MUSCULOSKELETAL DISORDER ANALYSIS-ADVANCED IN MEDICAL TECHNOLOGY: SHORT REVIEW

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ABSTRACT: Musculoskeletal disorders (MSDs) affect people all over the world and are the second leading cause of disability in the workplace. There are many methods used to analyse MSDs to know the real situation and affected on the employees. The review is to compare in terms of design the findings, methodology, approach and identify the method, sample size, and what they have found from the previous researchers that have many advantages dan disadvantages of the method to come out the best suggestion of proper method to used and suggestion method to explore more for the future researchers. The following technique was used to find relevant literature. After scoping research into different types of MSDs analysis techniques, keywords were found by focusing on the method and approach. The study found that most of the methods in MSD more focus on the Questionnaire as the Method of data in analysis for MSD. However, it is more to after injuries of MSDs happened, but not focusing on a method to avoid the MSD from happed. Thus, involving EMG signal is the proper way to identify MSDs problem with considering the current trend and suggestion from rehabilitation as SOCSO. This paper provides the suggestion method strategies for the researcher of the future to go further in MSD to tackle the more interesting and important information for MSD in the future.

***KEYWORDS**: Musculoskeletal Disorders (MDSs), Method Analysis, Lower Back Pain*

(LBD), Upper Limb Disorders (ULDs), Lower Limb Disorders (LLDs)

1.0 INTRODUCTION

MSD is a worldwide occupational health issue that is now being debated. In Malaysia, there has been an upward tendency in recent years, especially in the manufacturing sector [1]. One of the most common causes of workplace accidents and disabilities in the healthcare field is musculoskeletal disorders (MSDs) and injuries. Construction is regarded as the most dangerous activity when opposed to other sectors [2].

As a result, in many high-income nations, it has become a well-known topic in safety research [3]. Manual handling, heavy lifting, repetitive work, and difficult jobs have all been identified and documented workplace risk, issues caused by rapid exertion or excessive exposure to physical factors [3][4]. Muscles, nerves, tendons, joints, cartilage, and supporting tissues of the upper and lower limbs, spine, and lower back will be affected by these issues [5].

Musculoskeletal disorders (MSDs) affect people all over the world and are the second leading cause of disability in the workplace. These disorders account for 40-50 percent of the total cost of all work-related illnesses [6][7]. Furthermore, 50% of all more than 3 days' absences from work and 49% of all more than two-week absences cause by MSDs. The quantity, speed, and amount of power exerted with each movement are all directly related to the risk disorder [6], [8]. Muscle performance is the key to know the muscle recovery and suggest the average effect for intensive nixed exercise for strength and endurance exercise and massage to more effective for the subjects [9].

Some medical technologies, such as equipment and analysis methods, have been used to understand or measure the situation of MSD among humans, whether they are employees or have a history of accidents [10],[11]. It is being referred to as any tissue damage to the musculoskeletal and nervous systems, which affect organ function [12]. This study aims to know in detail about the previous method used to analyse MSDs issues and what the method offered to know the performances of MSD for particular mentioned. Thus, from the

study of previous techniques of MSDs analysis, it will able to know more detail about the advantage and disadvantages of all the methods used by researchers before.

1.1 Types of MSDs

Low Back Pain (LBP)

Low back pain is a very common symptom and becomes the most common MSD is back pain [13]. It affects people of all ages, from children to the elderly, in high-income, middle-income, and low-income countries. Between 1990 and 2015, the number of years spent disabled by low back pain rose by 54% globally, potentially arise from population growth and aging, with the greatest increases occurring in low- and middle-income countries, such as Asia, Africa, and the Middle East. Low back pain is now the most common cause of disability in the globe [14], and in areas where adequate resources to address the problem are lacking, the consequences are likely to be more severe [15]. Figure 1 shows the position of lower back pain in the human body.

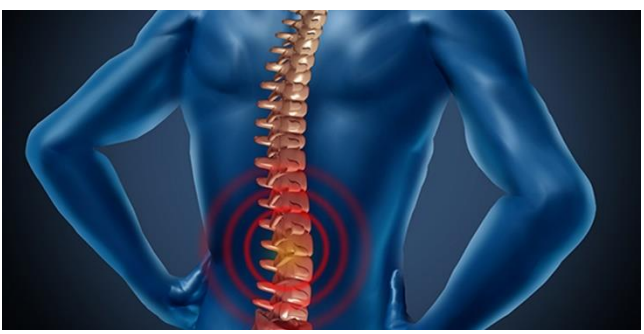

Figure 1: Lower Back Pain (LBP)

Upper Limb Disorders (ULDs)

Any injury or disease affecting the upper limbs, from the fingertips to the shoulder or spine, is classified as an upper limb disorder. Work-related musculoskeletal conditions are the most common occupational health problem in the UK, accounting for about 40% of sickness absences in the NHS. Work-related upper limb diseases (ULDs), which affect the hand, wrist, arm, shoulder, and neck, affect 700 people per 100,000 in the UK [16]. Because of the nature of anaesthetists' work, they are at an increased risk of bad posture,

which can contribute to the development of upper limb diseases. Figure 2 shows the position of upper limb disorders in the human body.

Figure 2: Upper Limb Disorder (ULDs)

Lower Limb Disorders (ULDs)

Injury and abnormalities of the lower limbs, ranging from the hip to the toes. Work-related musculoskeletal illnesses are a significant financial burden on society and one of the leading causes of lost productivity due to illness [17]. Work-related health problems have significant expenses for their employers, in addition to the apparent effects for the individual. Many researchers have looked into the prevalence of and risk factors for work-related upper limb, neck, and low back diseases [18]. However, when compared to other work-related musculoskeletal complaints in the upper body or low back pain, lower limb issues have received less attention. Lower limb disorder in the human body are shown in Figure 3 [19].

Figure 3: Lower Limb Disorders (LLD)

2.0 RESULTS AND DISCUSSION

2.1 Musculoskeletal Disorders (MSDs) analysis

Table 1: Types of method analysis of Musculoskeletal Disorders (MSD)

Authors	Objectives	Method	Sample Size	Results
[20]	MSD with depression as a mediator among school teachers to examine psychosocial aspects	Answer the Work Organization Assessment Questionnaire (WOAQ) Statistical Package for Social Science (SPSS)	367 respondents	80.1 % (95 percent confidence interval: 75.8–84.2 %), with 80.5 % of female teachers and 77.5 % of male instructors experiencing symptoms at that time
[11]	Improve the features of Health Screening Test System (HSTS) for MSD	development of HSTS evaluation Functional Range of Motion (FROM)	20	constructed for evaluating the plan, comparing it to the MTM standard, and providing criticism
[21]	Men and women veterans with TMD were compared in terms of MS, pain, and mental health comorbidities.	For cross-sectional analysis, chi-square tests, t tests, and logistic regression were used.	NA	Odds of TMD were higher in men of Hispanic ethnicity (OR¼1.38, 95% CI ¼ 1.27–1.48) and

[22]	During treadmill walking, electromyography (EMG) signals were obtained.	The significant level of EMG activity was determined using a paired sample t test.	105	The t-test was used to determine the significance level of EMG activity, and the results revealed significant differences between the right and left side packs.
[23]	identify the related factors of a taking healthy sitting posture in office workers	qualitative study aimed to use the theoretical domains framework (TDF)	25	Skills, knowledge, and behavioural regulation are among the TDF domains that have been mapped.
[24]	EMG signal categorization for a health screening job for musculoskeletal disorders	Functional Range of Motion (FROM)-time-frequency method- spectrogram -classification- k-Nearest Neighbor (k-NN), Linear Discriminant Analysis (LDA), Nave Bayes (NB), and Support Vector Machine are machine learning classifiers	5	LDA is the best classifier method for classify emg signal with features Mean Vrms (93.33%), standard deviation (80%)
[25]	Utilise the time-frequency spectrum obtained using generalised Warblet transform (GWT) for EMG fatigue analysis.	Time-frequency spectrum	20	In non-fatigue conditions, the IMNF, IMDF, and ISPEn increased by percentage, 34 %, and 36 %, respectively. In contrast, weariness is associated with a 22 % ISSkw.
[26]	cross-sectional - to determine musculoskeletal work related pain	Standardized Nordic Questionnaire (SNQ) Data so obtained was analysed using Statistical Package for Social Science (SPSS) Version-16 data analysis software	60	prevalence of musculoskeletal problems in the present study was found to be 68.3%
[27]	investigate the prevalence of musculoskeletal disorders (MSDs) in the general population.	Rapid Entire Body Assessment method	51	neck (47%), shoulder (51%), lower back (43%), and knee (47%)

[28]	suggest signal processing approaches for evaluating the temporal and spectral changes in characteristics of the surface myoelectric signal in different patient groups to investigate the electrical manifestations of neuromuscular disease using time-frequency	Continues Wavelet Transform (CWT) Mean absolute value, the energy, standard deviation as temporal parameters, total and mean power as frequency parameters	3- Normal, Myopathic and Neuropathic subjects	Neuropathy is the most severe pathology, accounting for 10% to 85% of cases, with an average of 47.5 %

Table 1 shows the topic method used to analyse musculoskeletal disorders. There are some of the methods used for method analysis MSD in the previous researchers, which are questionnaire, statistic analysis, qualitative analysis, and some of the articles is involving electromyography for time-frequency analysis and combining with classification method, and development of the technology to make it easier in interpretations.

From all results in the table, total and mean power are frequency parameters, while mean absolute value, energy, and standard deviation are temporal parameters [29] and Work Organization Assessment Questionnaire (WOAQ). The purpose of the questionnaire is to investigate how physical function is assessed in people with musculoskeletal disorders (MSD) [30]. This technique is common used by researchers because it can involve more respondents and easy to handle and analyse.

However, The Malaysian Social Security Organisation (SOCSO) has organised a Health Screening Programme (HSP) employing Functional Range of Motion (FROM), which has previously been performed in a rehabilitation clinic, to teach and diagnose patients using normal physical assessment procedures [31]. SOCSO existing functional testing is required the occupational therapist to do the subjective judgment in times of respondent to determine the capability of the patients [24]. The validation of results depends on the time consumed to fulfill the HSP tasks and compared to the standard time to determine the respondent's ability to perform functional reaching tasks (work capacity) [32], [33]. It is shown that to study MSD, the considering of EMG signal is become as one of important to be catered in MSD diagnosis.

Most of the methods in the results table do not accurately reflect the

muscle's condition. The reliability of the effort level determines whether the respondent is fit enough to continue working or not. In SOCSO, the decision is solely reliant on the instructor's decision, which has a significant disadvantage in that the instructor's opinion may be influenced by factors other than visual perception information [34]. Therefore, to solve all the issues, muscle performance is the key to know the muscle recovery and suggest the average effect for intensive nixed exercise for strength and endurance exercise and massage to more effective for the subjects [9].

Recent advancements in rehabilitation have revealed EMG pattern recognition as a promising approach with promise promising technique that has been crucial to use in clinical diagnosis [8]. Electromyography (EMG) signals are bioelectrical signals that are widely used as important tools in rehabilitation for providing information on neuromuscular activity from which it originates that will help to understand the human movements of activities [3], [35], [36]. There has been a lot of research done on MSDs that includes electromyography (EMG) in the activities [19], [37]. EMG is contained rich muscle information that would be used in clinical and rehabilitation applications [38]. The EMG is also used as a device for recording from the muscles' residual limb, and electrical signals have been studied in research to provide information on muscular movements during any human or animal activity [36], [37], [39]. Figure 4 shows the example of EMG signal for muscle inactive (contraction) and rest in baseline.

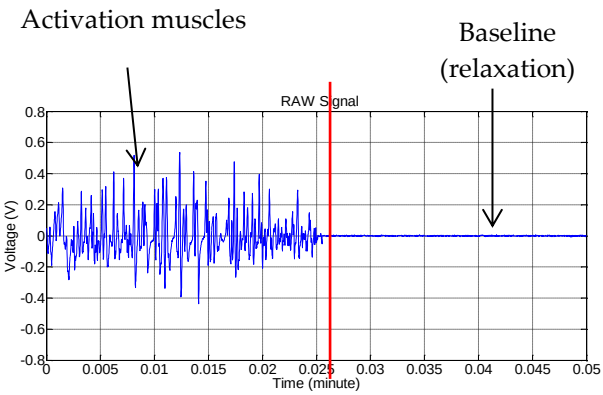

Figure 4: the example of EMG signal

The categorisation of surface electromyography (sEMG) signals is critical in man-machine interfaces for proper control of multiple-degree-of-freedom prosthetic devices. The most important components of this field's research are data gathering, pre-processing, feature extraction, and classification, as well as their practicality in terms of application and reliability [40]. Figure 5 shows the example of classification true and false. Based on this table, it is shown the classification of axial rotational reach is the best compared to kneeling reach and kneeling to standing reach health screening program (HSP) in SOCSO.

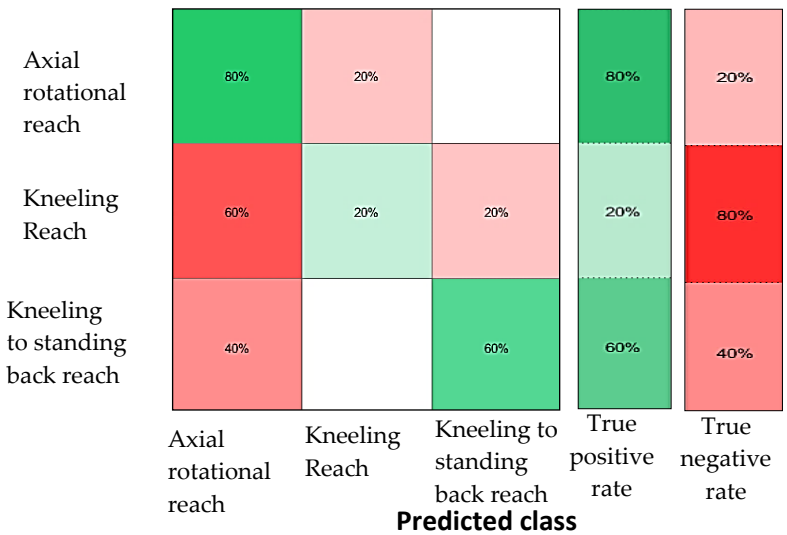

Figure 5: Positive predictive (PPV) and false discovery rate (FDR) for each type of tasks

The EMG classification task has been extensively researched, leading to the creation of a number of methods, including statistically generated mathematical models, discriminative learning models, and genetic algorithm-based strategies [40]. Linear Discriminant Analysis (LDA), Support Vector Machines (SVMs), and Hidden Markov Models (HMM) are three major methodologies for classifying sEMG signals for controlling upper limb prostheses, all of which show a slight improvement in classification accuracy [41]. The including of EMG in MSD is very interesting to explore more in the future analysis of MSD to gain more information, not visualisation but also from inside the body.

3.0 CONCLUSION

Based on the review, it can be confirmed some of the findings from the previous reviews have evaluated relationships between the objectives, method for MSDs analysis, the sample size for the questionnaire (quantitative) and experimental (qualitative) and results from the performance of each method analysis. There is a lack of evidence to perform detailed method analysis to get the results. Further investigations are required to examine more detail about the type of equipment and experiment use to know the performance of MSDs by considering Electromyography (EMG) with the assessment of the muscles inside of the body. The information of equipment and method in the literature can provide the extra understanding the overview of the concept of MSDs analysis and what the important thing is MSD to be considered. Thus, this review paper will be helpful for future investigation and become one of the references to find the method of analysis MSDs by considering on EMG signal. Besides that, this paper provides an overview of a current trend in analyzing of MSDs problem. It can provide more detailed information of the MSDs problem that would be helpful in the classification of the MSD from the muscles performances.

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