Faculty of Mechanical and Manufacturing Engineering Technology

A STUDY ON PATIENT BED FOR ERGONOMIC DESIGN

Azlini binti Ghazali

Bachelor of Manufacturing Engineering Technology (Product Design) with Honours

2018

A STUDY ON PATIENT BED FOR ERGONOMIC DESIGN

AZLINI BINTI GHAZALI

A thesis submitted
in fulfilment of the requirement for the Bachelor's Degree of Manufacturing
Engineering Technology (Product Design) with honours

Faculty of Mechanical and Manufacturing Engineering Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2018

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk**: A Study on Patient Bed for Ergonomic Design**

Sesi Pengajian: 2018

Saya **AZLINI BINTI GHAZALI** mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (X)

☐ SULIT* Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia sebagaimana yang termaktub dalam AKTA RAHSIA RASMI 1972.

☐ TERHAD* Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan.

☒ TIDAK TERHAD

Yang benar,   Disahkan oleh penyelia:

....

AZLINI BINTI GHAZALI   PROF MADYA TS DR WAN HASRULNIZZAM BIN WAN MAHMOOD

Alamat Tetap: Cop Rasmi Penyelia
KG KELISAR BATU GAJAH 17510
TANAH MERAH KELANTAN

Tarikh: Tarikh:

*Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declared this report entitled "A Study on Patient Bed for Ergonomic Design" is the results of my own research except as cited in references.

Signature: …………………………………

Author : AZLINI BINTI GHAZALI

Date:

APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Product Design) with Honours. The member of the supervisory is as follow:

Signature: ………………………………………….

Supervisor: PROF MADYA TS DR WAN HASRULNIZZAM BIN WAN MAHMOOD

DEDICATION

I dedicate my dissertation work to my family and all my friends, a special feeling of gratitude to my loving parent, Ghazali bin Ali and Azizah binti Hamid who always gives encouragements and positive vibes whenever I am needing it the most. Also, not to be forgotten, much love for my siblings who kept me going with their own success in their respective studies and work. And also big thanks to all my friends for their non-stop support and contribution in many ways for this research. Praying the best of luck for all of you in everything you will go through later in life.

ABSTRACT

In this research, information's, journals and article regarding to manual patient handling have been searched for the better understanding and acknowledge. Patient bed is one of the most important facilities in hospital for many benefits as well as for transferring patient and bed rest for the patient. However, an improper design and parameter of the patient affected the healthcare of nursing workers. Musculoskeletal disorder (MSD) represent in of the most frequently occurring and costly occupational issue in nursing. The main goal for this research is to determine the specific parameter for the patient bed in ergonomic design in order to reduce the risk factor that contribute the nursing staff to musculoskeletal disorder. Observation have been conducted on 20 nursing staff from local hospital with the underweight of Body Mass Index. The patient bed also being measured to ensure the parameter of height is fit to all workers. The loads during performing the task must exceed 50kg and above. This study also limited to workers that age 23 years old and above and experienced doing the task for 2 years and above. Moreover, the variation of body posture observed from respondent while during the task were characterized and analyses by using CATIA V5 software. Based on the anthropometric measurement data collected from the respondent, a lifelike manikin was inserted and edited in order to get the exact posture. In this project, three finalized postures of the respondent were taken and analyses by using Rapid Upper Limb Assessment (RULA) and method in CATIA V5. Throughout the RULA scores, the ideal posture of push and pull patient bed was proposed to minimize the risk factor from suffer Musculoskeletal Disorder (MSD). The output of this research would referred by the industrial design of patient bed in order to prevent the MSD among workers.

ABSTRAK

Dalam penyelidikan ini, maklumat, jurnal dan artikel berkaitan dengan pengendalian pesakit manual telah dicari untuk pemahaman dan pengakuan yang lebih baik. Katil pesakit adalah salah satu kemudahan yang paling penting di hospital untuk pelbagai faedah serta untuk memindahkan pesakit dan rehat tidur untuk pesakit. Walau bagaimanapun, reka bentuk dan parameter yang tidak wajar pesakit itu menjejaskan penjagaan kesihatan pekerja kejururawatan. Musculoskeletal disorder (MSD) mewakili isu pekerjaan paling kerap berlaku dan mahal dalam bidang kejururawatan. Matlamat utama untuk kajian ini adalah untuk menentukan parameter khusus untuk katil pesakit dalam reka bentuk ergonomik untuk mengurangkan faktor risiko yang menyumbang kepada kakitangan kejururawatan untuk gangguan musculoskeletal. Pemerhatian telah dijalankan ke atas 20 kakitangan kejururawatan dari hospital tempatan dengan kekurangan berat badan Indeks Massa Tubuh. Katil pesakit juga diukur untuk memastikan parameter ketinggian adalah sesuai untuk semua pekerja. Beban semasa menjalankan tugas mesti melebihi 50kg dan ke atas. Kajian ini juga terhad kepada pekerja yang berusia 23 tahun ke atas dan berpengalaman melakukan tugas selama 2 tahun ke atas. Selain itu, variasi postur badan diperhatikan dari responden manakala semasa tugas dicirikan dan dianalisis dengan menggunakan perisian CATIA V5. Berdasarkan data pengukuran antropometrik yang dikumpulkan dari responden, manikin seperti hidup disisipkan dan disunting untuk mendapatkan postur yang tepat. Dalam projek ini, tiga perkara yang telah dimuktamadkan oleh responden diambil dan dianalisis dengan menggunakan kaedah Rapid Upper Limb Rapid (RULA) dan kaedah di CATIA V5. Sepanjang skor RULA, postur yang ideal untuk menolak dan tarik katil pesakit dicadangkan untuk meminimumkan faktor risiko daripada menderita Musculoskeletal Disorder (MSD). Hasil penyelidikan boleh dirujuk oleh reka bentuk industri katil pesakit untuk mengelakkan MSD di kalangan pekerja.

ii

ACKNOWLEDGEMENTS

I would like to thank my supervisor, Prof Madya Ts Dr Wan Hasrulnizzam bin Wan Mahmood for believing me to take this opportunity and finish it successfully. I feel so appreciated with the support, technical skills, and willingness of sharing the valuable knowledge to me.

Not to be forgotten, I also like to thank the lab assistants that have given full cooperation and also important information which related to my studies. To my beloved parent Ghazali bin Ali and Azizah binti Hamid, I would like to express my very profound gratitude for the unfailing support and continuous encouragement throughout my years of study. Last but not least, I would like to thank all my friends that always with me and helped me directly or indirectly.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

CAM   Computer-Aided Manufacturing

CAD   Computer-Aided Design

CATIA   Computer-aided three-dimensional interactive application

LBP   Lower Back Pain

MSD   Musculoskeletal Disorder

REBA   Rapid Entire Body Assessment

RULA   Rapid Upper Limb Assessment

UTeM   Universiti Teknikal Malaysia Melaka

CHAPTER 1

INTRODUCTION

1.1   Project Background

Manual patient handling is known to be the major source of musculoskeletal load among hospital nurses. Transferring patients during care activities is a common task for nurses. Pushing and pulling hospital beds is a form of manual material handling that has been linked with a high risk for the development of musculoskeletal disorders. (Paul and Quintero-Duran, 2015) The case of hospital beds are not an exception with beds designed for patients and individuals who give priority to some form of health care (Choobineh *et al.*, 2004). Previous studies have identified nine patient handling tasks that place nursing staff at high risk for musculoskeletal injuries. The researchers evaluated back and shoulder muscle activity, forces on the lumbar spine, shoulder joint moments, and perceived comfort. (Nelson *et al.*, 2003)

Work-related musculoskeletal disorders (MSDs) are a genuine issue among hospital work force, and in particular the nursing staff. Of essential concern are back injuries and shoulder strains, which can both, be severely debilitating. The nursing career has been shown to be one of the most at risk occupation for low back pain (European Agency for Safety and Health at Work, 2003). The essential cause for MSDs is patient handling tasks such as lifting, transferring, and repositioning of patients. New patient handling technology and work practices control can be used to redesigned the nursing task in order to improve caregiver and patient safety. Nursing workers with patient handling tasks have a higher prevalence of body part problems. Victimization inappropriate and physically strenuous

1

ways once handling patients combined with low awareness regarding the employment of aid devises leads to inflated occupational injuries during preforming the task. (Abedini, Choobineh and Hasanzadeh, 2015).

Most early studies as well as focus on the healthcare workers which is particularly, face work environments that present high exposure to MSD risks. In order to protecting the nursing staff, manager of department should reap financial benefits from the implementation of ergonomic rules, with any progressive implementation costs outweighed by net savings. Absence of workers due to injuries, as well as workers compensation costs, should decline with improved ergonomic conditions in the workplace. (Springer, 2007). Ergonomics seeks ways to make the job fit the person, rather than the other way around. That means it is, a very individualized approach to designing tools, tasks and work areas.

The methods used in this project would be based on Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). Nowadays, one of the most popular ergonomic evaluation tools in an industry is REBA and RULA. A method for ergonomic assessment of advanced manual work was developed, based on working operator evaluation of video recordings and observation (S.Jadhav and Sawant, 2014). Due to the identification of either workers are working off their own boundaries, these two analyses were run and the data being collected. Analyses by using REBA was proved that some of workers were under lower levels and most of them at high risk. For RULA analyses, level of risks for the majority of workers are high. For the simulation of work posture, CATIA have provide variety of efficient analysis tools which can analyses all the data effectively.

1.2 Problem Statement

Patient bed is one of the most important facilities in hospital for many benefits as well as for transferring patient and bed rest for the patient. However, an improper design and parameter of the patient affected the healthcare of nursing workers. Musculoskeletal disorder (MSD) represent in of the most frequently occurring and costly occupational issue in nursing. This has been explored in prior study by Sciences, Studies, Hom, & Kong, (2001), out of 377 nurses interviewed, 153 (40.6%) reported having low back pain within 12 months of doing frequently manual repositioning of patient on the bed, transferring patient and required to assist patient while walking.

Critical care nurses known "road trips" as one of the foremost demanding tasks performed. These trips include pushing an occupied bed or stretcher off the unit for demonstrative testing, surgery or other procedure. (Waters, Nelson and Proctor, 2007). Along with the weight of patient and bed stretcher, these tasks are also compounded by adding the weight of medical devices. While performing these tasks, nurses been expected to monitor the patient and manually ventilating the patient during pushing or walking. Lifting occupied bed over small barrier such as door or elevator threshold is one of the problems that occurs during transporting patient. More generally, working on these tasks as a daily work affected the workers on many risk factors such as awkward posture, discomfort and low back pain

3

1.3 Project Objectives

This research has been develops based on several objectives:

i.   To identify the risk factor that contribute to musculoskeletal disorder (MSD) by the nursing staff while performing the handling task.

ii.   To analyse the assessment using subjective method (REBA and RULA scorecard) and direct measurement method (Anthropometry measurement) for the workers while transferring patient.

iii.   To validate the proposed idea on the best posture and the specific parameter for the patient bed in ergonomic design and that appropriate all nursing staff.

1.4   Project Scope

       This study is focus on the nursing staff that frequently perform the manual patient handling task. One of the major scopes to be investigated this research is the workers that been observed need to carry at least 50kg load during transferring the patient. This study also limited to workers that age 23 years old and above and experienced doing the task for 2 years and above. Ergonomic risk factor that contribute to musculoskeletal disorder (MSD) also the main focus that been analyse in this research. In order to get more information about the discomfort of the workers, a survey conducted based on the limitation of scope above and the data collection of recorded postural respondent would be examined as result at the end of this project. Figure 1.1 below indicate the ergonomic risk factor leads to MSD by pushing and pulling activities during transferring the patient.
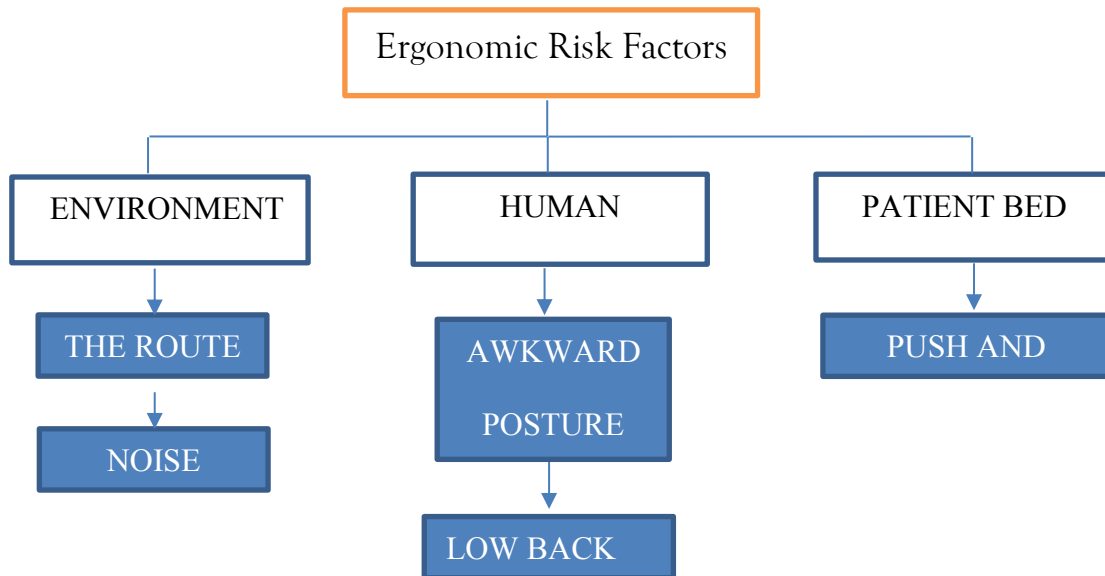

Figure 1.1: Ergonomic risk factors that lead to MSD in patient handling.

1.5   Significant of Project

The expecting result outcomes on bringing a benefit towards:

1. **New Knowledge**

   a. Malaysia Ministry of Healthcare can use the data to improve the existing guidelines of parameter for the proper patient bed due to reducing the occupational health among nursing staff.

   b. The output of this research can be referred by the industrial design of patient bed in order to prevent the MSD among workers.

   c. This study can offer new reference and methods for future research

2. **Contribution to Nation**

   RULA and REBA scoring wouldl be the outcomes for this research as well as can be used to create a new guideline for the healthcare of patient handling. Risk factors that contribute to the injuries such as low back pain and awkward posture also provided from this research. Meanwhile, by using RULA and Reba analyses, the posture that lead to MSD will be detected by the survey method so that the workers can refer the information given on how to prevent MSD during performing the patient handling task. The recommendation of the best posture and the proper parameter for the patient bed will be produced at the end of this project.

CHAPTER 2

LITERATURE REVIEW

2.1   Ergonomic

Ergonomic can be defined as a process of designing or organizing working environment, products and frameworks so that they fit the individuals who utilize them. Ergonomics is a study of science focusing on human fit, reducing fatigue and discomfort through product design (Scott Openshaw and Erin Taylor, 2006). Ergonomics can moreover be defined as a research of the relationship between people and their work environments, which is exceptionally imperative to both health and safety. Ergonomics aims to ensure that tasks, equipment, data and the environment fit each worker rather than forcing the worker to fit the job (HSE, 2013). Adapting errands, work stations, apparatuses, and equipment to fit the worker can offer the decrease of physical stress on a worker's body and eliminate numerous possibly genuine, impairing work related musculoskeletal disorders (MSDs) (US Department of Labor, 2000). Ergonomics is a branch of science that aim to learn about human abilities and limitations, and then apply this learning to improve people's interaction with products, systems and environments. Ergonomics is employed to fulfill the two goals of health and productivity. It is relevant in the design of such things as safe furniture and easy-to-use interfaces to machines (Zuhurudeen, 2011). So as technologies change, so too does the need to ensure that the tools we access for work, rest and play are designed for our body's requirements.