ASSESSMENT OF ERGONOMICS RISK FACTOR ASSOCIATED WITH UPPER LIMB DISORDERS AMONG CASHIERS IN GROCERY RETAIL INDUSTRIES

MUHAMMAD FAREEZ BIN AHMAD ZUHAIDI

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"Special thanks to my beloved parents and siblings for their love, supervisor and brotherhood friends for advices and undying support in the encouragement toward the success of this study. The sacrifices and encouragement will be etched in the hearts FOREVER"

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ABSTRACT

The cashier job is one of the occupations in developing musculoskeletal disorders (MSDs) concerning on the upper limbs mostly due to risk factors such as awkward postures, repetition motion and forceful exertions. The aim of this study was to identify the disability level of upper limb disorders (ULDs) and risk factors involved among 136 cashiers in grocery retail industries using Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire as a survey and Assessment of Repetitive Tasks (ART), Job Strain Index (JSI) and Rapid Upper Limb Assessment (RULA) as a direct observational method. Mostly, the age of cashiers were between 21-40 years old with a percentage of 86.8%. Based on the results, it showed that most of the cashiers experienced arm, shoulder and hand pain when doing specific job regardless on their workstation or at home with a disability score (Mean = 3.5, SD = 0.5). For ART method, most cashiers dealt with frequent and repetition of the arm movements with a score of (Mean = 3.2, SD = 0.4) and (Mean = 2.6, SD = 0.7). As for JSI method, mostly the cashiers experienced with intensity and duration of exertion based on the high rating mean values (Mean = 2.9, SD = 0.6) and (Mean = 2.5, SD = 0.5) respectively**.** In RULA method, cashiers obtained a high mean score of leg and wrist posture with a score of (Mean = 2.1, SD = 0.4) and (Mean = 1.9, SD = 0.5) respectively. The relationship between DASH and the three observational tools shows that variables of limited work with arm movements, weakness of arm, shoulder and hand with intensity of exertion, and changing light bulbs overhead with upper arm had a significant relationship between them with a score of $\chi^2 = 7.097$, $\chi^2 = 4.027$ and $\chi^2 = 8.536$ respectively ($p < 0.05$). In conclusion, cashiers' experienced arm, shoulder and hand disability due to frequent and repetition movement while performing tasks.

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ABSTRAK

Pekerjaan seorang juruwang adalah salah satu pekerjaan menyebabkan *Gangguan Otot Berangka (MSD)* berkaitan anggota atas badan terutamanya disebabkan oleh postur yang janggal, gerakan berulang dan usaha kuat. Tujuan kajian ini adalah untuk mengenal pasti tahap *Gangguan Atas Badan* (ULDs) dan faktor risiko terhadap 136 juruwang di industri runcit dengan menggunakan *Disabilities of the Arm, Shoulder and Hand* (DASH) *Questionnaire* sebagai alat kaji selidik dan *Assessment of Repetitive Tasks* (ART), *Job Strain Index* (JSI) dan *Rapid Upper Limb Assessment* (RULA) sebagai alat pemerhatian secara langsung. Kebanyakan juruwang yang bekerja adalah antara 21-40 tahun dengan 86.8 peratus. Berdasarkan hasilnya, ia menunjukkan bahawa kebanyakannya mengalami sakit pada lengan, bahu dan tangan apabila melakukan pekerjaan tertentu di stesen kerja atau di rumah dengan skor kecacatan sebanyak (*Mean* = 3.5, *SD* = 0.5). Untuk ART, kebanyakan juruwang berurusan dengan kerap dan pengulangan pergerakan lengan dengan skor sebanyak (*Mean* = 3.2, *SD* = 0.4) dan (*Mean* = 2.6, *SD* = 0.7). Manakala untuk JSI, kebanyakan juruwang mengalami masalah intensiti dan tempoh sewaktu melakukan kerja dengan skor sebanyak (*Mean* = 2.9, *SD* = 0.6) dan (Mean = 2.5, SD = 0.5). Untuk RULA pula, kebanyakan juruwang memperoleh masalah pada kaki dan pergelangan tangan dengan skor sebanyak (*Mean* = 2.1, *SD* = 0.4) dan (*Mean* = 1.9, *SD* = 0.5). Bagi hubungan antara DASH dan tiga alat pemerhatian, pembolehubah seperti kerja terhad dengan pergerakan lengan, kelemahan lengan, bahu dan tangan dengan keamatan tenaga, dan menukar lampu di atas kepala dengan lengan atas mempunyai signifikan antara mereka dengan skor sebanyak $\chi^2 = 7.097$, $\chi^2 = 4.027$ dan $\chi^2 = 8.536$ ($p < 0.05$). Sebagai kesimpulan, pekerjaan juruwang terdedah kepada pergerakan yang kerap dan pengulangan yang menyebabkan lengan, bahu, pergelangan tangan dan kaki mengalami kesakitan dan ketidakselesaan semasa menjalankan tugas.

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LIST OF SYMBOLS AND ABBREVIATION

ART	-	Assessment of Repetitive Tasks
CTS	-	Carpal Tunnel Syndrome
DASH	-	Disabilities of the Arm, Shoulder and Hand
DEOHS	-	Department of Environmental & Occupational Health Science
EU-OSHA	-	European Agency for Safety and Health Work
JSI	-	Job Strain Index
MMH	-	Manual Material Handling
MSDs	-	Musculoskeletal Disorders
OSHA	-	Occupational Safety and Health Administration
SPSS	-	Statistical Package for the Social Science
RULA	-	Rapid Upper Limb Assessment
SD	-	Standard Deviation
SOCSO	-	Social Security Organisation
UEMSDs	-	Upper Extremity Musculoskeletal Disorders
ULDs	-	Upper Limb Disorders
WRULDs	-	Work Related Upper Limb Disorders

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CHAPTER 1

INTRODUCTION

1.1 Background of Study

The cashiers' job is one of the occupations that contribute to musculoskeletal injuries related to upper limb disorders (ULDs) at workplace (US Department of Labor, 2000). ULD is an injury that affected the upper part of the body including neck, shoulders, elbows, wrists, and upper back (Garg & Kapellusch, 2011). These possible injuries is important for cashiers to be aware of as it can lead to ULDs such as carpal tunnel syndrome (CTS), neck disorder, wrist disorder and back disorder (Forcier *et al*., 2008).

Basically, ergonomics risk factor is considered as the relation between human behavior and their job (Jaffar *et al*., 2011). According to OSHA (2004), several risk factors such as awkward and static postures, repetition motion and forceful exertions may arise the risk of injury. The risk of injury is greater based on the duration, frequency and magnitude of the workers' work activities (Gagne *et al*., 2011).

ULDs act as high risk injury as studies claimed that these disorders (Lehman *et al*., 2001) mainly involve varying degrees of neck, shoulder, upper limb and back pain due to prolonged standing, reaching, bending. According to Bonfiglioli et al (2005), it is reported that full time and part time cashiers tend to experience carpal tunnel syndrome (CTS) with a percentage of 7.89% and 3.53% respectively. Clearly, these risk factors which could lead to ULDs should be prevented at an early stage.

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1.2 Problem Statement

Workers in the grocery store tend to work hard and repetitious which would lead them to feel aches and pain to the body (Department of Environmental and Occupational Health Sciences USA, DEOHS, 1999). Some risk factors such as uncomfortable work position, repeated and forceful motions and long working hours are the common problems that cashiers experienced (Schwarzenegger *et al*., 2006). Another report claimed that workers who develop disorders are due to high degree of repetitiveness, working in a period of time and the design of laser scanner checkout system (Clarke, 2003) or work techniques. Generally, cashiers' jobs require them to handle different types of goods repetitively where this behavior is related to light and repetitive manual material handling (MMH) task (Lehman *et al*., 2001). Cashiers are likely involve in flexion, lateral inclination and rotation movements which would lead to back problems (Cook & McGill, 2001). In addition, the usage of laser scanner can also be a factor in developing ULDs. Their work usually involves ULDs as Clarke (2003) explained that cashiers tend to be on their feet while handling customer purchases.

In Malaysia, many ergonomic studies were conducted among material handlers (Deros *et al*., 2015; Daruis *et al*., 2017), office workers (Mahmud *et al*., 2011; Faryza *et al*., 2015) and construction workers (Lop *et al*., 2017; Muktar *et al*., 2017). Researchers in different countries have conducted various studies on cashiers using ergonomic risk assessment tools. They used various questionnaire and observational tools such as Nordic Musculoskeletal Questionnaire (NMQ) (Sirge *et al*., 2014; Balogh *et al*., 2016), Rapid Entire Body Assessment (REBA) (Coyle, 2005; Harold *et al*., 2017) and Ovako Working Posture Analysing System (OWAS) (Carrasco *et al*., 2005; Galan *et al*., 2017).

To date, there is no further study on ULDs related to risk factors among cashiers in Malaysia. It is likely that cashiers will have serious issues if they are not concern on risk factors awareness as ULDs can cause disability, pain and reduced productivity (Punnett & Wegman, 2004). Therefore, this research is conducted to determine and examine the risk factors and disorders among cashiers in grocery retail industries in Malaysia.

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1.3 Objectives

The objectives of this study were:

1. To determine the disability level of upper limb disorders (ULDs) among cashiers in grocery retail industries.
2. To examine the level of risk factors associated with upper limb disorders (ULDs) among cashiers in grocery retail industries.
3. To evaluate on the relationship between the variables in DASH questionnaire and three different observational tools scores.

1.4 Scope of Study

The scopes of this study were:

1. The field of study was conducted at grocery retail industries in various state in Malaysia by using random sampling.
2. Sample size of 136 workers were subjected from selected grocery retail industries in Malaysia.
3. The Disabilities of Arm, Shoulder and Hand (DASH) Questionnaire assess on range of disability level while Assessment of Repetitive Task (ART), Job Strain Index (JSI) and Rapid Upper Limb Assessment (RULA) assess on level of risk factor.
4. The study focuses on the ULDs caused by both work and home activities which would lead to the contribution of risk factors.
5. The variables between the questionnaire and observational tools were investigated through significant relationship.
6. This study used mean, percentage, standard deviation (SD) and Chi-Square (χ^2) in the data analysis.

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1.5 Significance of Study

This study focuses on risk factors related to ULDs among cashiers with working in prolonged standing posture at workplace. Normally, cashiers in grocery retail industries suffer from ULDs such as wrist, shoulder and back pain which are mostly due to continuous reaching, bending, and twisting of work. These risk factors should be taken into account by the employers so that the workers can perform their jobs without having any problems or disorders.

Clearly, efforts in preventing injury such as provide training, prevention strategies and code of practices would be beneficial for the employees and employers. As for the employees, these efforts can help to reduce upper limb musculoskeletal disorders and improve the workers' morale. In addition, it will encourage the employees to work and stay longer besides discouraging any senior employees from retiring early. These efforts can act as guidelines for other grocery industries and surely can motivate the workers in the workplace.

As for the employers, they should implement these efforts and put to a program where productivity can be increased by eliminating unneeded motions, reducing fatigue and increasing worker efficiency. Moreover, these efforts can help the employers to have healthier workers, better morale and higher productivity which can lead to better customer service.

In this modern era, some grocery store might be replace with self-checkout machine which will not require cashiers. However, not all grocery store would accommodate this type of checkout system especially in small stores. Therefore, it is important that this study focuses on cashiers' task where most of the grocery store still require cashiers to handle this checkout station.

1.6 Thesis Organization

The thesis is organized into five chapters which consist of introduction, literature review, research methodology, result and discussion and lastly conclusion and recommendation. Chapter 1 discussed about the background of study, problem statement, objectives, scope of study, significance of study and thesis organization.

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Chapter 2 explained about how the study was done that linked to the topic and gave the research a picture. Basically, this chapter discussed on risk factors and upper limb disorders (ULDs) among cashiers in grocery retail industries.

Chapter 3 is about the research methodology that was used in this study. Collection, evaluation and analyzation of data were focused in this chapter. Disabilities of the Arm, Shoulder and Hand (DASH) Questionnaire was used to collect upper limb disorders (ULDs) data among cashiers in grocery retail industries. Meanwhile, Assessment of Repetitive Tasks (ART), Job Strain Index (JSI) and Rapid Upper Limb Assessment (RULA) were used as observational tools to identify the exposure of risk factors in workplace.

In Chapter 4, it was on the discussion of results that was analyzed based on the data obtained. The results acquired that involved DASH, ART, JSI and RULA were presented as numbers, mean, standard deviation (SD) and percentages. Statistical Package for Social Science (SPSS) Software Version 22.0 was used for the analysis of the results.

Chapter 5 explained the conclusion that summarized the findings throughout the thesis and the recommendations for future improvement research. The thesis organization is presented in Figure 1.1.

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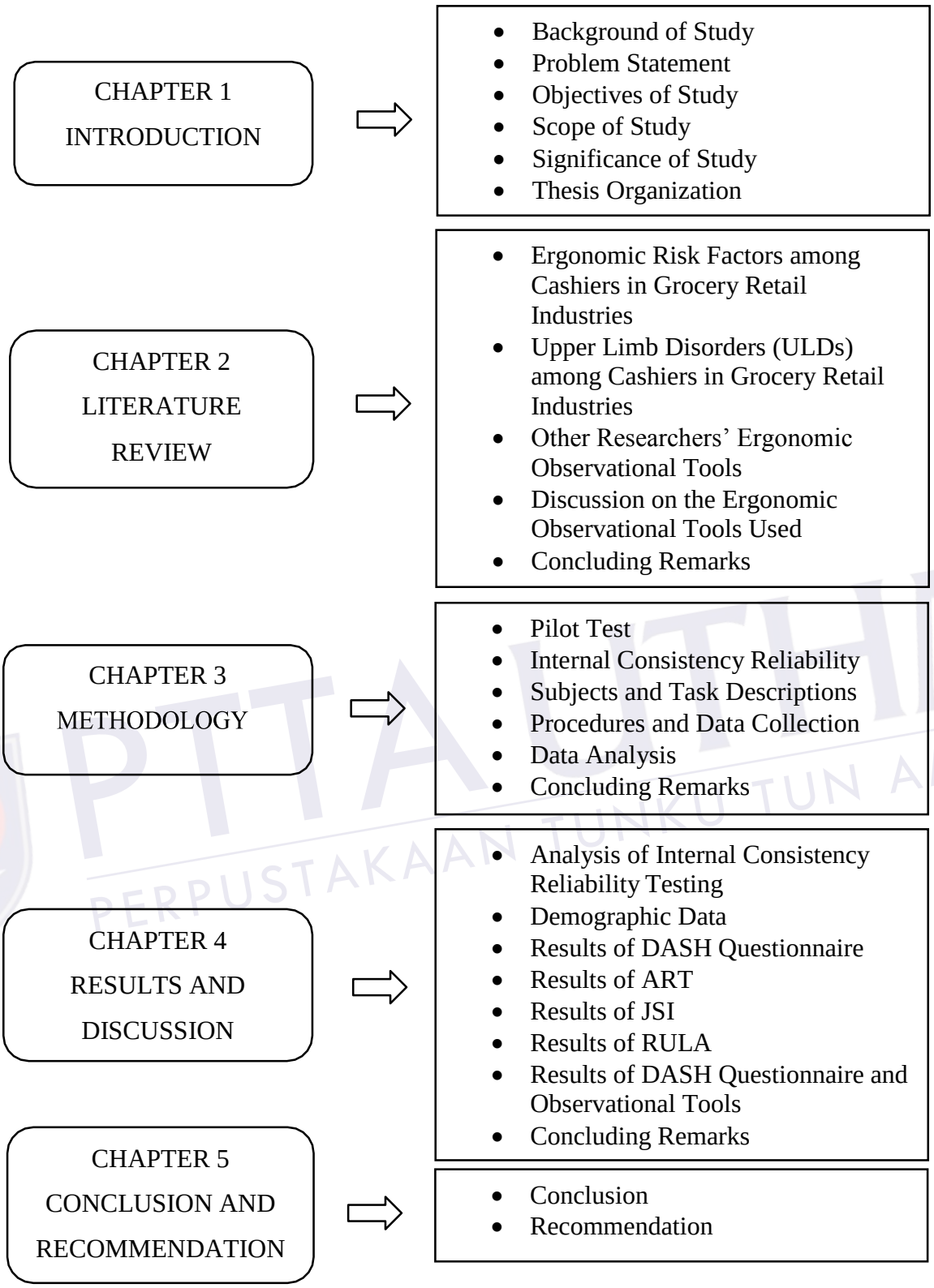

Figure 1.1: Thesis Organization

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CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter includes knowledge including substantive findings as well as theoretical and methodological contributions to the investigation. The main purpose of this literature review is to summarize the results of writing and research related to upper limb disorders and risk factors in grocery retail industries. Section 2.2 describes the generalization of ergonomic risk factors involved while Subsections 2.2.1, 2.2.2 and 2.2.3 describe the ergonomics risk factor. As for Section 2.3, it explains the generalization of upper limb disorders among cashiers. Subsection 2.3.1 overviews the statistics of upper limb disorders while Subsections 2.3.2 to 2.3.4 describes the related injuries towards upper limb disorders. Section 2.4 describes about the generalization and comparison of the questionnaire and observational tools used for this research and other research. Section 2.5 discusses on beneficial of the tools used. Lastly the concluding remarks is explained in Section 2.6. Literature review acts as a framework of this study and it proves to be beneficial. In this chapter, the collection of information is from a variety of resources such as journals, books, internet and working papers.

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2.2 Ergonomics Risk Factors among Cashiers in Grocery Retail Industries

Repetition, overload, awkward position or some combinations are some risk factors related to injuries of the human body (Rahman *et al*., 2010). European Agency for Safety and Health Work, EU-OSHA (2012) claimed that supermarket work can be physically demanding as workers are in danger from having back and upper limb disorders. Risk factors such as awkward and static postures, lifting and pushing, repetition and forceful exertions are categorized as the main factors of cashiers experiencing ULDs. Another researcher claimed that these disorders are probably due to improper movements of repetitive bending and twisting (Tanaka *et al*., 1997). In addition, the range of motion and working posture of a cashier are also contributing factors in leading to an injury (Vieira & Kumar, 2004).

Discomfort and pain in the back is common nowadays as cashiers' activities usually involve combining flexion, lateral bending and rotation movements (Cook & McGill, 2001). Moreover, movements such as lateral bending combined with movements in other planes are also claimed to be a risk factor of acquiring low back disorders (Rodacki *et al*., 2010). Based on other studies, common complaints on musculoskeletal discomfort and pain come from occupations that are due to repetitiveness and monotonous work. The usual discomfort constantly experienced on the neck and shoulder is due to monotonous work while the lower back, neck and shoulder are due to repetitive tasks (Lundberg *et al*., 1999).

2.2.1 Awkward Postures

Cashiers are among the workers who experience awkward posture as they tend to reach goods across a conveyor which would deviate the shoulder from its neutral position. Experiencing awkward posture can be tiring to the muscles and stressful to the joints if performed repetitively (Department of Environmental & Occupational Health Sciences, 1999).

Based on several studies, supermarket cashiers were exposed to work-related musculoskeletal disorders (Rissén *et al*., 2002; Bonfiglioli *et al*., 2007; Forcier *et al*., 2008). The main risk factors are mainly due to physical work conditions such as awkward

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postures (Kihlstedt & Hägg, 2011; Draicchio *et al*., 2012) and psychosocial environment (Lundberg *et al*., 1999). Everyday cashiers have to reach repetitively and stretch their arm awkwardly to handle goods and these actions may lead to ULDs (Cooper & Baker, 2002). Moreover, they also experience awkward posture by leaning over the counter to reach goods and twisting their upper trunks as these would lead to injuries or sprain or strain (Gagne *et al*., 2011). Awkward posture is considered worse if the work tasks involve repetitive motions and forceful exertions (Lin & Chan, 2007).

Figure 2.1: Awkward Posture of the Back - Twisted Upper Trunk
(Schwarzenegger *et al*., 2006)

Obviously, awkward posture has its own disadvantage. Some actions such as twisting and bending the wrist to scan, reaching too far for the goods and twisting to face the customers can all lead to pain and injury (Schwarzenegger *et al*., 2006). There is proof that exposure to combinations of physical workplace strains such as overhead working, heavy lifting, forceful work and awkward posture would likely increase the risk of shoulder disorders (Linaker & Walker-Bone, 2015). Not only that, carpal tunnel syndrome can also be affected from repetitive actions, exertion of significant force and awkward posture of the hand and wrist (Bugajska *et al*., 2007). In addition, back pain can also be acquired by cashiers as studies claimed that axial twisting, lateral bending and awkward postures of the upper trunk can affect such disorders (Rodacki *et al*., 2010).

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2.2.2 Repetition Motion

Repetitive movement is considered to occur if the upper limbs (joints of the shoulders, elbow, wrists and hand) are performed in repeated motions (Peereboom & Langen, 2008; Voskamp *et al*., 2008). According to Workplace Safety and Health Council WSHCOUNCIL (2014), repetitive movements can become harmful if the same action is done quickly and too often in a matter of time. Repetitive movements are common in professions involving conveyor belts and cash register (Arbobalans, 2011; Arbeid, 2012). Employee who work as a cashier is one of the common workers that frequently perform repetitive movements during working (Bongers *et al*., 2006; Arbobalans, 2011; Arbeid, 2012).

In a survey from Statistics Sweden (2003), 93% of the supermarket cashiers are reported to perform physically monotonous and repetitive work for at least half of their work time. In fact, cashiers' work can be repetitive and hand intensive especially when the European Article Number (EAN)-codes of a large number of groceries need to be turned towards the scanner (Peter *et al*., 2012). Schwarzenegger *et al*. (2006) explained that cashier's tasks can be painful as they involve reaching, scanning, keying, grasping items and lifting heavy items with one hand. These tasks are done repeatedly all day long which can cause injuries to muscles and joints. Generally, repetitive movements which act as work-related musculoskeletal disorders are still high in prevalence among grocery store workers (Nordander *et al*., 2009; Farioli *et al*., 2014).

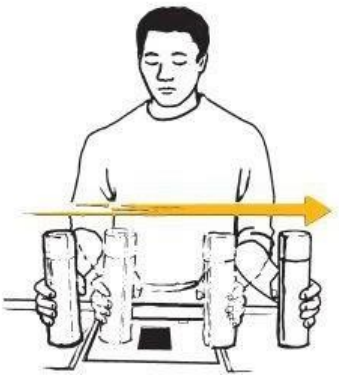

Figure 2.2: Repetitive Movements of the Arm (Schwarzenegger *et al*., 2006)

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