

ORIGINAL ARTICLE

A CASE STUDY: ASSESSMENT OF EQUIPMENT DESIGN, TASK AND RISK OF MUSCULOSKELETAL DISORDERS AMONG PHYSIOTHERAPIST

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ABSTRACT

Musculoskeletal disorders (MSDs) is one of the most common injuries to the physiotherapists at the treatment center. There are many factors leading to this problem, such as repeated movement, manual handling of heavy equipment, and inappropriate posture. Therefore, the aim of this paper is to identify the risk of MSDs among physiotherapist and investigate the specific treatment designs. This study used questionnaire method that has been distributed to patients and physiotherapist at one of the treatment center in Peninsular Malaysia. Rapid Entire Body Assessment (REBA) was performed also on the physiotherapist to evaluate the effectiveness of the equipment before and after improvements. There were three equipment that have been considered in this study; hydro collator pack, luminous and non-luminous infrared machine. Based on the questionnaire, majority of the physiotherapists were exposed to the risk of MSDs in their occupational task. The REBA's finding shows there is a decrement of the score after improvement have been made on the luminous machine. Based on paired sample tests on the REBA score before and after improvements, the *P value* (significance < 0.05). It proves that there is a big different in the REBA score after the tools was modified. In conclusion, this study was related to assessments and improvements that can be performed on treatment equipment and the tasks among physiotherapist.

Keywords: *Musculoskeletal Disorders (MSDs), Occupational Safety and Health, Rapid Entire Body Assessment (REBA), Treatment equipment.*

INTRODUCTION

Musculoskeletal Disorders (MSDs) will happen in the event of an injury to the person. This problem will affect the skeletal system and limits the movement of the human body. Shariat et al., (2018) agreed that muscle disorders are associated with a person's health-risk factors that have MSDs problem. Skeletal muscle disruption is an injury in the nervous system and soft tissues on the human body such as muscles, tendons, ligaments, joints and cartilage (Gillespie, Herbert, & Punnett, 2013). This usually happens because the workers perform their work by adapting incorrect posture and most of the tasks are manual work. In addition, task with long completion time also will provide a negative effect to the body (Ribeiro, Serranheira, & Loureiro, 2017).

MSDs are one of the most common injuries among physiotherapists in the treatment centre. To determine a person's tendency to gain MSDs at work is by obtaining information about their position and movement as they do their work (Vieira & Kumar, 2004). This problem occurs when minor injuries occur frequently and cause them to become serious. The duration of this problem can be serious, but can be short-term if the person does not have time to recover properly (Sukadarin, 2017). According to Anderson & Oakman (2016),

there are various factors that can cause them into the risks of MSDs which is repeated movement, handling heavy equipment and inappropriate posture while giving the service (Mirmohammadi, 2015). As therapists at the treatment centre, they also can have this kind of problem while providing the treatment to the patients. When MSDs is associated with an activity or task at work, it can be known as Work-Related Musculoskeletal skeletal muscle Disorders (WRMSDs) (Yasobant & Rajkumar, 2014).

Physiotherapist are mentally overloaded, involved with numerous task and are frequently disrupted. Working under physical abundance due to long working hours and patients demands leads to a risk of WRMSDs (Sukadarin et.al. 2016). WRMSDs also has links to problems in the area such as body aches, nausea, numbness and seizures (Auberlet et al., 2012). Recent evidence also suggests that therapists or nurse are at risk of WRMSDs in several parts of their bodies, including their arms, shoulders and back, spine hip and knees (Daraiseh et al., 2003). Most of the repeated motion affect the upper body such as the wrists, elbows and shoulders (Antwi-Afari et al., 2017) and yet other parts are also impressed with this repeat activity (Chander & Cavatorta 2017).

Worker's pain and injury can occur at work because of wrong postures. Chen et al. (2017) mentioned that many factors cause incorrect

working posture due to of facility layout, equipment designs and methods of works. However, the skills of the physiotherapists to adapt themselves to the problem are really needed (M&M et al., 2013). A variety of treatments have been designed to help treat patients with skeletal muscle (Baoge et al., 2012). The same is true of the situation at the selected treatment centre. The treatment centre has many facilities for treating patients (Pantartzis, Edum-Fotwe, & Price, 2017).

Besides, various treatment tools have been developed to help in treat skeletal muscle. The same is true of the situation at the selected treatment centre. The treatment centre has many facilities for treating patients. However, there are still drawbacks to some of these tools and they are still ergonomic. Many tools are not used properly due to not fit the patient. There are also tools that take a long time to prepare before treating the patient (Sheikhzadeh, Gore, Zuckerman, & Nordin, 2009). This tools are difficult to manage and apply by the physiotherapists to the patient. As a result of these disorders, the effectiveness of treatment for patients is seen to be less effective (Sreeraj, 2013). Every item or tool that available in the market should be user friendly and safe to use. This can cause musculoskeletal recovery process more complicated. Therefore, this study aims to focus on the tools that physiotherapists use in giving their service to treat the patients. This tool will improve its ergonomic status and all previous research data will be reused to obtain the best results.

METHODS

Interview, Observation and Questionnaire Survey

The observation and measurement were used to identify the Musculoskeletal Disorders (MSDs) faced by the physiotherapists. All the information from the treatment centre physiotherapists and observation considered in the questionnaire. Nevertheless, the potential factors for MSDs faced are also determined through previous research. The observation was done based on the how the activities involved during they giving their treatment service. The current tools used were observed in term of working posture, equipment placing and material handling. Through the use of a camera for more analysis all these concerns were recorded.

From all the information and the previous study, questionnaire was developed to get information which related to the selected equipment. Before the questionnaire was distributed to the respondents, each of the questions were review by the ergonomic's expert for improvements purpose. Then, the

experimenter distributed the questionnaire to the related respondents.

Two types of questionnaire developed according to the target respondents which patients and physiotherapist. Generally, this consists of five sections for patients: Part A- Personal Information; Part B- Type of treatment; Part C- Hydrocollator; Part D- Luminous infrared machine and Part E- Non-luminous infrared machine. Meanwhile, the modified Nordic Musculoskeletal Questionnaire (MNQ) (Kuorinka et al., 1987) for physiotherapy covers Part A- Background information; Part B- Working information, Part C-Physical risk and Part D- Physical symptoms. For Part C, there were four scales used in this part; never, sometimes, frequent and always. There were eleven factors of physical risks have been listed in the Part C; C1: an extraordinary body position, C2: in static body position, C3: incorrect grip, C4: Hands are incorrect position when doing the task, C5: extreme lifting loads, C6: push the load, C7: pulling, C8: repetitive work, C9: work fast, C10: stand while doing the task and C11: sit down while doing the task. In Part D, there were four physical symptoms according to the body part; D1: numbness and discomfort in the area, D2: trouble managing daily activities, D3: met with a specialist and D4: shoulder problems in the last 7 days.

Posture analysis using the REBA method was used in this study. REBA was chosen because of this technique involving all the bodies part (Nur Syazwani et al., 2016). This method is used when the physiotherapist operates the treatment device before and after the modified. The REBA technique will calculate the scores for the neck, waist, leg, lower and upper arm and wrists. The REBA also calculate about position and characteristics of the body when handling the treatment device. Scores from this REBA technique will be assessed according to the risk of the equipment.

RESULTS

Questionnaire

The questionnaire was distributed to physiotherapy who came to the treatment centre at Negeri Sembilan. This questionnaire also was distributed to the patients as well to identify the problem by them during the treatment.

Figure 1 shows the results of a questionnaire to patients about the equipment they are using in the treatment and compared with gender of the patient. There were ten patients were get involved in identifying their problem during the treatment. Results shows male patients (50%) using more treatment equipment. Among other examples are ultrasound, laser therapy and etc. Some of female patients (50%) receive

treatment by non-luminous infrared machines. In-depth analysis using Statistical Packages for the Social Sciences (SPSS) statistical software, pearson Chi-Square shows that there is no significant difference between the gender and treatment equipment with P (significance = 0.517), these two differences $X(2) = 1.39$ at $P > 0.05$

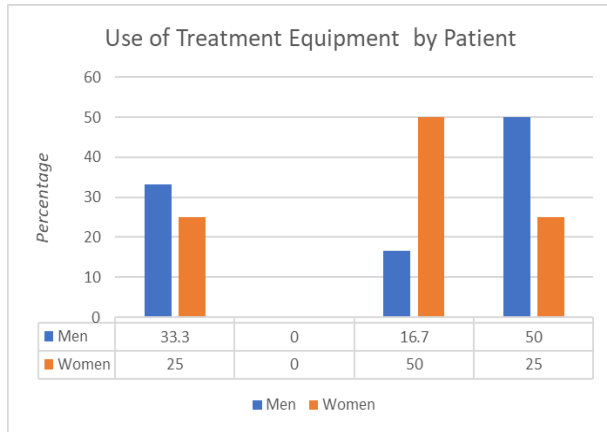


Figure 1 Percentage of patients using treatment equipment

Nordic Musculoskeletal Questionnaire (NMQ)

Nordic Musculoskeletal Questionnaire (NMQ) is used to collect data on MSDs. The questionnaire studies the MSDs according to body regions which are the neck, shoulders, elbows, wrists/hands, upper back, lower back, hips/thighs, knees, and ankles/feet. There were 33% of male and 67% women physiotherapy get involved in this study. Most of the physiotherapy with the age 21 to 27 years old have been in the field: 5 to 6 years, 60%; 3 to 4 years, 13.7% and 26.3% had experience for 1 to 2 years. Figure 2 illustrated the number of physiotherapy according to the age group.

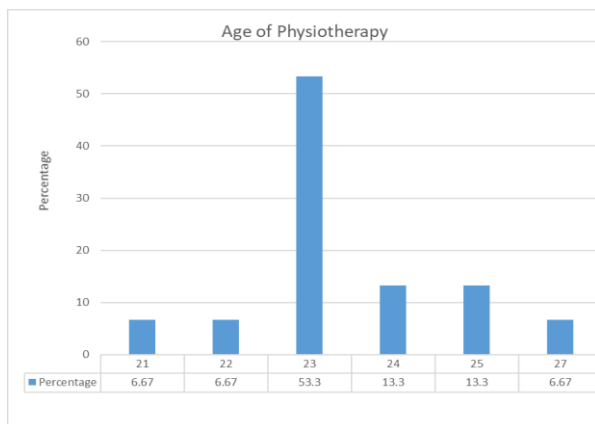


Figure 2 Age group of physiotherapy

The recent of health status of the physiotherapy were illustrated in Figure 3. All subjects did not regularly consume alcohol, cigarettes, or drugs and never have surgery in

the last 3 months. 40% of physiotherapists regularly do exercise and 80% of them have health problems. In addition, about 20% of physiotherapists have previous accidents.

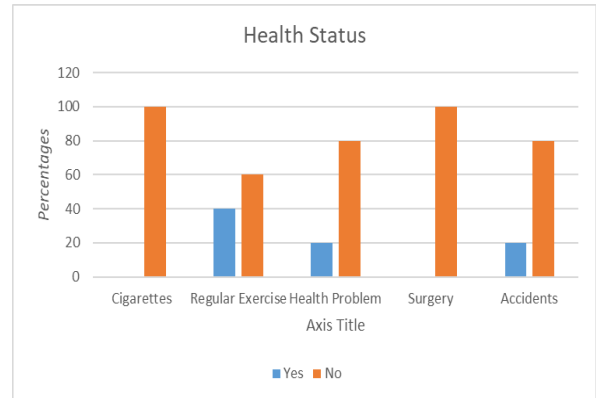


Figure 3 Health status

In term of working hours of the physiotherapy per week, about 30% of them are working for six and five and half days a week. Others work for 5 days as well as 2 days with 26.7% and 6.7% respectively.

Based on the observation, the main risk factors that effects the posture of the physiotherapy in their daily routine are human factors and design of the treatment equipment. The risks factors to unsafe working posture are determined accordingly through the questionnaire.

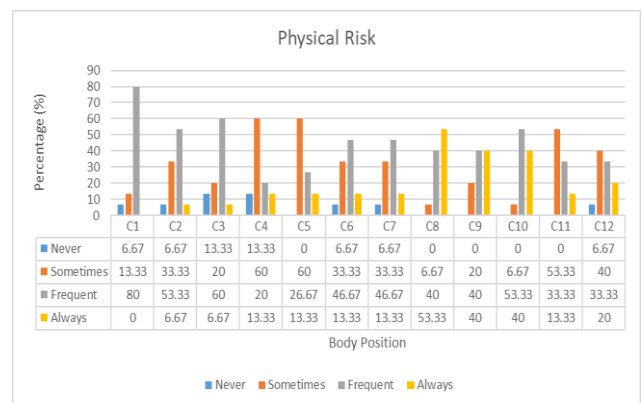


Figure 4 Physical risk

Figure 4 shows results of their physical risk. There were four frequent physical risks that scored more than 50%; extraordinary body position (C1) with 80%, and static body position (C2) with 53.3%, incorrect grip (C3) with 60% and stand while doing the task (C10) with 53.3%. Furthermore, about 53% of physiotherapists always do repetitive work (C8). These patterns are in line with the nature of health care worker's tasks as clarified in the past studies (Daraiseh et al. 2003; Mirmohammadi et al. 2015; Ribeiro et al. 2017;

Sheikhzadeh et al. 2009; Yasobant & Rajkumar 2014).

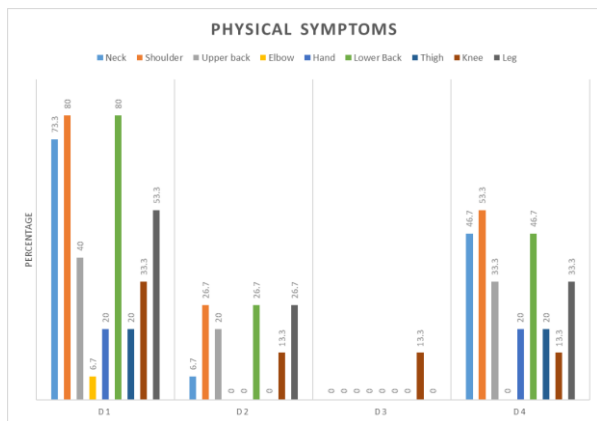


Figure 5 Physical symptoms

Figure 5 shows the physical symptoms that occurred to the subject. The top complaints of physical symptoms regarding numbness and discomfort in the body part (D1), about 80 percent of subjects have shoulder and lower back problems in the last 12 months, followed by neck (73.3). For D2, due to shoulder, lower back and leg problems, 26.7% of them had trouble managing daily activities. However, 13.3% of the subjects met with a specialist (D3) to treat a knee problem. This finding is in line with Menzel et al. (2004) that mentioned majority of the health care personnel experienced problem in knee due to handling patient and lifting load during their work. In addition, 53.3% had shoulder problems in the last 7 days (D4), followed by neck and lower back problem (46.7%).

Observation at treatment centre

The observation is used to identify the potential factors for physical posture experienced by the physiotherapy at the treatment centre. All input from treatment centre observation are considered through the type of equipment such as luminous infrared, non-luminous infrared machine and



hydrocollator pack.

Figure 6 The physiotherapists handling and performing treatment at the treatment centre

As shown in Figure 6, the physiotherapy doing the non-neutral working posture which they need to bend and lean forward their body in order to bring the equipment and performing the treatment to the patients. Physiotherapy need to move their hands during fold the hot pack on the towel, so their wrists will bend to the side. Besides, physiotherapists need to adjust the height of the device to suit the patient's position, so their wrists will rotate and bend to the side.

Questionnaire is used to identify the capabilities and limitations of the treatment equipment used by physiotherapist for patients. Meanwhile Rapid Entire Body Assessment (REBA) is used to obtain the score levels of the posture physiotherapists during handling and perform the treatments. Table 1 describes the posture of each section and the level of risk in the REBA method.

Table 1: Posture of each section and the level of risk in REBA method

Posture	Level 1	Level 2	Level 3	Level 4
Neck	0° - 20°	> 20°	-	-
	bend to the front	bending forward / backward		
Waist	0°	0° - 20°	20° - 60°	>60°
		(back / front)	(back / front)	
Leg	Both leg straight	One leg straight and the other slightly bent	Bend 30° - 60°	>60°
Upper arm	20°	20° - 45°	45° - 90°	>90°
	(back / front)	(back / front)	(back / front)	
Lower arm	-	Bend 60° - 100°	Bend <60° or >100°	-
Wrist	15° bend	>15° bend	-	-

REBA is an ergonomic assessment tool for assessing overall postural MSD. This assessment uses the systematic process to determine the risk to the work performed by the worker (Nur Syazwani et al. 2016). REBA is very suitable for calculating entire body segments including neck, trunk, legs, arms and wrists (McAtamney & Hignett, 2004)

REBA score	Risks level	Action needed
1	Safe	Not necessary
2 to 3	Low	Can be necessary
4 to 7	Medium	It is necessary
8 to 10	High	It is necessary to be done fast
11 to 15	Very high	It is urgent

Figure 7 Risk level of ergonomic injury based on REBA score

Figure 7 illustrated the REBA score that calculates the score of each movement performed by the perpetrator. Muscle and force scores have been added to the calculation, hence, this will form the final score for both groups. The scores will be expressed on a scale of 1 to 15 as from safe of risks level to very high of risk level.



Figure 8 Handling and treatment service using luminous infrared machine

As illustrated in Figure 8, the physiotherapist practice and handle the luminous infrared machine by non-neutral working posture and handle the equipment in order to perform the treatment. Moreover, they need to perform several times while giving the treatment. It is difficult for a physiotherapy to handle the equipment and giving the best along the treatment period.

By using REBA technique, researchers have done it on physiotherapists who operate luminous infrared machine tools. This REBA technique calculate scores for the entire body, including neck, waist, legs and hands. Table 2 shows the results of the REBA score. The REBA score for this tool before modification is 11. This result shows that handling this device is very high risk and needs to be changed immediately. All the data obtained allows the researcher to make improvement to the machine. After modification, the result of the assessment found that the REBA score for the modified tool was 4. It shows a slight improvement based on previous condition.

Table 2 Results of REBA for luminous infrared machine

Noted	Before	After
REBA	11	4
Result	High risk and need to be exchanged quickly	Medium risk and need further investigation

Figure 9 shows a luminous infrared machine before and after the change is made. Table 6 shows improvements that have been made to the luminous infrared machine. The innovation has been made for this machine is improve the base part of the machine by placing the wheel so that physiotherapists only need to push compare to lift the machine to the patient's place. On the body part of the machine, it also has been repaired and a guideline for physiotherapy has been prepared to adjust the height of the tool. Additionally, another proposed improvement is to create semi-auto wire storage systems such as systems used in measuring tape or vacuum cleaner.

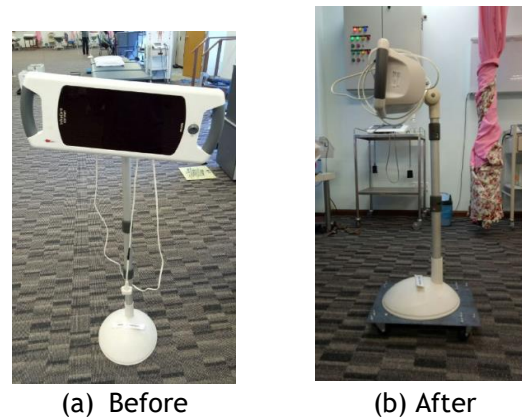


Figure 9 Luminous infrared machine before and after modified

Table 3: Improvement on luminous infrared machine

Part Changes	Improvement	Purpose
Base part	Placing the wheels	Easy for physiotherapy to move the machine
Body or trunk part	Repair and place a guidance how to adjust the height	Reduce time to adjust height of the machine
Wire	Make a semi-auto wire storage system	Reduce energy of physiotherapy to roll the wire

Since this research is about modification tools, pre and post should be done to identify the effectiveness of the tool. By using SPSS statistical software, paired sample tests have been performed on that tools as shown in Table 7. Based on the paired sample test, there is a significance difference between before and after modified the tools ($t(14) = -29.510$, $p=0.001$). There was a big change occurred after the changes were made to the tool.

CONCLUSION

From this study, it can be concluded that physiotherapy work is also less secure and have a risk with MSDs problem. This problem will occur if they do not consider the ergonomic concept while treating the patient. It includes handling the patient and equipment for treating the patient. Based on data from the modified Nordic Muscle Questionnaire and REBA technique conducted among physiotherapists, the potential for their illness is very high. Most of physiotherapists with MSDs disease are associated with their activities at work. Not only how they operate the machine but also the environment around their workplace. The data from the REBA investigation proved that the design of the tool was less ergonomic. This may be due to saving costs without thinking about the safety of its users. Furthermore, there are also a part of physiotherapists who are less skilled in handling the equipment. This will somehow affect treatment on patients and it is impossible for the worker to deal with MSDs. In addition, treatment equipment has been assessed for its effectiveness before and after improvements. Based on the findings, it proved that the modified equipment provide comfort to the physiotherapist when using it. Although not much to be changed for that machine due to the high cost and lack of equipment to improve the tool, it still provide significant effect on the physiotherapist routine. Suggestions for improvement have also been proposed to help the physiotherapists carry out their daily tasks. Therefore, to ensure that MSDs problem would diminishes among physiotherapists is by increasing the level of ergonomics in the treatment equipment. Perhaps it requires a high investment in developing such treatment tools, but MSDs can be avoided.

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COMPETING INTERESTS

There is no conflict of interest.

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