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Risk Analysis of Homecare Physiotherapist Work Posture in Stroke Patients with Arm Paralysis

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Abstract

This study will examine to the extent of the homecare-service physiotherapist workload applies the task. This workload can be both physical and mentally which the first could bring greater burden than the latter one. In this discussion, the physical workload will be very much influenced by how good work the methods used or work postures to avoid the risk of illness due to incorrect work methods. The methodology in this study was using observation on the first stage. An observation to the working methods of physiotherapist was done to measure and observe the work posture of physiotherapist. Processing on work position data using REBA was then processed by calculating REBA scores from the working position of the arm therapy. Based on the ergonomic analysis that has been done on work postures, the risk of musculoskletal fatigue can be concluded that the physiotherapist needs to be improved, especially at the level of effort and time requirements of the physiotherapist. Improvement of work posture is needed because the results of the calculation of REBA score show the current work posture has a level of risk.

Keywords: Physiotherapist, Homecare service, Work posture, REBA score, Arm Therapy

1. Introduction

In an effort to cure stroke suffers is need therapy and treatment to restore body function and quality of life of patients (Catherine Woodyard,2011). One type of therapy that needs to be done is motion therapy. This therapy is to restore the muscle strength of stroke patients and is performed on every part of the body affected by a stroke. In its application stroke therapy is carried out by patients with the help and supervision of doctors, nurses or physiotherapists'. However, post stroke rehabilitation therapy so far has been done manually by physiotherapist. The implementation of stroke therapy can be done with homecare services, and it's at the patient's home. This is to make it easier for patients to remember that stroke patients have limited mobility. Stroke therapy with homecare requires the physiotherapist to bring the equipment needed to carry out the therapy and carry out the therapeutic process even though with limited place situations. Physiotherapists in homecare services can treat several patients in one day in a row. This physiotherapist's work can have health impacts both in the short and long term (Niall McGrane, et.al, 2014, Gregory Minnis, 2017). Work done manually and repeatedly can cause fatigue both physically and psychologically (Michael R. Frone and Marie-Cecile O. Tidwell, 2015).

In this study work analysis will be carried out on the physiotherapist in homecare services for stroke patients with arm paralysis. Meanwhile, studies on physiotherapists' workload in the hospital or homecare service had attracted

few interests (Bonnie Lau, et.al, 2016, Renate AMM Kieft, et.al, 2014). This study will examine to the extent of the physiotherapist workload applies the task. This workload can be both physical and mentally which the first could bring greater burden than the latter one. As it is related to a service job could be interfered by fussiness or uncooperative manners between patients and the physiotherapist.

In this discussion, the physical workload will be very much influenced by how good work the methods used or work postures to avoid the risk of illness due to incorrect work methods. According to Pullat (B.Mustafa Pulat, 1992), the risk of illness due to wrong and repetitive work methods will cause Cumulative Trauma Disorder (CTD). At first CTD was studied by researchers in relation to the types of jobs that exist in the industry (Somnath Gangopadhyay,2003, Clifford S. Mitchell MS, MD, MPH, 1996). Recently, the problem is not only studied for jobs in industry but also in all types of work that is done repeatedly (EHS Insight Resources, 2019, Chris Adams, 2018). Mistakes usually occur due to insecurity and comfort in interacting between people and objects or subjects in working or taking action sphere. Investigations will be carried out on physiotherapy workers in delivering their work or service on rehabilitation in cases of arm paralysis due to stroke. It is hoped that this study will get a picture of how the physiotherapy workload in his work at homecare and good work posture in interacting with patients to avoid the risk of illness due to work.

2. Methodology

An observation to the working methods of physiotherapist was done at the beginning of this stage. It observed the implementation of therapy. In addition to visual observation, a brief interview with a physiotherapist was made. It was about the obstacles they experienced in conducting therapy. At this stage data were also collected on physiotherapists and patients who were willing to become research respondents. Observations made by measuring and observing the work posture of the physiotherapist. The observed work position is to focus on the work position on arm movement therapy.

Data analysis was based on physiological physiotherapist conducted using REBA (Mark Middlesworth, 2019). This study was conducted on two physiotherapist respondents. Both physiotherapists are physiotherapists serving homecare service. Both physiotherapists do not want their names to be disclosed. The both profile of the Physiotherapist can be seen in Table 1.

Table 1. Profile physiotherapists

Details	Physiotherapist 1	Physiotherapist 2
Alias	HW	AY
Sex	M	M
Age	42	45
Weight/Height	84 kg /178cm	75 kg /173cm
Numbers of patients	16	10
Numbers of therapy/day	4-5	3-4
Operational hr/day	3 hr/day	4 hr/day

Physiotherapists are male and are 42 and 45 years old respectively. The total number of patients in physiotherapist 1 was 16 people and 10 people for physiotherapist 2. All patients have different types and causes of stroke. They are in the range of 17 to 70 years old. In one day, physiotherapist 1 was able to do therapy for 4-5 patients, and physiotherapist 2 is 3-4 patients. Each patient takes therapy 3-4 times a week on average.

Therapy carried out by both physiotherapists was rehabilitation movement therapy for post stroke patients. Movement therapy was performed on the part of the body affected by a stroke. This therapy lasts 30-45 minutes to Adjustment the patient's needs. Movement therapy starts from the most distant limbs of the body such as the fingers and toes. According to interviews and observations, there are 2 types of motion therapy performed, namely

passive and active movement therapy (Evelyn C. Pearce, 2006). Each type of therapy has different goals, as follows:

Passive Motion Therapy

Passive motion therapy is a movement therapy which the patient's movements are fully supported by the physiotherapist. It can be said that the lifting force derived from the physiotherapist. In this type of therapy, the physiotherapist expends more energy to support the weight of the patient's limb. The purpose of this exercise is to reduce the risk and eliminate the patient's muscle stiffness caused by muscle's rarely usage. Muscles that are rarely used can cause muscle shortening and contractures.

Active Motion Therapy

Active motion therapy is a movement therapy in which the patient performs the movements themselves from the body members which are trained. It is different from the passive one where the force to move the patient's limbs is fully from the patient themselves. In this type of therapy, the physiotherapist only gives examples of movements to the patient in conducting therapy. The purpose of this therapy is to increase the muscle strength of the patient so that the muscles are expected to function normally and hold maximum resistance. In the implementation of active motion therapy could increase patient's muscle strength.

Procedure for Therapy Implementation

Before the implementation of the therapeutic movement, the body part to be trained is irradiated using infrared light. The process of warming up aims to relax the muscles and improve blood circulation in the part of the body to be trained (Figure 1). The duration of the warm-up time is 5 to 15 minutes. During the heating process, the physiotherapist provides a light massage to parts of the body. The supporting equipment of this process is a portable infrared lamp. Implementation of Passive Movement Therapy was done by stretching the fingers' muscles. It was derived from the fingers' muscle stiffnes of most of stroke patients. It was done on 2 sets processes in 8 reps. Furthermore, wrist was stretched with abduction and adduction in a same calculation as the previous but per repetition should be in a count of 2 seconds.
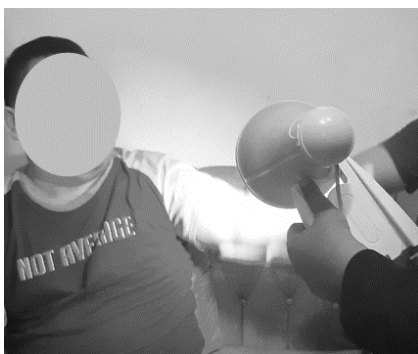

Figure 1. Infrared Heating Process

In the elbow, the flexion and extension movements are followed by the shoulder movements using the same counts. In the lower limbs, passive motion therapy starts from the ankle by doing dorsiflexion and plantarflection with 8 repetitions held for 2 seconds and the exercise is done in 2 sets of exercises and followed by flexion and extension movements of the foot with the same number of repetitions. Implementation of Active Movement therapy begins with giving the patient direction to stretch the palm of the hand and then unite each fingertip on both sides of the hand. Each movement in active motion therapy has the same number of repetitions as passive motion therapy. The flick of the wrist is next. Therapy on the elbows and shoulders is done the same as in passive motion therapy but in active motion therapy all movements are carried out independently by the patient and the physiotherapist only gives an example. In the legs, active motion therapy is done by walking exercises for patients accompanied by a physiotherapist.

3. REBA Analysis

REBA analysis is performed at the position of the physiotherapist when performing arm therapy movements. The analysis is carried out by measuring the angle on the part assessed in REBA. Angle measurements are made using a Geniometer. REBA analysis for the implementation of arm therapy for each physiotherapist is described as follows:

a. REBA Analysis for Physiotherapist 1

The position of the Physiotherapist 1 when performing arm therapy can be seen in Figure 2. The angular measurement data when the position of the Physiotherapist 1 arm can be seen in Table 2.

Figure 2. Physiotherapist 1's Posture on Arm Lifting Therapy

Table 2. Physiotherapist 1 Arm Position Data

Body Parts	Details	Adjustmentment
Neck	Forming 8° backward	-
Body	Straight (0°)	Circling
Leg	Balanced (Both feet are on the ground)	Forming 90°
Weight	Less than 5kg	
Upper Arms	Forming 62° upward	Shoulder is lifted
Lower Arms	Forming 46° to the upper arms	
Arms Position	Forming 30°	Bending
Holds	Acceptable	
Activity	16 repetitions in 1 min	

A score was determined for each part of the body based on observation. REBA assessment based on observations can be seen in Table 2. When doing therapy, the physiotherapist's neck position tends to lean backward to form an angle of 8 ° so as to get a score of +2. Physiotherapist's body position is not bent (has an angle of 0 °) ie score +1, plus rotating with a score +1. The total score on body position becomes +2. The foot is balanced with both feet perfectly tread has a score of +1, and sitting position with an angle of 90 ° so that the foot score +2. Total foot score +3. The neck, leg, and body scores were then processed with table A. The position A score on the arm therapy position was 5 (Figure 3.). A score is the sum of position A score plus the load score. Physiotherapist's weight is the patient's arm that weighs less than 5 kg so that the load score is 0 and the A score is 5.

Figure 3 . Physiotherapist 1 Table A Score Position

Part B was evaluated after the part A. Part B consists of the upper arm, forearm and hand. Position of the upper arm is at an angle of 62 ° and shoulders raised with a score of +3. Forearm position has an angle of 46 ° with a score of +1. The position of the hand has an angle of 30 ° and is bent so the hand's position score is +3. The position score of B is 5 which can be seen in Figure 4. B score is the sum of the position B with the handle score. The position of the handle can be accepted has score of 0, so the score B is 5.

Figure 4. Physiotherapist 1 Table B Score Position

Score A and score B are then processed with Table C score which produces a score of 6. The details can be seen in Figure 5.

Figure 5. Physiotherapist 1 Table C Scores

To get a REBA score, a C score is added with an activity score. Arm therapy activities carried out in 2 sets of movements. Each set consists of 8 repetition of movements. 2 sets of movements can be done in 1 minute so that the activity score becomes +1. The REBA score for the arm therapy position is 7.

Table 3. REBA Score on Physiotherapist 1 Arms Therapy

Body Part Position	Details	Adjustment	Score
Neck	Forming 8° backwards	-	2
Body	straight (0°)	Circling	2
Leg	Sit in balance	Forming 90°	3
Position A Score			5
Weight	Less than 5kg		0
Score A			5

Upper arms	Forming 62° upward	Lifted shoulder	4
Lower arms	Forming 46° towards upper arms		1
Hand	Forming 30°	bending	3
Position B Score			5
Holding	Acceptable		0
Score B			5
Score C			6
Activities	16 repetitions in 1 minute		1
REBA Score			**7**

Based on the provisions of the REBA score, the position of stroke arm therapy in Physiotherapist 1 has a moderate risk and immediate changes in work position are needed.

b. REBA Analysis for Physiotherapist 2

Physiotherapist 2 did not agree to do the documentation in the form of photographs, so the REBA analysis data on Physiotherapist 2 was elaborated using the Table which can be seen in Table 4.

Table 4. Data on Physiotherapist Position on Arm Therapy

Body Part Position	Details	Adjustment
Neck	Forming 0° (straight)	-
Body	Forming 24° ke depan	
Leg	Kneel down	Forming >90°
Weight	Less than 5kg	
Upper arms	Forming 48° upward	-
Lower arms	Forming 83° towards upper arms	
Hand	Forming 0° (straight)	

Based on observations made, then a score is determined for each part of the body. REBA assessment based on observations on Physiotherapist 2 can be seen in Table 4.

Physiotherapist neck 2 position was straight with an angle of 0 during the therapy service which scored +1. Physiotherapist body position bent to form an angle of 24 ° forward. That was score +3. The foot is not balanced and score +2. His sitting position formed an angle of more than 90 ° so the foot score is +2. Total foot score +4. The neck, leg, and body scores were then processed with table A. The position A score in the physiotherapist's arm therapy position 2 is 6 (Figure 6.). A score is the sum of position A score plus the load score. Physiotherapist's weight is the patient's arm that weighs less than 5 kg so that the load score is 0 and the A score becomes 6.

Figure 6. Score Posisi Table A Fisioterapis 2

Part B consists of the upper arm, forearm and hand. The position of the upper arm has an angle of 48 ° and above with a score of +3. The position of the forearm has an angle of 83 ° with a score of +2. Straight hand positions form an angle of 0 ° so that the score of the position of the hand is +1. The position score of B in physiotherapist

2 is 4 which can be seen in Figure 7. B score is the sum of the position B score with the handle score. The position of the handle can be accepted that has a score of 0, so the score B is 5.

Figure 7. Score Posisi Table B Fisioterapis 2

Score A and score B in physiotherapist 2 are then processed with Table C score which produces a score of 6. It can be seen in Figure 8.

Figure 8. Score Table C Fisioterapis 2

To get a REBA score need the C score to add with an activity score. Arm therapy activities carried out in 2 sets of movements. Each set consists of 8 repetition of movements. 2 sets of movements can be done in 1 minute so that the activity score becomes +1. The REBA score from the arm therapy position is 8.

Table 5. REBA Scoring on Physiotherapist 2 Arm Therapy

Body Part Position	Details	Adjustment	Score
Neck	Forming 0° (straight)	-	1
Body	Forming 24° ke depan		3
Leg	Kneel down	Forming >90°	4
Position A Score		Position A Score	6
Weight	Less than 5kg		0
Score A		Score A	6
Upper arms	Forming 48° upward	-	3
Lower arms	Forming 83° towards upper arms		2
Hand	Forming 0° (straight)		1

Position B Score		Position B Score	4
Holding	Acceptable		0
Score B		Score B	4
Score C		Score C	7
Activities	16 repetitions in 1 minute		1
REBA Score		REBA Score	8

Based on the REBA score, the position of stroke arm therapy in Physiotherapist 2 has a high risk and changes must be applied in work position.

4. **Discussion**

Based on the ergonomic analysis that has been done on work postures, the risk of musculoskletal fatigue and the workload of the physiotherapist can be concluded that the physiotherapist and mental workload needs to be improved, especially at the level of effort and time requirements of the physiotherapist. Improvement of work posture is needed because the results of the calculation of REBA score show the current work posture has a level of risk. Work improvement also needs to be done based on the mental workload scores which is considerably high level of workload.

It is hoped that improving the work system can reduce the risk of musculoskletal fatigue and mental workload of the physiotherapist. Improvements are made by analyzing the causes of the problems that occur at the first place. Cause and effect analysis is done using fishbone diagrams. The results of mental workload analysis show the type of workload that causes the high mental workload on physiotherapist. It is the level of effort. Proposed improvements are based on the cause of the problems found in the analysis with the fishbone diagram. Proposed improvements can be seen in Table 6.

Table 6. Improvement Ideas Based on Cause - Problems Analysis

Cause-Problems	Improvement Ideas
Improper place for therapy	Establishing standard operational procedures
No standardization on therapy position	
Wrong working posture	
Supporting tools specification does not match with the needs	Designing supporting tools that meets the needs
Immobilized supporting tools	
No fixed schedule from patients	Arranging therapy schedule
Patients numbers	

Proposed Improvement in Establishing Work Posture Standards

Proposed improvement of work posture is given by simulating several work posture alternatives that can be used and also calculating REBA score on each alternative proposal. The proposed improvement to be used is an alternative proposed improvement with the lowest REBA score. Alternative proposals that can be made are arranged with an alternative generation table which can be seen in Table 7.

Table 7. Working Posture Alternatives

Details		Patients	
		Sitting (1)	Laying (2)
Physiotherapist	Sitting (A)	A1	A2

	Standing (B)	B1	B2

The alternatives obtained are up to 4 alternatives, including:
a. Alternative 1 (A1): Sitting physiotherapist - patient sitting
b. Alternative 2 (A2): Sitting physiotherapist - supine patient
c. Alternative 3 (B1): Standing physiotherapist - patient sitting
d. Alternative 4 (B2): Standing physiotherapist - supine patient

a. REBA Proposed Alternative Improvement 1

In this alternative the position of the Physiotherapist is to sit upright on the side of the patient's body and face the patient. The patient's position is sitting straight. Simulation of work posture with alternative 1 can be seen in Figure 9.
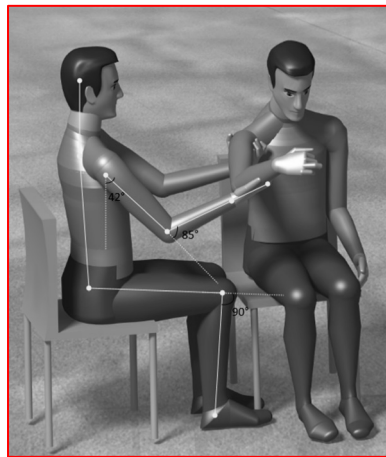

Figure 9. Proposed Work Posture on Alternative 1

Based on the proposed working posture alternative 1 will count the REBA score which can be seen on Table 8.

Table 8. Calculations of REBA Score on Alternative 1

Body Part Position	Details	Adjustment	Score
Neck	Forming 0° (straight)	-	1
Body	Forming 0° (straight)		1
Leg	Sit in balance	Forming 90°	3
Position A Score			3
Weight	Less than 5kg		0
Score A			3
Upper arms	Forming 42° upward	-	2
Lower arms	Forming 85° towards upper arms		1
Hand	Forming 0° (straight)		1
Position B Score			1
Holding	Acceptable		0
Score B			1
Score C			2
Activities	16 repetitions in 1 minute		1
REBA Score			3

REBA score calculation results in alternative work posture 1 is 3 with a low level of risk.

b. REBA Proposed Alternative Improvement 2

In this alternative the position of the physiotherapist is standing on the side of the patient's body and face the patient. The patient's position is laying down. Simulation of work posture with alternative 2 can be seen in Figure 10.
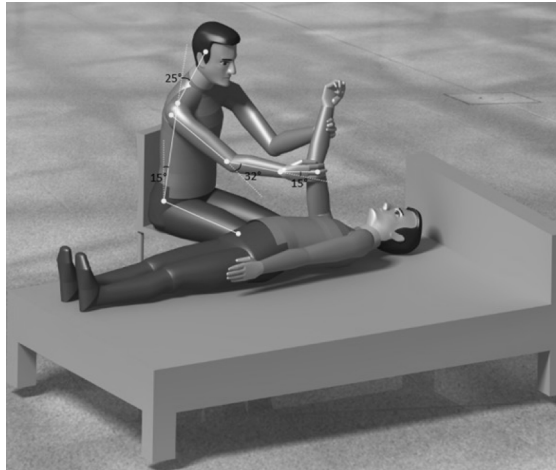

Figure 10. Proposed Work Posture on Alternative 2

The REBA score is calculated based on the work posture on simulation of alternative 2 which can be seen in Table 9.

Table 9. Calculations of REBA Score on Alternative 2

Body Part Position	Details	Adjustment	Score
Neck	Forming 25° (look down)	-	2
Body	Forming 15° (look down)		2
Leg	Sit in balance	Forming 90°	3
Position A Score			5
Weight	Less than 5kg		0
Score A			5
Upper arms	Forming 70° upward		3
Lower arms	Forming 32° towards upper arms		2
Hand	Forming 15° (bending)		1
Position B Score			4
Holding	Acceptable		0
Score B			4
Score C			5
Activities	16 repetitions in 1 minute		1
REBA Score			6

REBA score calculation results in alternative work posture 2 is 6 with a moderate level of risk.

c. REBA Proposed Alternative Improvement 3

In this alternative, the position of the physiotherapist is to stand on the side of the patient's body and face the patient. The patient's position is sitting up straight. Simulation of work posture with alternative 3 can be seen in Figure 11.
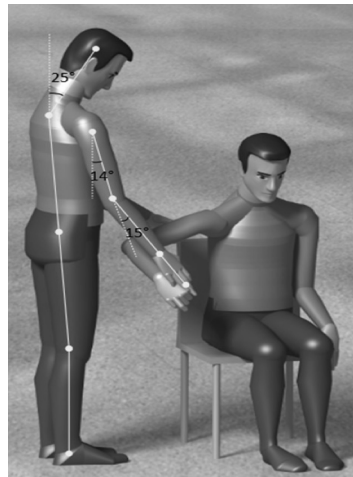
Figure 11. Proposed Working Posture on Alternative 3

The REBA score is calculated based on the work posture simulation of alternative 3 which can be seen in Table 10.

Table 10. REBA Score Calculations on Alternative 3

Body Part Position	Details	Adjustment	Score	
Neck	Forming 25° (look down)	-	2	
Body	Forming 0° (straight)	Tilting	2	
Leg	Steadily standing up		1	
Position A Score				3
Weight	Less than 5kg		0	
Score A				3
Upper arms	Forming 14° upward	-	1	
Lower arms	Forming 15° towards upper arms		2	
Hand	Forming 0° (straight)		1	
Position B Score				1
Holding	Acceptable		0	
Score B				1
Score C				2
Activities	16 repetitions in 1 minute		1	
REBA Score			3	

The results of the calculation of REBA score on alternative work posture 3 are 3 with a low risk level.

e. REBA Proposed Alternative Improvement 4

The position of the physiotherapist is to stand on the side of the patient's body and face the patient. The patient's position is supine. Simulation of work posture with alternative 4 can be seen in Figure 12.
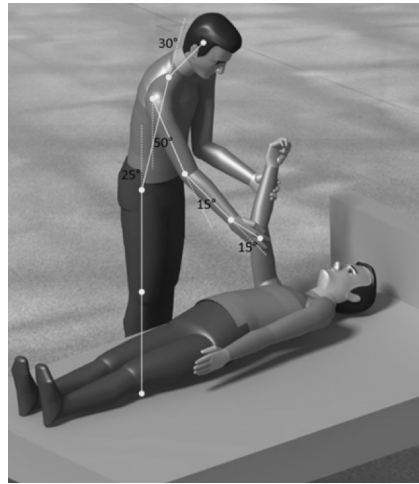
Figure 12. Proposed Working Posture Alternative 4

Based on the work posture simulation of alternative 4, the REBA score calculation is performed which can be seen in Table 11.

Table 11. REBA Score Calculation on Alternative 4

Body Part Position	Details	Adjustment	Score
Neck	Forming 30° (look down)	-	2
Body	Forming 25° (look down)	Tilting	3
Leg	Balanced		1
Position A Score			4
Weight	Less than 5kg		0
Score A			4
Upper arms	Forming 50° upward		3
Lower arms	Forming 15° towards upper arms		2
Hand	Forming 15° (bending)		2
Position B Score			5
Holding	Acceptable		0
Score B			5
Score C			5
Activities	Repetition 16 times in 1 minute		1
REBA Score			6

REBA score calculation results in alternative work posture 4 is 6 with a moderate level of risk. A summary of REBA scores obtained from 4 alternative work posture proposals can be seen in Table 12.

Table 12. Summary of REBA Scores on Alternatives Improvement Proposal

Alternatif	Score REBA
1	3

2	6
3	3
4	6

Alternative work postures that have low scores are found in Alternatives 1 and 3. They are the position of therapy with the patient sitting in a chair, with a REBA score of 3 and a low level of risk. This shows that based on simulations and recalculation of REBA scores, managing work positions in such a way can improve the physiotherapist's work posture and reduce the risk of musculoskletal disorder. Proposed improvements obtained through REBA analysis include:

i. The physiotherapist arranges the work position before taking therapeutic action by preparing chairs for the patient
ii. The position of the patient during the implementation of therapy is sitting in a chair
iii. The position of the Physiotherapist when performing therapy is on the side of the arm to be treated and facing straight to the patient

Acknowledgment

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