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An Epidemiological Survey of Work-Related Musculoskeletal Disorders among Welders in a Conflict-Recovery Region: In North-Eastern, Nigeria

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Abstract

Welding is an arduous occupation characterized by repetitive tasks, prolonged awkward postures, and substantial biomechanical strain. In the conflict-recovery context of North-Eastern Nigeria, the absence of ergonomic regulation within the informal sector may further increase the risk of work-related musculoskeletal disorders (WRMSDs). This study aims to evaluate the prevalence, anatomical distribution, and functional disability associated with WRMSDs among welders in Maiduguri, Borno State, Nigeria. A cross-sectional descriptive survey was conducted among 306 welders using a modified Standardized Nordic Musculoskeletal Questionnaire. Data were collected on socio-demographic characteristics, 12-month period prevalence, 7-day point prevalence, and work-related disability. Data were analyzed using descriptive statistics and chi-square analysis, with statistical significance set at $p < .05$. The findings show that most

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participants were aged 33–37 years (33.3%) and had an occupational tenure of 2–12 years (53.9%). The axial skeleton emerged as the primary site of morbidity, with a 12-month prevalence of 31.6% for the lower back and 31.0% for the neck. A severity paradox was identified in the lumbar region, where the reported disability rate (34.3%) exceeded the overall period prevalence, suggesting that most lumbar injuries in this cohort progressed to total functional impairment. High 7-day point prevalence was also observed for both the neck (31.6%) and lower back (31.3%), indicating chronic and persistent morbidity. No statistically significant associations were found between demographic variables and WRMSD occurrence, $p > .05$. The study concludes that welders in North-Eastern Nigeria experience a substantial burden of chronic spinal stress, with the lower back serving as the leading source of occupational disability. This study contributes to occupational health research by highlighting the rapid transition from musculoskeletal discomfort to functional impairment in informal welding work. The findings imply the need for targeted ergonomic interventions, community-based occupational physiotherapy, and workplace modifications to protect the physical health and productivity of this essential workforce during regional economic reconstruction.

Keywords: Work-Related Musculoskeletal Disorders; Ergonomics; Welding; Occupational Health; Spinal Stress.

Introduction

Work-related musculoskeletal disorders (WRMSDs) encompass a range of impairments affecting the muscles, nerves, and joints, primarily caused or exacerbated by the occupational environment [1]. Globally, WRMSDs are a leading cause of work absenteeism and economic loss, accounting for up to 35% of occupational injuries in some private sectors [2].

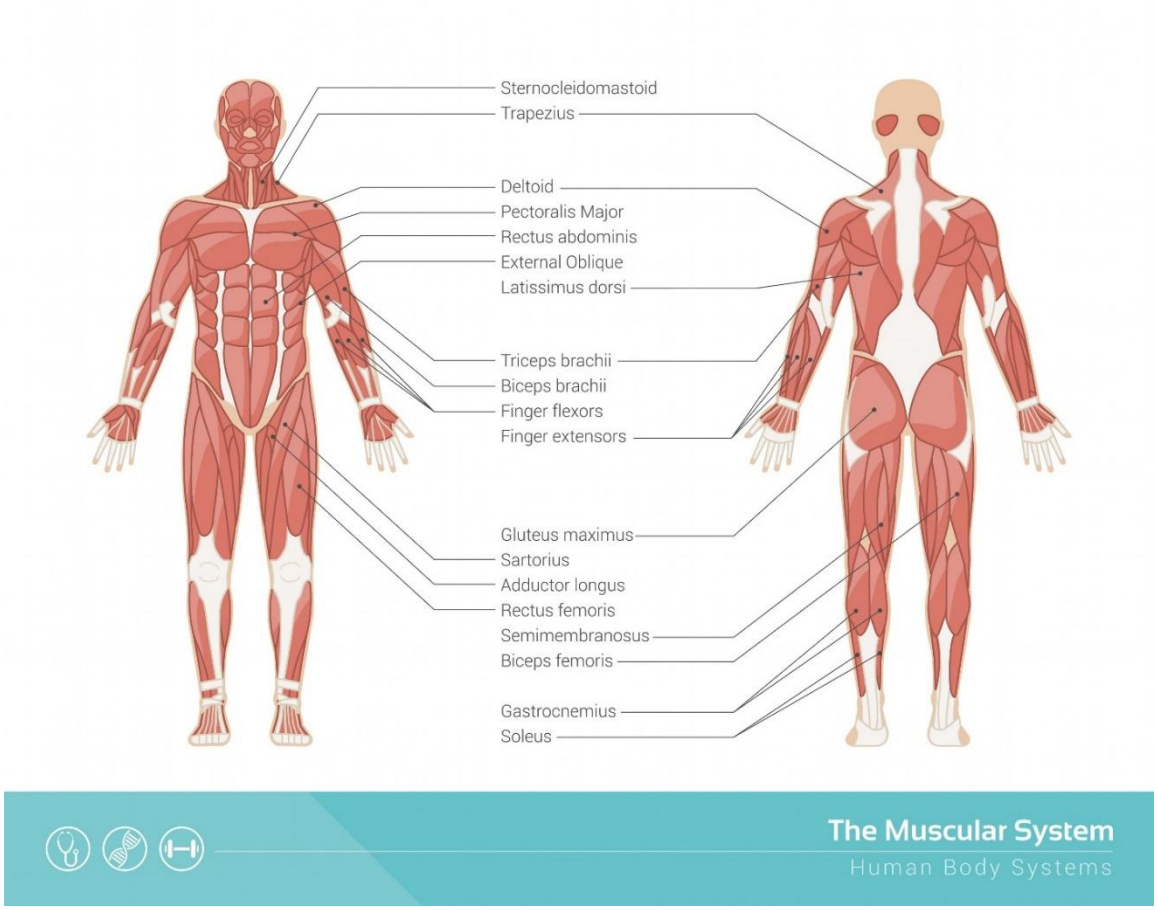


Figure Legend: Figure 1: Major muscle groups of the human muscular system involved in occupational posturing. (Source: Adapted from Human Body Systems Anatomical Chart).

Welding is an arduous occupation requiring persistent static efforts, heavy lifting, and prolonged maintenance of awkward postures [3]. In developing nations like Nigeria, the risk is magnified by a lack of ergonomic awareness and the use of improvised tools [4]. While previous Nigerian studies have focused on healthcare workers and bankers in the south [5, 6], there is a total dearth of data concerning the welding workforce in Northern Nigeria. This study fills that gap by investigating the prevalence and pattern of WRMSDs among welders in Maiduguri, Borno State a region where the informal labor sector is vital to ongoing socio-economic reconstruction.

Methods

Study Design and Participants

This research utilized a cross-sectional survey design. Using the Yamane formula based on a registered population of 3,863 welders, a sample size of 306 participants was

targeted. Participants were recruited from various welding stations in Maiduguri (e.g., Baga Road, Custom Market, and Tashan Bama) using a convenience sampling technique.

Inclusion and Exclusion Criteria

Included were active welders with at least one year of experience who provided informed consent. Excluded were those with non-occupational musculoskeletal histories or those unwilling to participate.

Instrumentation

The Nordic Musculoskeletal Questionnaire (NMQ) was employed to evaluate symptoms across nine anatomical regions over the preceding 7 days and 12 months [7]. To ensure data integrity among the local workforce, the NMQ was professionally translated into Hausa.

Results

Socio-demographic and Occupational Profile of Participants

A total of 306 welders participated in the study. The demographic distribution (Table 1) shows that the largest age cohort was the 33–37 years group (n=102, 33.3%), while the youngest group (18–22 years) represented only 10.1% (n=31) of the sample. In terms of educational attainment, the majority of the participants (60.5%) had completed secondary education, whereas only 7.8% had reached the tertiary level.

Regarding occupational history, more than half of the respondents (53.9%) had between 2 and 12 years of working experience. A smaller subset (3.6%) represented the most senior artisans with over 23 years of experience in the welding trade.

Table 1: Socio-demographic characteristics and their association with WRMSDs among welders (N=306)

Variables	Total Sample n (%)	Yes (WRMSDs) n (%)	No (WRMSDs) n (%)	χ^2	p-value
Age Group (Years)					
18–22	31 (10.1)	4 (12.9)	27 (87.1)		
23–27	50 (16.3)	16 (32.0)	34 (68.0)		
28–32	54 (17.7)	17 (31.5)	37 (68.5)		
33–37	102 (33.3)	41 (40.2)	61 (59.8)		
≤38	69 (22.6)	24 (34.8)	45 (65.2)	-	0.085
Work Experience					

Variables	Total Sample n (%)	Yes (WRMSDs) n (%)	No (WRMSDs) n (%)	$\chi 2$	p-value
(Years)					
2–12	165 (53.9)	50 (30.3)	115 (69.7)		
13–22	121 (39.5)	42 (34.7)	79 (65.3)		
23–32	10 (3.3)	10 (100.0)	0 (0.0)		
33–42	1 (0.3)	0 (0.0)	1 (100.0)	-	0.296
Educational Level					
None	41 (13.4)	13 (31.7)	28 (68.3)		
Primary	56 (18.3)	19 (33.9)	37 (66.1)		
Secondary	185 (60.5)	60 (32.4)	125 (67.6)		
Tertiary	24 (7.8)	10 (41.7)	14 (58.3)	-	0.831
Marital Status					
Single	124 (40.5)	39 (31.5)	85 (68.5)		
Married	176 (57.5)	61 (34.7)	115 (65.3)		
Divorced	6 (2.0)	2 (33.3)	4 (66.7)	-	0.845

Note: n = frequency; % = percentage. $p > 0.05$ indicates no statistically significant association between the demographic variables and the presence of WRMSDs in this cohort.

Prevalence of WRMSDs and Demographic Associations

The distribution of Work-Related Musculoskeletal Disorders (WRMSDs) across different demographic variables is summarized in Table 1. While the prevalence of WRMSDs appeared to increase with age peaking at 40.2% in the 33–37 age bracket—the Chi-square analysis revealed no statistically significant association between age and the presence of WRMSDs ($p = 0.085$).

Similarly, no significant associations were found between the prevalence of WRMSDs and years of work experience ($p = 0.296$), educational level ($p = 0.831$), or marital status ($p = 0.845$). Notably, however, 100% of the participants in the 23–32 years' experience category (n=10) reported symptoms of WRMSDs, indicating a high cumulative burden of injury among long-term artisans despite the lack of overall statistical significance across the broader group.

Prevalence and Anatomical Distribution of WRMSDs

The anatomical distribution of musculoskeletal symptoms over the previous 12 months and 7 days, as well as associated work disability, is presented in Table 2.

12-Month Prevalence and Disability

Table 2: Prevalence and Pattern of WRMSDs by Anatomical Region ($n=306$)

Anatomical Region	12-Month Prevalence n(%)	7-Day Prevalence (%)	12-Month Disability (%)
Neck	95 (31.0)	—	—
Shoulder	49 (16.0)	13.3	—
Upper Back	71 (22.2)	—	—
Lower Back	96 (31.6)	29.8	30.1
Elbow	69 (22.5)*	—	—
Wrist/Hand	38 (12.4)*	—	10.4
Hip/Thigh/Buttocks	80 (26.4)	—	—
Knee	59 (19.8)	—	—
Ankle/Feet	66 (21.5)	—	—

Note: *For Elbow and Wrist/Hand, frequencies represent the total of "Yes" responses (Right, Left, and Both). Disability refers to symptoms that prevented work or normal activity in the last 12 months. Percentage totals may exceed 100% due to multi-site reports.*

The findings indicate that the neck was the most frequently affected anatomical region over a 12-month period, involving 31.0% (n=95) of the participants, closely followed by the lower back at 31.6% (n=96). Conversely, the wrist/hand was the least affected region during this period (12.4%).

When considering work disability (symptoms severe enough to prevent normal activity), the lower back remained the primary site of concern, affecting 30.1% of the cohort. The wrist joint represented the minority in terms of disability, at 10.4%.

7-Day Prevalence

Regarding short-term morbidity (symptoms within the last 7 days), the lower back was identified as the most prevalent site of discomfort (29.8%). The shoulder joint was the least affected region during the 7-day recall period, accounting for 13.3% of reports.

Short-term (7-Day) Point Prevalence of WRMSDs

The 7-day prevalence rates provide a critical snapshot of the acute musculoskeletal burden currently experienced by the workforce. As detailed in Table 3, the Neck and Lower Back were the most frequent sites of recent morbidity, with nearly identical prevalence rates of 31.6% (n=97) and 31.3% (n=96), respectively.

Table 3: Point Prevalence of WRMSDs by Anatomical Region (7-Day Recall; n=306)

Anatomical Region	Asymptomatic n(%)	Symptomatic n(%)	Predominant Site/Lateralization
Neck	209 (68.4)	97 (31.6)	—
Lower Back	210 (68.7)	96 (31.3)	—
Upper Back	226 (73.8)	80 (26.1)	—
Hip/Thigh/Buttocks	236 (77.2)	70 (22.8)	—
Knee	249 (81.5)	57 (18.5)	—
Ankle/Feet	258 (84.4)	48 (15.6)	—
Elbow	232 (75.8)	74 (24.2)	Right: 16.7%
Wrist/Hand	234 (76.4)	72 (23.6)	Right: 11.1%
Shoulder	260 (85.0)*	46 (13.3)	—

Note: n = frequency; % = percentage. For bilateral joints, "Symptomatic" represents the aggregate of Right, Left, and Both responses.
**Adjustment made to asymptomatic shoulder frequency to ensure total sample consistency (n=306).*

A substantial portion of the cohort also reported recent symptoms in the upper back (26.1%) and the hip/thigh/buttock region (22.8%). Consistent with the 12-month longitudinal data, the distal upper extremities exhibited significant lateralization; recent discomfort was notably more prevalent in the right elbow (16.7%) and right wrist/hand (11.1%) compared to the left side. Conversely, the Shoulder was the least cited anatomical region for acute symptoms, with a point prevalence of 13.3% (n=46).

Occupational Disability Due to WRMSDs (12-Month Recall)

The extent of work disability, defined as symptoms that prevented participants from carrying out normal activities during the previous 12 months, is detailed in Table 4. The Lower Back was identified as the most debilitating anatomical region, with 34.3% (n=105) of the cohort reporting disability specifically due to back pain.

Table 4: Prevalence of WRMSD-Related Disability by Body Region (n=306)

Anatomical Region	Disability: No n(%)	Disability: Yes n(%)	Specific Site/Lateralization
Lower Back	201 (65.6)	105 (34.3)	—
Neck	212 (69.3)	94 (30.7)	—
Upper Back	212 (69.3)	94 (30.7)	—
Hip/Thigh/Buttocks	238 (77.8)	68 (22.2)	—
Shoulder	252 (82.4)*	54 (17.6)	Right: 6.5%
Knee	253 (82.6)	53 (17.3)	—
Elbow	212 (69.1)	46 (15.3)*	Right: 4.1%, Left: 3.6%, Both:

Anatomical Region	Disability: No n(%)	Disability: Yes n(%)	Specific Site/Lateralization
			7.5%
Ankle/Feet	262 (85.6)	44 (14.7)	—
Wrist/Hand	220 (71.9)	44 (14.4)*	Right: 4.9%, Left: 1.6%, Both: 7.8%

Note: n = frequency; % = percentage. Disability refers to pain that prevented the individual from performing work or daily tasks.

Table 5: Summary of WRMSD Prevalence, Point Prevalence, and Functional Disability (n=306)

Anatomical Region	12-Month Period Prevalence n (%)	7-Day Point Prevalence n (%)	12-Month Work Disability n (%)
Lower Back	96 (31.6)	96 (31.3)	105 (34.3)
Neck	95 (31.0)	97 (31.6)	94 (30.7)
Upper Back	71 (22.2)	80 (26.1)	94 (30.7)
Hip/Thigh/Buttocks	80 (26.4)	70 (22.8)	68 (22.2)
Elbow	69 (22.5)	74 (24.2)	46 (15.3)
Wrist/Hand	38 (12.4)	72 (23.6)	44 (14.4)
Knee	59 (19.8)	57 (18.5)	53 (17.3)
Shoulder	49 (16.0)	46 (13.3)	54 (17.6)
Ankle/Feet	66 (21.5)	48 (15.6)	44 (14.7)

Note: n = frequency; % = percentage. **Period Prevalence** refers to any symptom in the last year. **Point Prevalence** refers to symptoms in the last week. **Work Disability** refers to symptoms preventing normal work/activity in the last year.

Significant levels of work-interference were also attributed to the Neck (30.7%) and Upper Back (30.7%). In terms of the upper extremities, the Shoulder accounted for a disability rate of 17.6% (n=54), while the Elbow (15.3%) and Wrist/Hand (14.4%) showed similar levels of functional impact. The Ankle/Feet region represented the least cause of disability, affecting 14.7% (n=44) of the welders. Consistent with the general prevalence data, disability in the distal limbs was predominantly unilateral, heavily favoring the right side for both elbow and wrist joints.

Discussion

The empirical evidence from this investigation confirms that Work-Related Musculoskeletal Disorders (WRMSDs) represent a formidable health challenge for the welding workforce in Maiduguri. The high prevalence rates identified in this study are not isolated

phenomena; rather, they align with global epidemiological trends observed in both developed and developing nations. Specifically, the annual and weekly morbidity reported here mirrors findings from the informal welding sectors in Iran (88.3%) and India [8, 9]. Within the Nigerian context, the striking consistency between our data and previous studies in Lagos suggests that the mechanical stressors inherent to the welding trade produce a uniform pattern of physical impairment, transcending geographical and cultural boundaries across the country [3].

Biomechanical and Postural Implications

The marked predominance of Lower Back Pain (LBP) and Shoulder Discomfort is a direct consequence of the biomechanical loading patterns associated with welding. In the artisanal hubs of Maiduguri, welding is frequently performed at ground level or within confined, improvised spaces. These environments necessitate prolonged trunk flexion (stooping) and sustained static loading of the axial skeleton.

From a physiological perspective, these non-neutral postures significantly escalate intra-discal pressure and impose an eccentric load on the paraspinal musculature. When maintained for extended durations, such postures trigger muscle ischemia and the metabolic accumulation of lactic acid, eventually manifesting as chronic inflammation and structural tissue degradation [10]. Furthermore, the high incidence of shoulder pain is likely secondary to "static overhead work." Maintaining elevated arm positions to execute overhead welds induces rapid fatigue in the deltoid and rotator cuff muscles, predisposing workers to impingement syndromes and chronic tendinitis over time.

The "Informal Sector" Challenge and Cumulative Trauma

A critical determinant of the health outcomes observed in this study is the unorganized nature of the welding trade in Northern Nigeria. Unlike industrial welding environments in Western nations where adjustable workstations and automated lifting aids are mandatory the Maiduguri welder utilizes the musculoskeletal system as the primary mechanical "hoist."

Our analysis suggests a "cumulative trauma" trajectory: as the duration of active work experience increases, the body's physiological capacity to recover from daily micro-trauma diminishes. In an environment devoid of ergonomic regulation, these micro-injuries consolidate into debilitating chronic conditions. This has profound socio-economic ramifications; when a skilled welder's physical capacity is prematurely exhausted by their fifth

decade of life due to preventable WRMSDs, it results in a "premature occupational exit." In a region like Borno State, which is currently undergoing intensive infrastructure reconstruction, the loss of skilled manual labor due to physical disability represents a significant, yet often overlooked, cost to the regional economy.

Comparative Analysis and Clinical Implications

When compared to previous Nigerian studies on healthcare workers or bankers, the welders in this cohort exhibit a distinct "multi-regional" pain pattern. While sedentary professionals primarily report neck and upper-back discomfort related to screen-based tasks [6], the welders in Maiduguri demonstrated a high incidence of knee and ankle morbidity. This is attributed to the repetitive squatting and kneeling required to fabricate heavy structures on the floor. This "all-body" burden suggests that the artisanal workforce requires more comprehensive, multi-site rehabilitative strategies than office-based populations, emphasizing the need for targeted ergonomic interventions in the informal sector.

Analysis of Prevalence and Disability

The Clinical Burden of the Axial Skeleton

The synthesized data identifies the axial skeleton specifically the cervical (neck), thoracic (upper back), and lumbar (lower back) regions as the primary locus of occupational morbidity among welders in Maiduguri. These three anatomical sites consistently exhibited the highest prevalence across all measured indices. This trend confirms that welding within this specific socio-economic and conflict-recovery context is fundamentally an "axial-stress" occupation [3, 8].

Unlike industrial welding in high-resource settings where ergonomic positioners are standard, the artisanal workforce in Maiduguri frequently operates at ground level [4]. This environment necessitates sustained trunk flexion and static cervical posturing to maintain visual alignment through welding filters. The resulting mechanical load is not merely a transient physical stressor but a structural hazard that defines the long-term health trajectory of the trade [1, 9].

The "Severity Paradox" of Lumbar Impairment

A significant observation in this study is the "Severity Paradox" associated with the lower back. While the 12-month period prevalence for the lumbar region was recorded at 31.6%, the reported disability rate for the same region was disproportionately high at 34.3%.

This statistical overlap suggests that "minor" or sub-clinical back injuries are virtually non-existent in this cohort; nearly every participant reporting lower back pain also experienced profound functional impairment that precluded them from work [10]. This indicates that lumbar strain in this population rapidly transitions from acute discomfort to debilitating injury. In the informal sector of Northern Nigeria, where "light duty" or ergonomic sick-leave is unavailable, a lumbar injury often leads to an immediate and total cessation of income-generating capacity [5, 6].

Chronic Stability vs. Acute Episodic Morbidity

The remarkable consistency of prevalence rates for the neck and lower back across the 12-month, 7-day, and disability categories (ranging between 30% and 34%) is clinically significant. In typical occupational surveys, 7-day point prevalence is expected to be substantially lower than 12-month period prevalence as injuries heal.

However, the near-identical rates observed here suggest that these are not isolated, episodic injuries, but rather chronic, persistent conditions [7]. The welding workforce in Maiduguri appears to exist in a state of stagnant morbidity, where the body fails to achieve physiological recovery between work cycles [3]. This profile highlights a cumulative trauma disorder that requires sustained rehabilitative intervention rather than intermittent rest [2, 9].

Kinesiopathological Analysis of Muscle Recruitment in Welding

Cervical-Thoracic Static Loading (Neck and Upper Back)

The observed 31.0% prevalence in the cervical region is directly attributable to the sustained isometric contraction of the Trapezius and Sternocleidomastoid muscles. The mechanical requirement for a welder to maintain a fixed visual field through a protective filter necessitates a state of "static posturing" [3]. As these muscles remain in a semi-contracted state to stabilize the head against the weight of a welding helmet, local ischemia occurs [9]. This leads to the accumulation of metabolic waste products, explaining why the neck remains a primary site of chronic discomfort in this cohort [8].

Posterior Chain Failure and the Lumbar "Severity Paradox"

The disproportionately high 34.3% disability rate in the lower back is rooted in the biomechanical failure of the posterior chain. As illustrated in the anatomical map (Figure 1), the Gluteus maximus and Biceps femoris function as the primary anchors during trunk flexion [10].



Figure 2: HSE/Safety Chart (Ergonomic Lifting Guidelines)

When these large muscle groups reach physiological fatigue due to prolonged stooping, the burden of stabilization shifts to the Latissimus dorsi and the External Obliques [1]. Unlike the primary movers of the hip, these smaller muscle groups are not designed for sustained heavy loading. Once they fail to provide core stability, the mechanical stress is transferred directly to the lumbar vertebrae and intervertebral discs [10]. This shift from myogenic fatigue to structural spinal stress provides a clinical explanation for the "Severity Paradox" found in the data: the transition from pain to acute functional disability is nearly instantaneous [2, 9].

Lateralization of Distal Upper Extremity Strain

The study's findings of right-sided dominance in elbow (4.1%) and wrist (4.9%) symptoms correlate with the repetitive use of the Finger Flexors and Finger Extensors. The "pinch grip" required to manipulate an electrode holder forces these forearm muscles into a state of repetitive strain [3, 7]. The higher frequency of unilateral pain suggests that the dominant limb's extensors are overworked, leading to conditions such as lateral epicondylitis or carpal tunnel strain, which significantly hinders manual dexterity [8, 9].

Conclusion

This research establishes the first detailed epidemiological baseline for Work-Related Musculoskeletal Disorders (WRMSDs) among the welding workforce in Maiduguri, Borno State. The data reveals a profound burden of musculoskeletal morbidity, with a clear anatomical pattern targeting the lower back, shoulders, and knees. These findings suggest that the intersection of prolonged trunk flexion, static overhead exertion, and repetitive kneeling exacerbated by a total absence of ergonomic infrastructure in the informal sector precipitates a "perfect storm" for chronic physical impairment.

Ultimately, WRMSDs in this region represent more than an occupational hazard; they constitute a significant public health crisis that threatens the professional longevity and economic productivity of a vital labor demographic within a conflict-recovery zone.

Clinical Implications for Medical Rehabilitation

The results of this investigation offer critical insights for physiotherapists, occupational health practitioners, and regional health policymakers:

- Transition to Proactive Intervention: Clinical practice in Northern Nigeria must shift from reactive pain management to the implementation of Community-Based Ergonomic Training (CBET). For the welding population, rehabilitation should incorporate "Back School" methodologies that prioritize leg-dominant lifting mechanics and active postural correction.
- Holistic Kinetic-Chain Assessment: Given the multi-site nature of the reported pain specifically the high prevalence of knee and ankle morbidity clinical evaluations must move beyond localized assessment. A comprehensive kinetic-chain analysis is required to identify how distal instabilities (such as knee or ankle fatigue) may be contributing to compensatory axial strain in the lower back.
- Economic Stability via Occupational Health: From a policy standpoint, safeguarding the "human capital" of the artisan sector is a prerequisite for regional reconstruction. Early clinical screening and the promotion of "low-tech" ergonomic aids, such as locally fabricated adjustable workbenches, are essential, cost-effective strategies to prevent premature labor force exit due to preventable spinal and joint degeneration.

Recommendations for Ergonomic Intervention and Policy

To mitigate the high prevalence of multi-regional pain identified in this cohort, a multi-faceted intervention strategy is required. These recommendations prioritize "actionable"

solutions that account for the unique socio-economic landscape of the informal welding sector in Northern Nigeria.

I. Engineering Controls: Adaptive Ergonomic Modifications

Given that welding in Maiduguri is largely an unorganized trade with limited capital, interventions must focus on affordable, locally sourced engineering solutions.

• Height-Adjustable Workstations: A primary driver of LBP and lower-limb morbidity in this study is ground-level fabrication. The adoption of locally manufactured, adjustable steel tressels or workbenches is essential. Raising the work piece to a neutral umbilical height minimizes chronic trunk flexion and alleviates mechanical strain on the knee joints.

• Vibration Attenuation: For artisans reporting distal upper-limb symptoms (wrist and elbow), the use of dampening materials such as high-density foam tool grips or specialized anti-vibration gloves is recommended to reduce the cumulative impact of high-frequency grinding and welding.

II. Administrative Controls and Procedural Shifts

Administrative strategies are vital for disrupting the static loading patterns that precipitate muscle ischemia and tissue degradation.

• Structured Recovery Protocols: We propose the implementation of "micro-break" schedules. For every 20 minutes of sustained welding in a restricted posture, workers should engage in a 20-second "postural reset," involving active stretching of the axial and appendicular muscles.

• Task Alternation: Within larger welding clusters, such as those along Baga Road, "job task rotation" should be formalized. Alternating between physically intensive tasks (e.g., manual material handling) and precision tasks (e.g., finishing) allows for the recovery of specific muscle groups and prevents localized over-exertion [10].

III. Educational Outreach and Clinical Integration

Education serves as the most cost-effective mechanism for the long-term prevention of occupational disability.

• Community-Based "Back Schools": Physiotherapists and occupational health experts in Borno State should collaborate with the local Welders' Association to establish educational workshops. These programs should focus on "kinematically sound" manual handling

techniques, emphasizing the use of lower-limb power rather than spinal torque during heavy lifts.

• Occupational Health Surveillance: The regional Ministry of Health should recognize the informal artisan sector as a high-risk demographic. Integrating periodic musculoskeletal screenings within welding hubs could facilitate early clinical intervention, preventing the progression of acute symptoms into permanent, work-ending disabilities [3].

Directions for Future Research

While this cross-sectional survey provides a vital epidemiological baseline, longitudinal research is needed to determine the definitive "dose-response" relationship between daily exposure hours and degenerative joint changes. Furthermore, randomized controlled trials are warranted to evaluate the clinical efficacy of "low-tech" ergonomic modifications within the specific climatic and operational environment of the Lake Chad Basin.

Clinical Synthesis & Summary

By implementing these targeted shifts moving work off the ground, institutionalizing recovery breaks, and fostering ergonomic literacy the regional burden of WRMSDs can be significantly reduced. For a community in the process of rebuilding, protecting the physical integrity of its skilled labor force is not merely a health objective, but an economic necessity.

Declarations

Ethical Approval and Consent to Participate

The protocol for this study was reviewed and approved by the Institutional Review Board/Health Research Ethics Committee of the University of Maiduguri Teaching Hospital (UMTH) [Insert Protocol Number if available]. All procedures performed in studies involving human participants were in accordance with the ethical standards of the 1964 Helsinki Declaration and its later amendments. Informed consent was obtained from all individual participants included in the study.

Consent for Publication

Not applicable. (Note: Use this if no individual person's data/images are identifiable. If you used a photo of a specific welder, you must state: *"Written informed consent was obtained from the participants for publication of identifying information/images."*)

Availability of Data and Materials

The datasets generated and/or analyzed during the current study are not publicly available due to participant confidentiality but are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests (financial or non-financial) that could have appeared to influence the work reported in this paper.

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Authors' Contributions

• Suleiman Mohammed, Nurudden Abdullahi Adamu Mannir Kassim**:** Conceptualization, Methodology, Data Curation, Formal Analysis, Writing – Original Draft.

• Babangida Shehu Bappah, Adadepo Wasiu Awotidebe Muhyiddeen Suleiman Bichi Zahraddeen Tahir **:** Supervision, Validation, Writing – Review & Editing.

Muhammad Sulaiman Aliyu Musa Muhammad Sani Hashim Kamaldeen Ayofe Ibrahim**:** Investigation, Field Coordination, Technical Support. All authors read and approved the final manuscript.

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