

Investigating the relationship between work incidents and musculoskeletal disorders in motorcycle technician workshops: a cross-sectional analysis

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ABSTRACT

Workplace hazards and incidents pose significant risks in the automotive industry, necessitating meticulous risk assessment and management. This cross-sectional study aimed to explore the prevalence of work-related injuries and musculoskeletal disorders (MSDs) among motorcycle technicians in workshops situated within Lombok Island, West Nusa Tenggara, Indonesia. A sample of 105 male participants was recruited for the study. Findings revealed that the majority of workers were aged between 20-30 years (67.6%), possessed Vocational High School education (61%), were married (55.2%), had 1-10 years of work experience (83.8%), were smokers (58.1%), and abstained from alcohol consumption (83.8%). Workplace incidents predominantly comprised minor injuries (93.3%), with the hands being the most frequently affected body part (65.5%). Additionally, lower back MSDs were prevalent (74.3%) and significantly correlated with workplace incidents. The study concludes that upper extremities were the most commonly affected body part in both incidents and MSDs. These findings underscore the importance of prioritizing workplace safety and implementing preventative strategies to mitigate MSDs in motorcycle workshops, ultimately fostering worker well-being and enhancing workshop productivity.



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1. Introduction

Work hazards and incidents in the automotive industry are a critical concern that requires thorough risk assessment and management (Nealon et al., 2023). Studies have shown that poor hazard recognition is a prevalent issue in industrial settings, impacting workers' ability to identify and avoid potential dangers (Nealon et al., 2023; Pandithawatta et al., 2023). The importance of understanding hazards in process industries has been highlighted, emphasizing the need for improved experimental methods to enhance safety measures. In automotive industry, factors such as repetitive tasks, awkward postures, and strenuous physical exertion contribute to musculoskeletal disorders among workers (Mohd Fazi et al., 2019; Valeeva et al., 2023). Occupational risks in this industry can result in absenteeism, reduced productivity, and employee turnover.

Recent research by Johnson & Mashuga, (2023), indicates that workers with at least five years of work experience showed better hazard recognition accuracy and missed detection rate compared to workers with less than a year of experience. This emphasizes the significant role of experience in enhancing workplace safety and suggests the potential for implementing interventions to improve hazard recognition among less experienced workers. Workplace culture, lack of understanding of personal protective equipment (PPE), and physical work environment significantly impact occupational

accidents experienced by workers. (Hayashi et al., 2020; Shier et al., 2019; Tang & Sun, 2021). Demographic factor (e.g., gender, age, experience, habits), organizational culture, social support, and quality training, impact perceived safety among employees, with workplace characteristics playing a significant role (Guerin et al., 2020; He et al., 2023; Tasdelen & Özpınar, 2023; Wawersik et al., 2023). These findings underscore the importance of considering individual characteristics in promoting a culture of safety and enhancing hazard identification and error reporting in various work environments.

Indonesian motorcycle users predominantly rely on two-wheeled vehicles for transportation due to their affordability and widespread availability. Based on BPS-Statistics Indonesia, (2022), In 2022, there were over 125 million motor vehicles in Indonesia, with more than 1.8 million motorcycles in West Nusa Tenggara alone. This number is increasing each year and is expected to continue rising in 2023 and 2024. Based on the Directorate of Population and Labour Statistics, (2023), the automotive maintenance and repair industry ranks second after the processing industry in terms of the percentage of workers in Indonesia. Information from Ministry of Manpower, (2023), in 2021-2022, 28.2%-34% of workers in West Nusa Tenggara province were employed in this industry. While the implementation of the Occupational Safety and Health Management System in West Nusa Tenggara is considered good with a score of 86%, there is a significant gap with the number of companies receiving awards in the field of occupational safety, which is only 41.7%. This indicates the need for evaluation and improvement efforts to achieve optimal occupational safety standards.

In this research, a cross-sectional study design was utilized. This type of study is valuable for simultaneously assessing exposure, outcomes, and other variables, allowing for the estimation of prevalence and correlation values (Tafere et al., 2020; Tolera et al., 2023). However, it's important to exercise caution when making causal inferences. A cross-sectional study conducted in the automotive industry highlighted various safety concerns among workers. The research revealed that workers in this sector face significant occupational hazards, including work-related musculoskeletal disorders (MSDs) such as low back disorders, neck and shoulder issues, and upper extremity disorders (Kambris et al., 2019). Additionally, the study emphasized the importance of safety practices, indicating that many workers lack proper safety training and awareness regarding exposure to physical and chemical hazards in the workplace (Sirzai & Dundar, 2022). Furthermore, findings suggested a need for improved safety measures, regular training on safety guidelines, and enforcement of standard safety practices to mitigate potential occupational hazards and ensure the well-being of automotive workers (Valeeva et al., 2023). Overall, the study underscored the necessity for enhanced safety protocols and awareness initiatives in the automotive repair industry to protect workers' health and safety (Abiodun, 2018).

This research is crucial not just academically but also for practical reasons. By understanding the factors that contribute to accidents among motorcycle technicians, it can develop interventions to reduce risks and improve safety standards. This is important not only for protecting workers' health but also for the overall functioning of the automotive service industry. Given the limited research on this topic, this research aims to fill this gap by investigating the relationship between individual characteristics and workplace accidents using a cross-sectional study. The research focus on Lombok Island, West Nusa Tenggara Province, Indonesia. The findings will be valuable for policymakers, business owners, and safety managers, helping them develop targeted interventions to enhance safety in motorcycle Technician workshops.

2. Methods

This cross-sectional study will investigate the prevalence of work-related injuries and musculoskeletal disorders (MSDs) among motorcycle technicians in workshops located within Lombok Island, Nusa Tenggara Barat, Indonesia. A sample size of 105 participants will be recruited. Data analysis will leverage a two-pronged approach. First, descriptive statistics will be used to paint a clear picture of the demographic makeup of the participant pool. Additionally, it will reveal the prevalence of both work-related injuries and MSDs within the sample population. Subsequently, bivariate analysis will be employed to explore potential associations between the reported unsafe work practices and the occurrence of injuries or MSDs. By identifying these potential links, the study aims to shed light on specific work environment factors that contribute to the development of musculoskeletal problems among motorcycle technicians. This knowledge can pave the way for targeted interventions aimed at

improving workplace ergonomics and ultimately, protecting the health and well-being of motorcycle technicians.

To ensure the research is conducted with the utmost respect for participant well-being, all participants voluntarily provided informed consent before participating in the study. An independent review confirmed that the surveys and interview procedures met the standards set by the institute's ethical research policy. This informed consent process ensures they fully comprehend the nature of the study and participate willingly. Furthermore, the study adheres to strict protocols regarding anonymity and confidentiality of all participant information. This safeguards participant privacy and fosters trust within the research community.

3. Results and Discussion

Demographics

This research examines work-related injuries and musculoskeletal disorders (MSDs) among motorcycle repair technicians (N=105). This workforce consists of individuals from a total of 41 motorcycle repair shops scattered across Lombok Island, West Nusa Tenggara, Indonesia. In comparison to official dealerships categorized as large-scale enterprises, these repair shops are classified as small and medium-sized enterprises or Small-Medium Enterprises (SMEs), with a technician workforce ranging from 2 to 5 individuals, all of whom are male. Demographic descriptions encompass age, education level, marital status, work experience, smoking habits, and alcohol consumption, and their correlations with the incidence of injuries and MSDs are investigated.

Table 1 Demographics of sample

| Demography | Criteria | Frequency | Percent. (%) |
|-----------------|------------------------|-----------|--------------|
| Age | <20 years old | 6 | 5.7% |
| | 20-30 years old | 71 | 67.6% |
| | 31-40 years old | 16 | 15.2% |
| | >40 years old | 12 | 11.4% |
| Education | Elementary School | 4 | 3.8% |
| | Junior High School | 8 | 7.6% |
| | Senior High School | 27 | 25.7% |
| | Vocational High School | 64 | 61.0% |
| Marital Status | Bachelor Degree | 2 | 1.9% |
| | Single | 46 | 43.8% |
| | Married | 58 | 55.2% |
| | Widower | 1 | 1.0% |
| Work Experience | 1-10 years | 88 | 83.8% |
| | 11-20 years | 11 | 10.5% |
| | 21-30 years | 4 | 3.8% |
| | 31-40 years | 1 | 1.0% |
| Smoke | Yes | 61 | 58.1% |
| | No | 24 | 22.9% |
| Alcohol | Yes | 17 | 16.2% |
| | No | 88 | 83.8% |

Based on Table 1, the age distribution of the study population leans towards middle adulthood, with the largest proportion of participants falling within the 20-30 years old range (67.6%, n=71). A smaller, but significant portion fell between 31-40 years old (15.2%, n=16). The youngest and oldest age groups (<20 years old: 5.7%, n=6; >40 years old: 11.4%, n=12) were represented by a smaller number of participants. The educational level within the study population reveals a dominance of vocational high school (61.0%, n=64). This is followed by a substantial portion holding a senior high school diploma (25.7%, n=27). Those with lower educational attainment (elementary school: 3.8%, n=4; junior high school: 7.6%, n=8) comprise a smaller segment, with a minimal number of participants possessing a bachelor's degree (1.9%, n=2).

In terms of marital status, the study population reflects a relatively even distribution between married (55.2%, n=58) and single individuals (43.8%, n=46). Widowed individuals comprised a negligible portion of the sample (1.0%, n=1). The distribution of work experience within the study population leans heavily towards individuals with 1-10 years of experience (83.8%, n=88). This is

followed by a smaller segment with 11-20 years of experience (10.5%, n=11). Work experience exceeding 20 years is less frequent, with only a minimal number of participants having 21-30 years (3.8%, n=4) and a single individual exceeding 30 years (1.0%, n=1). The study population leans towards a smoking habit, with over half (58.1%, n=61) reporting smoking. Alcohol consumption, however, appears less prevalent, with only a minority (16.2%, n=17) acknowledging it. The vast majority (83.8%, n=88) reported abstaining from alcohol.

Overview of Work Incidents in Motorcycle Technician Workshops

This study examined the distribution of workplace incidents by severity. Near miss describes a close call where potential injury is narrowly averted. Minor injuries, like abrasions, cuts or scrapes, can be addressed with first aid, while major injuries, such as fractures or burns, necessitate further medical intervention and potentially longer recovery times.

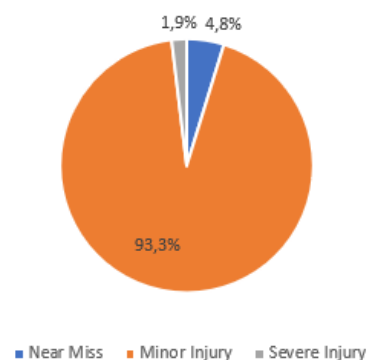


Fig. 1 Distribution for incident at work by severity.

The findings from Fig. 1, revealed a clear distinction, with minor injuries constituting the overwhelming majority (93.3%) of reported incidents. Near misses, fortunately, were less frequent (4.8%), indicating a baseline level of safety awareness. However, the presence of even a small number of near misses underscores the importance of preventative measures. Conversely, severe injuries were the rarest category (1.9%), suggesting a relatively robust safety culture within the workplace. Despite this positive trend, the occurrence of any severe injury necessitates continued vigilance. Therefore, a comprehensive approach to workplace safety is crucial. This should encompass proactive measures to address potential hazards identified through near miss reports, with the goal of not only preventing severe injuries but also significantly reducing the high frequency of minor incidents.

Fig. 2, show the analysis of workplace injuries reveals a dominance of upper limb involvement. Hand injuries comprise the most frequent category (65.5%), followed by foot injuries (34.5%). This distribution suggests a work environment that may involve tasks placing stress on hands and feet, or potentially one with increased risk of slips, trips, and falls. Finger injuries (14.5%) further support this notion. While lower back injuries are present (5.5%). The "Other" category (12.2%), encompassing various body parts like the upper back, arm, elbow, eyes, knee, thigh, and head, highlights the potential for a wider range of injuries to occur depending on the specific work activities.

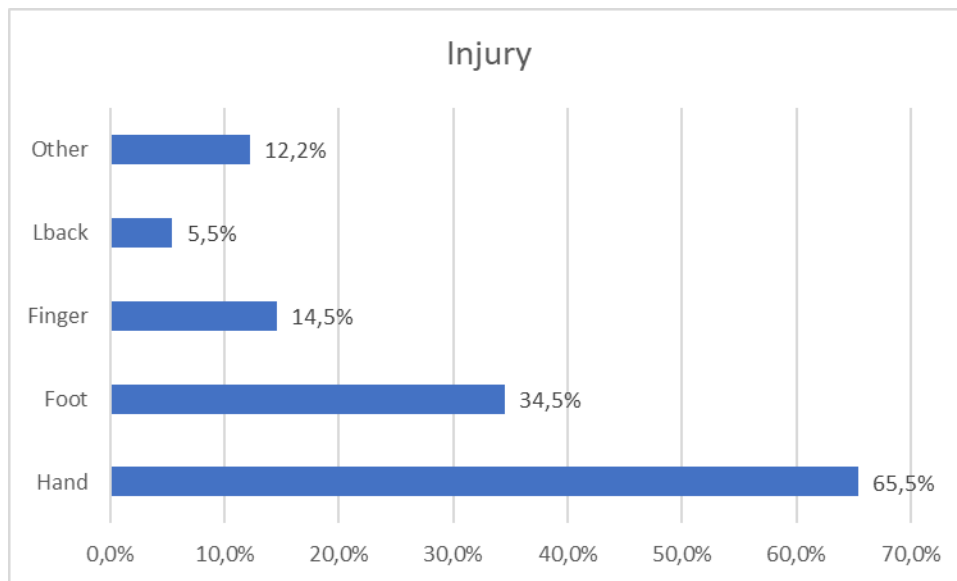


Fig. 2 Injury rate on body part.

Prevalence and Patterns of Musculoskeletal Disorders

The study identified a concerning prevalence of work-related musculoskeletal disorders (MSDs) across the entire musculoskeletal system (Fig. 3). Lower back issues were the most frequent (74.3%), followed closely by upper back pain (50.5%). These findings suggest a high risk of postural strain throughout the core. Furthermore, a significant portion of participants reported MSDs in the hands (39.0%), neck (34.3%), and feet (19.0%), indicating potential risk factors associated with repetitive tasks and awkward postures affecting both upper and lower extremities. Even though less frequent, MSDs in knees (16.2%), shoulders (12.4%), and thighs (4.8%) warrant investigation to identify the specific work activities contributing to these issues.

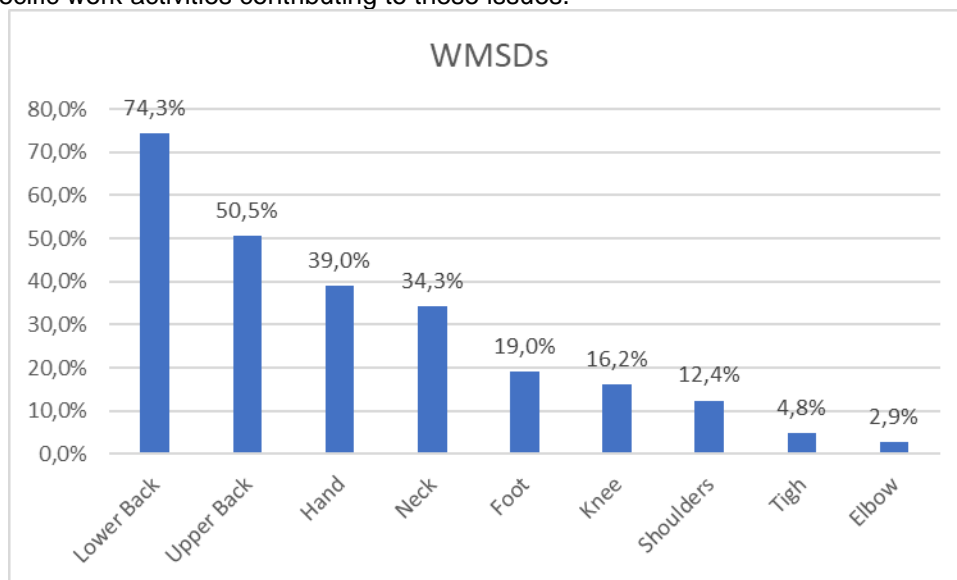


Fig. 3 Work related musculoskeletal disorders on body part.

The Relationship Between Work Incidents and Musculoskeletal Disorders

This study investigated the relationship between Musculoskeletal Disorders (MSDs) in various body regions and the occurrence of workplace incidents. The analysis focused on data from 9 body parts commonly affected by MSDs, as shown in Table 2. Statistical analysis revealed a significant association between workplace incidents and MSDs in the lower back only. This finding is supported

by a p-value of 0.012, which is lower than the predetermined significance level of $\alpha = 0.05$. Conversely, no statistically significant correlations were observed between workplace incidents and MSDs in the neck, shoulders, upper back, elbow, hand, knee, thigh, or foot. Figure 1 illustrates the distribution of incident categories experienced by workers. Minor injuries represent the most prevalent category, followed by near misses and severe injuries. Interestingly, for workers experiencing minor injuries in body parts other than the lower back, a majority reported no associated pain. These findings suggest that lower back MSDs are a significant risk factor for workplace incidents. Workers with lower back problems appear to be more susceptible to experiencing incidents compared to those without such conditions.

Table 2 Relationship between work-related incidents and musculoskeletal disorders (MSDs)

| MSDs | | Incident by severity level | | | | p-Value (Chi Square) |
|------------|-----|----------------------------|--------------|---------------|-------------|-------------------------|
| | | Near Miss | Minor Injury | Severe Injury | Total | |
| Neck | Yes | 2 (1.9%) | 33 (31.4%) | 1 (1.0%) | 36 (34.3%) | 0.766 |
| | No | 3 (2.9%) | 62 (59.0%) | 4 (3.8%) | 69 (65.7%) | |
| Shoulders | Yes | 1 (1.0%) | 11 (10.5%) | 1 (1.0%) | 13 (12.4%) | 0.744 |
| | No | 4 (3.8%) | 84 (80.0%) | 4 (3.8%) | 92 (87.6%) | |
| Upper Back | Yes | 3 (2.9%) | 47 (44.8%) | 3 (2.9%) | 53 (50.5%) | 0.818 |
| | No | 2 (1.9%) | 48 (45.7%) | 2 (1.9%) | 52 (49.5%) | |
| Lower Back | Yes | 1 (1.0%) | 74 (70.5%) | 3 (2.9%) | 78 (74.3%) | 0.012 |
| | No | 4 (3.8%) | 21 (20.0%) | 2 (1.9%) | 27 (25.7%) | |
| Elbow | Yes | 0 (0.0%) | 2 (1.9%) | 1 (1.0%) | 3 (2.9%) | 0.060 |
| | No | 5 (4.8%) | 93 (88.6%) | 4 (3.8%) | 102 (97.1%) | |
| Hand | Yes | 2 (1.9%) | 37 (35.2%) | 2 (1.9%) | 41 (39.0%) | 0.998 |
| | No | 3 (2.9%) | 58 (55.2%) | 3 (2.9%) | 64 (61.0%) | |
| Knee | Yes | 1 (1.0%) | 14 (13.3%) | 2 (1.9%) | 17 (16.2%) | 0.318 |
| | No | 4 (3.8%) | 81 (77.1%) | 3 (2.9%) | 88 (83.8%) | |
| Thigh | Yes | 1 (1.0%) | 4 (3.8%) | 0 (0.0%) | 5 (4.8%) | 0.238 |
| | No | 4 (3.8%) | 91 (86.7%) | 5 (4.8%) | 100 (95.2%) | |
| Foot | Yes | 0 (0.0%) | 19 (18.1%) | 1 (1.0%) | 20 (19.0%) | 0.539 |
| | No | 5 (4.8%) | 76 (72.4%) | 4 (3.8%) | 85 (81.0%) | |

Discussions

Occupational injuries among automotive workers encompass various types, including burns, fractures, and eye injuries. The majority of workers in this industry are male. Studies reveal that small company employees face higher risks of certain injuries (Berli et al., 2022; Driscoll et al., 2005). The results depicted in Figure 1 indicate that the majority of incidents result in minor injuries such as abrasions, cuts, or scrapes, which can be treated with first aid. The body parts most commonly affected by these incidents are the Upper Limb, including the hands, fingers, and lower back, while the lower extremities primarily involve the feet. Minor injuries in technician workshops are a significant concern, impacting both the health of workers and the operational efficiency of these facilities. The types of injuries commonly reported in repair workshops include superficial wounds, dislocations, sprains, and bone fractures, with small enterprises presenting a higher risk factor for these injuries (López-Arquillos & Rubio-Romero, 2016).

Research suggests a strong correlation between work activities performed by automotive technicians and the development of musculoskeletal disorders (MSDs). This study explores the prevalence of musculoskeletal disorders (MSDs) in motorcycle technicians, identifying the lower back (74.3%), upper back (50.5%), hand (39.0%), neck (34.3%), foot (19.0%), knee (16.2%), shoulders (12.4%), thigh (4.8%), and elbow (2.9%) as the most affected body regions. Based on this result, show the majority of MSDs result are on upper limb. Research by Hafez, (2022), revealed that technicians frequently adopt awkward postures during tasks, which they associate with pain in the lower back, shoulders, neck, hands, and knees. Monaco et al., (2019), identified similar areas of pain concentration, including the upper limbs, neck, hands, and shoulders. Additionally, Sirzai & Dundar, (2022), reported lower back disorders as the most common MSD diagnosis (66.5%), followed by neck and shoulder (58%) and upper limb (23%) issues. A study conducted by Zhang et al., (2023), revealed that 32.8% of workers were found to have MSDs, with the most affected areas being the lower back (17.1%), neck (16.3%), and shoulders (14.5%).

The current study aligns with existing research (Anita et al., 2014), by demonstrating a high prevalence of musculoskeletal disorders (MSDs) among workers (Figure 3). Notably, complaints of lower back pain emerged as the most frequently reported MSDs (Figure 3). This finding is further substantiated by a statistically significant association between lower back MSDs and the severity of reported incidents (Table 2: $p < 0.05$). Conversely, MSDs in other body regions lacked a significant correlation with incident severity. As highlighted in previous literature (Gane et al., 2018), MSDs are a recognized occupational health concern with detrimental impacts on both worker well-being and overall work capacity. Industrial settings, particularly those demanding tasks performed above shoulder level, elevate the risk of MSDs in the shoulder and neck regions due to increased muscular exertion in these positions (Hellig et al., 2021). Managing such injuries encompasses addressing both direct costs (e.g., lost workdays) and indirect costs (e.g., employee replacement, productivity decline). Therefore, mitigating the incidence and impact of MSDs necessitates a multifaceted approach. This includes implementing ergonomic training programs, delivering regular health education sessions, and establishing preventive measures tailored to address the specific risk factors associated with diverse occupational tasks and environments (Bao et al., 2020; Gane et al., 2018; Hellig et al., 2021).

Motorcycle technician face a high risk of upper limb injuries and pain. This is evident from both reported incidents and surveys of workers experiencing musculoskeletal disorders (MSDs). This aligns with studies showing a connection between upper limb problems and reduced strength, endurance, and overall ability to do the job (Fifolato et al., 2021). Upper limb issues can affect any part of the neck, shoulders, arms, wrists, hands, and fingers, impacting workers in many industries. Age and gender seem to play a role too, with some research suggesting these factors influence how often these disorders occur (Nichols et al., 2021; von Schroeder et al., 2020). There might be fewer reported claims of upper limb issues lately. This could be due to better workplace design (ergonomics) or changes in how injuries are reported (Fifolato et al., 2021; Tilley et al., 2023). However, these problems are still a major concern because they affect workers in many ways, both physically and mentally, and limit their ability to work effectively (Dabbagh et al., 2022; Haddar et al., 2022). The physical consequences can include pain, disability, and missed workdays, hurting not only the worker but also costing employers and healthcare systems a lot of money (Saeed-Banadaky et al., 2019). In conclusion, to address upper limb issues in motorcycle mechanics, it is needed a comprehensive approach that considers both the physical and mental effects, as well as how age and gender might influence risk. Effective strategies should focus on getting workers back to work safely and for the long term, using a combination of medical treatment and support for mental wellbeing.

Limitations and Future Research

A noteworthy limitation of this study pertains to the sample size. A relatively small sample pool can restrict the generalizability of the findings. Employing a larger and more diverse sample in future iterations would enhance the study's statistical power and allow for more conclusive results. Several avenues beckon for further investigation in this domain. Firstly, a compelling research thrust could center on elucidating the intricate link between upper limb injuries and both workplace incidents and the development of musculoskeletal disorders (MSDs). Additionally, research endeavors that delve into specific body parts exhibiting the highest MSDs prevalence rates hold promise in uncovering deeper insights into the mechanisms of injury and preventative strategies. Lastly, exploring the influence of demographic factors, such as age, gender, and pre-existing health conditions, on workplace safety presents an intriguing area of inquiry. Given that individual characteristics can significantly impact susceptibility to injuries and job-related disorders, incorporating this facet into future research designs could lead to a more holistic understanding of workplace safety and well-being, ultimately paving the way for the development of more targeted and effective interventions.

4. Conclusion

This study employed a descriptive design to investigate the relationship between workplace incidents, musculoskeletal disorders (MSDs), and motorcycle workshop technicians. The findings revealed demographic of the technician, with the majority being young adults (20-30 years old) possessing vocational high school diplomas. Marital status leaned towards married, and work experience ranged from 1 to 10 years. Notably, the study identified a trend of smoking among technicians, while alcohol consumption appeared uncommon. The analysis of workplace incidents and MSDs highlighted a prevalence of minor injuries, predominantly affecting the hands. Lower back

issues emerged as the most common MSD, exhibiting a significant association with reported incidents. Overall, the upper extremities were disproportionately impacted by both workplace incidents and MSDs.

These results underscore the critical importance of addressing workplace incidents and MSDs within motorcycle technician workshops. Implementing effective strategies to manage these issues holds the potential to improve worker well-being and potentially enhance workshop productivity. Future research endeavors should focus on strengthening the generalizability of these findings. Exploring the influence of work-related upper extremity disorders and demographic factors, such as age and pre-existing health conditions, on workplace safety, particularly incidents and MSDs, presents a compelling direction for further inquiry.

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