits such as smoking through rehabilitation could all play important roles in reducing workplace accidents.

3.3 Work environment-related characteristics of respondents.

Respondents were assessed on the number of hours they spent at the work site per week. A total of 69 (86.25%) reported working more than 40 hours per week while the remainder worked less than 40 hours. Regarding their work experience, it was found that most of them, 53 (66.3%) were between 2 – 4 years of experience. On the other hand, most of them, 60(75%) stood for more than 6 hours per day at the work site (Table 3).

Table 3: Work environment-related characteristics of the respondents

Variable	Description	N (%)
Work Experience	≤1 year	17(21.3)
	2 – 4 years	53(66.3)
	≥ 5 years	10(12.5)
Work Hours per week	20 - 40	11(13.7)
	40 - 60	64(80)
	60 +	5(6.3)
Work pause	Yes	64(80)
	No	16(20)
Hours spent standing at work/day	1–3 hours	6 (7.5)
	4–6 hours	14(17.5)
	>6 hours	60(75)

3.4 Ergonomic and Psychosocial Characteristics of Respondents

In terms of working posture, 47 (58.75%) of the respondents sometimes worked in the same position for more than 2 hours per day, and 68 (85%) of respondents' jobs awkwardly required constant bending/twisting However, in their daily work, 63 (78.75%) of the participants routinely pushed, pulled, lifted, and moved loads weighing more than 5 kg without assistance or assistive equipment. The majority of the workers, 72 (90%), had never received any training in ergonomic postures or safe equipment handling. They hardly used assistive equipment 13(16.25) during work and used a lot of force 72(90%) when using tools and equipment. In terms of the most commonly used work posture, only 8(10%) adopted a sitting position, while the rest preferred either standing, 23(28.75%), kneeling, 21(26.25%), bending, 15(18.75%), or squatting, 13 (16.25%). In terms of psychosocial characteristics, 23 (28.75%) of respondents reported job stress, while 62 (77.5%) reported dissatisfaction with their current occupation (Table 4).

Table 4: Ergonomic and psychosocial characteristics of the workers

Variable	Description	N (%)
Use of assistive tools	Yes No	13(16.25) 67(83.75)
Exert force while using tools	Yes No	72(90) 8(10)
The most commonly adopted work posture	Sitting Standing Kneeling Bending Squatting	8(10) 23(28.75) 21(26.25) 15(18.75) 13(16.25)
Hours spent standing at work/day	1–3 hours 4–6 hours >6 hours	6 (7.5) 14(17.5) 60(75)
Bending/twisting in an awkward way	Never Sometimes Always	0(0) 12(15) 68(85)
Working in the same position for>2 hrs	Never Sometimes Always	0(0) 47(58.75) 33(41.25)
Repetitive motions	Never Sometimes Always	24(30) 17(21.25) 39(48.75)
Job stress	Yes No	23(28.75) 57(71.25)
Job satisfaction	Yes No	62(77.5) 18(22.5)
Lift, push, pull, carry, move >5 kg	Yes No	63(78.75) 17(21.25)
Training on ergonomics-related issues	Yes No	8(10) 72(90)

3.5 Prevalence of Self-Reported Work-Related Musculoskeletal Disorders

Twelve (12) - months and seven (7) - day prevalence of MSDs in different body parts showed differing prevalence for the different body parts (Fig 3).

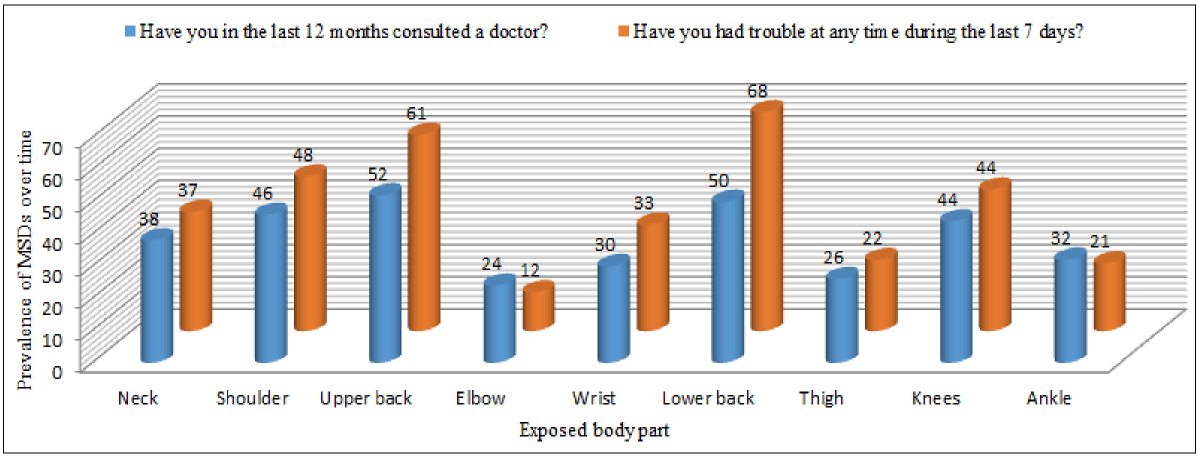

Fig. 3: Prevalence of WMSDs in different body segments

We infer from figure 3 that the upper back was the area with the highest prevalence rate 52(65%), followed by the lower back 50(62.5%), the shoulders 46(57.5%), and the knees 44(55%) were the areas of the body that required the most medical attention in the previous year, while the low back 68(85%), upper back 61(76.25%), and knees 44(55%) were body parts most commonly affected in the recent 7 days.Although there is significant literature on the prevalence of MSDs, most studies only look at MSDs reported in the previous 12 months (Sirajudeen et al. 2018) or the previous 7 days (Solis-Soto et al. 2017).. Our study included both previous 7-day and previous 12-month MSDs. This provides more reliable data on the ongoing process as well as the population's history of MSDs. Moving loads of more than 5 kg, repetitive tasks, force exertion, and job stress were all significantly associated with the prevalence of MSDs.

3.6 Multiple Body Parts (Right and Left Side) WMSDs

The majority of the workers reported pains in both the right and left parts of the body, including the shoulder, elbow, hand/wrist, knee, hip/thigh, and feet/ankle. Of those with shoulder complaints, 21(26.25%) of the total participants reported pains, aches, or discomforts in both shoulders, while none reported elbow pains, aches, or discomforts on both sides of the body (Fig. 2).

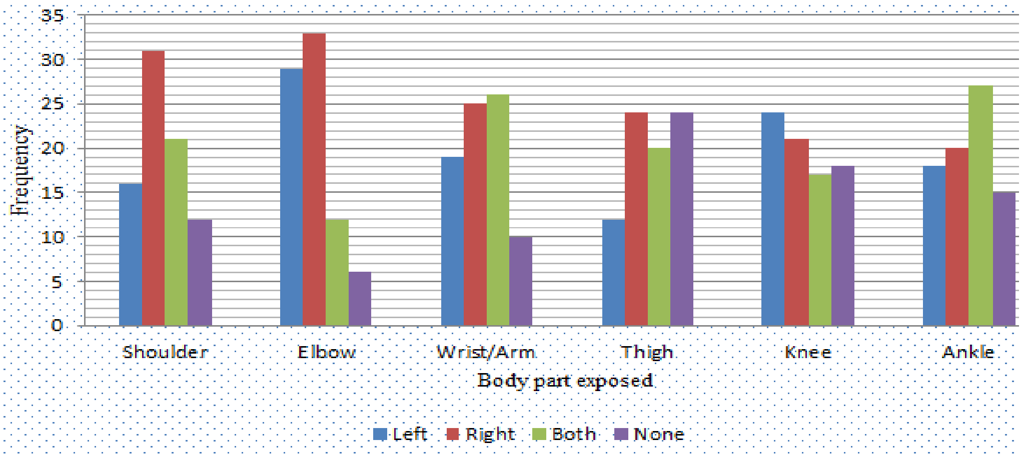

Fig. 3: Multiple body parts (right and left side) WMSDs among the workers

The presence of multiple disorders is most likely exacerbated by the fact that most workers in the developing world maintain, install, dismantle, or even repair heavy materials using crude appliances that necessitate manual handling. All of these activities put workers at risk of MSDs [38]. The low back, neck, and shoulders were the hardest hit. Back pain could be a result of several interconnected factors, including insufficient equipment, incorrect static postures, psychosocial and organizational factors, stress, job satisfaction, and work pressure.

Harcombe et al. (2010) found similar results among nursing personnel in New Zealand, with 96.3% experiencing musculoskeletal discomfort in the previous 12 months and 73.1% experiencing it in the previous 7 days. Workers frequently maintaining twisted, bent, and/or other non-neutral trunk postures while working could explain the similarity of the findings.

3.7. Relationship between MSDs symptoms, demographic/Ergonomic, and psychosocial related factors

According to the chi-square independence test results in Table 2, some significant relationships were found between individuals experiencing MSDs and socio-demographics.

Table 2: Relationship between MSDs symptoms and demographic related characteristics

Variable	Description	Experienced MDSs?		N (%)	P-value
		Yes(%)	No(%)		
Demography of the study population					
Sex	Female	5(7.94)	3(17.65)	8(10)	.000*
	Male	58(92.06)	14(82.35)	72(90)	
Age (years)	20–30	20(33.33)	8(40)	28(35)	.000*
	30–40	36(60)	10(25)	46(57.5)	
	40+	4(6.67)	2(10)	6(07.5)	
Marital status	Single	32(49.23)	6(40)	34(42.5)	.245
	Married	27(41.54)	7(46.67)	38(47.5)	
	Others	6(9.23)	2(13.33)	8(10)	
Education level	Primary	38(62.29)	9(47.37)	47(58.75)	.000*
	Secondary	14(22.95)	6(31.58)	20(25)	
	Post-secondary	9(14.75)	4(21.05)	13(16.25)	

*$p < .01$

All working environment-related characteristics showed significant associations with MSDs (Table 3).

Table 3: Relationship between MSDs symptoms and work environment-related characteristics

Variable	**Description**	**Experienced MDSs?**		**N (%)**	**P-value**
		Yes(%)	**No(%)**		
Work Experience	≤1 year	7(12.5)	5(20.83)	12(15.00)	.000*
	2 – 4 years	18(32.14)	9(37.5)	27(33.75)	
	≥ 5 years	31(55.36)	10(41.67)	41(51.25)	
Work Hours per week	20 - 40	7(11.67)	4(20)	11(13.75)	
	40 - 60	51(85)	13(65)	64(80)	
	60 +	2(3.33)	3(15)	5(6.25)	.000*
Work pause	Yes	58(87.88)	4(28.57)	62(77.5)	.000*
	No	8(12.12)	10(71.43)	18(22.5)	
Hours spent standing at work/day	1–3 hours	3 (5.17)	3 (13.64)	6(7.5)	
	4–6 hours	9(15.52)	5(22.73)	14(17.5)	
	>6 hours	46(79.31)	14(63.64)	60(75)	.000*

*$p < .01$

All ergonomic and psychosocial characteristics of workers also showed significant association with MSD symptoms (Table 4)

Table 4: Relationship between MSD symptoms, Ergonomic, and psychosocial characteristics of workers

Variable	Description	Experienced MSDs? Yes(%)	No(%)	N (%)	P-value
Job stress	Yes No	16(27.59) 42(72.41)	7(31.82) 15(68.18)	23(27.5) 57(71.25)	.000*
Hours spent standing at work/day	1–3 hours 4–6 hours >6 hours	4 (6.78) 9(15.25) 46(77.96)	2 (9.52) 5(23.81) 14(66.67)	6(7.5) 14(17.5) 60(75)	.000*
Bending/twisting in an awkward way	Never Sometimes Always	0(0) 7(14.29) 42(85.71)	0(0) 5(16.13) 26(83.87)	0(0.0) 12(15) 68(85)	.000*
Working in the same position for>2 hrs	Never Sometimes Always	0(0) 37(64.91) 20(35.09)	0(0) 10(43.48) 13(56.52)	0(0.00) 47(58.75) 33(41.25)	.000*
Repetitive motions	Never Sometimes Always	16(29.09) 11(20) 28(50.91)	8(32) 6(24) 11(44)	24(30) 17(21.25) 39(48.75)	.000*
Job satisfaction	Yes No	48(82.76) 10(17.24)	14(63.64) 8(36.36)	62(77.5) 18(22.5)	.000*
Lift, push, pull, carry, move >5 kg	Yes No	48(82.76) 10(13.79)	15(68.82) 7(31.82)	63(78.75) 17(21.25)	.000*
Training on ergonomics-related issues	Yes No	6(8.45) 65(91.55)	2(22.22) 7(77.77)	8(10) 72(90)	.000*
Use of assistive tools	Yes No	8(13.33) 52(86.67)	5(25) 15(75)	13(16.25) 67(83.75)	.000*
Exert force while using tools	Yes No	58(93.55) 4(6.45)	14(77.77) 4(22.22)	72(90) 8(10)	.000*
The most commonly adopted work posture	Sitting Standing Kneeling Bending Squatting	5(8.62) 15(25.86) 7(12.07) 15(25.86) 16(27.58)	3(13.34) 5(22.73) 4(18.18) 6(27.27) 4(18.18)	8(10) 20(25) 11(13.75) 21(26.25) 20(25)	.000*

*$p < .01$

3.7 Factors Associated with WMSDs among metallurgical workers

Moving loads weighing more than 20 kg, professional training, repetitive motions, force exertion, and job stress were found to be significant predictors of MSDs (Table 7).

Table 7: Multivariate logistic regression of factors associated with MSDs among the workers.

Variable	Work-related MSD Yes, N(%)	No, N(%)	COR (95% CI)	AOR (95% CI)	P value
Educational status					
Primary	23(63.89)	13(36.11)	2.27 (0.75–9.87)	1.07 (0.20–5.51)	.023
Secondary	19(65.52)	10(34.48)	2.04 (1.18–3.52)	1.64 (0.74–3.62)	.013
Post-secondary	9(60)	6(40)	1.33 (0.79–2.26)	0.83 (0.38–1.79)	.018
Professional training					
Yes	27(42.86)	36(57.14)	1	1	
No	8(47.06)	9(52.94)	2.08 (1.34–3.20)	2.04 (1.09–3.81)	0.02

Most commonly adopted posture :					
Sitting	5(62.5)	3(37.5)	1	1	0.344
Standing	12(52.17)	11(47.83)	1.44 (0.45–4.55)	0.50 (0.12–2.02)	0.273
Kneeling	8(38.09)	13(61.90)	1.59 (0.46–5.44)	0.973 (0.20–4.66)	0.309
Bending	7(46.67)	8(54.33)	1.53 (0.48–4.90)	0.921(0.226–3.75)	0.062
Squatting	6(46.15)	7(53.85)	1.80 (0.44–7.30)	1.17 (0.19–6.89)	0.121
Lift, push, and pull loads of >5 kg					
Yes	26(41.27)	37(58.73)	6.19 (3.86–9.94)	4.85 (2.65–8.87)***	0.000
No	9(52.94)	8(47.06)	1	1	
Repetitive motions					
Never	11(57.89)	8(42.11)	1	1	
Sometimes	8(47.06)	9(52.94)	.76 (0.97–3.16)	4.49 (1.94–10.4)***	.000
Always	24(54.54)	20(45.45)	2.50 (1.36–4.59)	4.29 (1.78–10.2)***	.001
Exert force while using tools					
Yes	54(75)	18(25)	2.97 (1.88–4.68)	2.40 (1.24–4.62) **	0.000
No	6(75)	2(25)	1	1	
Job stress					
Yes	58(85.29)	10(14.71)			0.001
No	8(66.67)	4 (33.33)			

*Significant association; significant at *P≤0.05, **P≤0.01, and ***P≤0.001 (OR: odds ratio; CI: confidence interval

We infer from the table that workers with no professional training were 2.04 times more likely to develop WMSDs than those with professional training (AOR: 2.04, 95% CI (1.09-3.81)). This could be explained by the fact that Workers who have received professional training are more likely to follow recommended safety rules and to be more knowledgeable about the prevention of work-related injuries and disorders [40].

Heavy manual handling was another important determinant of MSDs in this study. Workers who usually pushed, and pulled loads greater than 20 kg without assistance from colleagues or assistive tools had a 4.85-fold greater exposure to the risk of MSD than those who did not (AOR: 4.85, 95% CI: (2.65-8.87). This was however expected since, in many developing nations, most workers resort to manual material handling, as there is limited access to weight-lifting equipment. Our findings concur with those of other authors such as [41],

Another important explanatory variable of MSD was repetitive motions. Workers whose activities frequently involved repetitive motions were 4.29 times more likely to develop WMSDs than those whose tasks did not involve repetitive motions (AOR: 4.29, 95% CI (1.78–10.2)). According to studies, workers who perform highly repetitive tasks are at the greatest risk of developing MSDs [42].

In a globalizing world, enterprises must improve their ergonomic and psychosociological performances to compete on a global scale. Work-related MSDs lead to long-term impacts, resulting in workers being unable to work for a long time, creating huge costs for enterprises. In addition, the workers being unable to work because of their injuries, and their inability to continue their work for a long time, psychologically depress individuals, apart from economic problems. Investing in techniques and equipment that can minimize or prevent work-related MSDs and educating individuals in this area are important in terms of reducing costs. The development of an ergonomic and safety culture throughout the workplace is important in this context.

4. Conclusion

The study aimed specifically to assess the prevalence of musculoskeletal injuries among metallurgical workers as well as the relationship between these injuries and workers' sociodemographic characteristics and work-related risk factors has been studied in the above discussion. A simple machine learning algorithm that predicts the risk of the problem has been used. A comparison shows that the results are similar to those of other researchers in the field. The collection of data from a selected number of workers in the sector, as well as the use of internationally accepted or validated measurement tools to assess workers' musculoskeletal complaints, job stress, and job satisfaction, were key strengths of this study. Nonetheless, this study has some limitations. There is a risk of over-, under-, or misreporting of musculoskeletal complaints in self-reported studies. Furthermore, participant responses may be skewed due to social desirability to provide socially preferred answers over answers that reflect their true experiences. The main causes of the existing health problems were found to be force exertion when using tools; repetitive tasks; manual handling of loads greater than 5 kg; job-related stress; and a lack of professional training.

Competing Interests

The authors declare that they have no competing interests

Acknowledgment
The authors wish to thank the authorities and personnel of the metallurgical sector in the chosen municipalities for their valuable cooperation. We would also like to express our gratitude to Cameroon's head of State for his wonderful support through the modernization allowance.

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