

**Review Article**

# Literature Review of Musculoskeletal Disorders and Their Risk Factors Among Supermarket Cashiers

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**Abstract:** *Background:* People working as supermarket cashier are at a risk of suffering musculoskeletal disorders. Those cashiers experienced occupational diseases as a result of working in a forced position, such as sitting for long periods of time. Moreover, a high prevalence of Work-related Musculoskeletal Disorders has been reported among them. *Objective:* This literature review aims to describe previous studies and its findings among the supermarket cashiers to explore and discover the prevalence of MSDs among them and to understand other aspects related to the role of a supermarket cashier. *Methods:* Ovid MEDLINE, CINAHL, PsycINFO and Web of Science databases were searched to explore MSDs among supermarket cashiers. *Results and conclusion:* The prevalence of symptoms varies among different body regions such as the spine, upper limbs, and lower limbs. However, the spinal and upper limb regions are more susceptible to have such disorders. Moreover, some of these symptoms may develop or exaggerate due to psychosocial factors. The supermarket cashier job has several risk factors that may be related to ergonomic workstations, a person's characteristics, and some related to the nature of work, which involves repetitive movements. Finally, future studies on supermarket cashiers should recruit more males than females, because previous studies focused on females only.

**Keywords:** Musculoskeletal Disorders, Supermarket Cashiers, Risk Factors, Work-related Injuries

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## 1. Introduction

Work plays an important and essential role in a person's life in many aspects associated with improvement of quality of life. Work is defined as the performance of tasks for money [1]. Work can be associated with physical and mental health benefits. In addition, work can support people in recovery; after illness or injury. To the contrary, not working and longtime absences can be associated with negative effects on health and wellbeing [2].

Various work types necessitate specific positions and tasks. Pain, discomfort, or disease may occur among individuals based on the nature of their work. Many factors can contribute to the development of disorders and diseases, such as static and/or awkward postures, long sitting and standing, repetitive movements and excessive force [3]. Disease occurring

because of work duties is known as occupational disease [4].

Work-related musculoskeletal disorders (WMSDs) represent one of the most common types of occupational diseases. However, underlying pathophysiological mechanisms causing MSDs are not fully known [5]. The term "musculoskeletal disorders" (MSDs) is used to describe varying degree of inflammatory and degenerative changes affecting the extremities and/or spine with symptoms of unknown diagnoses to symptoms with known exact diagnosis [6]. However, such disorders may or may not be associated with work duties. Moreover, it may not be easy to confirm its association with workers' work.

Published data shows that prevalence of MSDs among European people working in the field of retail service, shops and market sales is high, as reported by the European Agency for Safety and Health at Work [7]. It has also been reported

that grocery workers have a high prevalence of MSDs [8]. Moreover, the Bureau of Labor and Statistics, in a report issued for the Occupational Safety and Health Administration (OSHA), found that sales clerks or cashiers have the second-highest prevalence of MSDs among grocery store workers [9]. The prevalence of such disorders in supermarket cashiers in Saudi Arabia has been found to be 90% of participants had MSD symptoms in at least one body region [10].

Supermarket cashiers have a very high risk of developing WMSDs due to several biomechanical issues at checkout workstations [11]. A group of cashiers experienced occupational diseases as a result of working in a forced position, which is sitting for long periods of time [12]. Moreover, previous publications reported a high prevalence of WMSDs among supermarket cashiers [13-16]. Several studies have shown that 37–56% of grocery cashiers suffer from frequent back pain or pain in the upper extremities [17-20]. This huge percentage requires more focus and care for cashiers, as they are greatly affected by microtrauma due to repetitive movements involved in handling of products during their day-to-day work [5].

#### *Supermarket Cashier Description*

An online dictionary defines the term ‘cashier’ as a worker who receives payments of customer purchases [21]. However, this definition may not represent the actual role of a supermarket cashier. At first glance, the cashier’s work looks easy or not very demanding and is supposed to be related only to cash. However, this work has several difficulties and challenges, for understanding which, there is a need to understand the job description.

Working as a supermarket cashier does not require a specific level of education. Consequently, this work is suitable for majority of the people belonging to any age group or of either gender. The hiring company provides training for new recruits by an experienced employee, with regard to procedures, policies, and other operational methods at the checkout workstation [22]. Workers’ training has been suggested to help in reducing or eliminating the risk factors for work-related injuries [9]. Whether individuals start working as cashiers in developing countries get enough training and education in order to avoid WMSDs is unknown.

The cashier receives products or grocery items placed on the conveyor belt from the side, either right or left. They need to pick up the items one by one and turn the product around to swipe the barcode through the laser barcode scanner. After that, the product is placed in the bagging area. This task is repeated numerous times, depending on the number of items that a customer has purchased. The purchased items vary in weight, shape, and size. Products sometimes need to be turned and manipulated several times in order for the laser scanner to read the barcode [14, 23].

Furthermore, if a product or item is too heavy to be lifted onto the conveyor belt and is placed inside the shopping trolley, the cashier needs to reach for it and use a hand scanner to read the product barcode. This may require assume a difficult and awkward posture, which may need to be repeated

several times during the work shift.

On some occasions, when the laser scanner fails to read the barcode, the cashier has to lift the item from the conveyor belt regardless of how heavy the object is, and register the item manually by entering the code on the keyboard of the cash register [14]. Finally, the cashier is responsible for receiving payment from customers in the form of cash or credit card [24]. As dealing with money is involved, this step demands high accuracy. In addition, there are some variations in the terms of service among supermarkets.

Some supermarkets provide additional services, which may demand additional tasks on the part of cashiers. For example, these tasks may include unloading grocery items from the shopping trolley and bagging items for their valued customers [24, 25]. The cashier’s job further requires social interaction and verbal communication with customers [24], which can lead to added mental fatigue [12]. These are some of the many challenges that the workers in this sector may face. Psychological factors for such workers may need to be investigated as well. Moreover, supermarket cashiers, during their work, face (a) a lot of stress due to working under extreme time pressure; (b) mental pressure arising from both the customer, who expects good quality, yet a fast service, and the employer, who expects greater productivity; and (c) the physical demands of the job which require repetitive physical performance [23]. Thus, the job related physical and mental demands on a supermarket cashier may lead to MSDs. Taken together, all these actions and postures by the supermarket cashiers can be risk factors for development of MSDs.

This literature review aims to describe previous studies and its findings among the supermarket cashiers to explore and discover the prevalence of MSDs among them and to understand other aspects related to the role of a supermarket cashier. These include, structure of the cashier workstation, frequency of job rotation within the supermarket and other risk factors. This review is written and classified according to body regions, workstations and their features, postures assumed during work, gender and age-related factors, repetitive nature of cashier’s job, psychosocial aspects and recommendations from previous studies.

## **2. Repetitive Movement and Accumulated Injuries/Disorders Among Cashiers**

The etiology of MSDs occurrence remains unclear; however, some work-related factors increase the prevalence of MSDs among cashiers [26]. These factors include, (a) performing repetitive upper limb and hand activities [27], (b) working in a static posture [28], (c) performing work at high speed [23] and (d) worker satisfaction and dissatisfaction regarding the job [29].

Repetitive work is defined as performing the same movement/work over and over again, which is an important feature of the job of a cashier, especially involving the hand and arm [30]. Many jobs require specific body postures and

positions, and repetitive physical activities for a prolonged duration [31]; the job of a cashier being one such job. WMSDs tend to occur more commonly in individuals with jobs known to involve repetitive and monotonous postures and movements [32].

Supermarket cashiers spend about 45–50% of their time scanning or handling products for customers, which is considered as a light manual repetitive task [33, 34]. Cashiers may sometimes need to handle 500 to 1000 items per hour [35]. Fast cashiers handling items/products may scan up to 1442 items per hour using their dominant hand [27]. However, working with high speed is a risk factor for development of MSDs in the upper limbs as suggested by previous studies [36–38]. Therefore, studying upper limb disorders and disabilities among cashiers should be investigated as those workers may be at a higher risk of developing MSDs and disabilities.

Spending more than half of a working day in the form of short work-cycle durations of less than 30 seconds, and performing multiple repetitions of the same activity or task significantly increases the risk of hand and wrist joint injuries and other MSDs [39]. In addition, repetitive movements have been found to be a risk factor for the development of lower back, neck and shoulder disorders among cashiers [14]. This finding is compatible with reports of muscle and tendon injuries being caused by repetitive tasks requiring force, which can lead to inflammatory reactions [40].

Working with highly repetitive movements, with little time in between for rest, a cashier does not allow the muscles to return to a resting state during the handling of products [34]. In contrast, a cashier who works at a checkout station for customers with a limited number of items performs fewer repetitive movements in scanning and packing. This gives him more frequent opportunities to rest; therefore, it reduces fatigue effect, and reduces the risk of developing injuries [25]. In general, checking out groceries may be considered lightweight work, with variation in weight between items. However, cumulatively, in an eight-hour shift, it has been reported that the cashier lifts more than 6000 pounds (2722 kilograms) of items [9]. With repetitive handling, it has been found that even a weight of less than one kilogram can lead to fatigue [41, 42]. This is another cause that emphasizes the need to study MSDs among such workers.

Several previous studies have demonstrated the risks inherent to the job of a cashier, MSDs due to repetitive stress and cumulative injuries being the major risk [16, 20, 27]. While there is a greater prevalence of MSDs due to cumulative injury in supermarket cashiers than the other supermarket workers [43], the main risk factor, which causes cumulative injury, is exposure to repetitive movements for a prolonged time [44]. Therefore, there is a need for more awareness in cashiers to take measures to minimize the risks of developing MSDs.

Supermarket cashiers in shifts, perform a large number of repetitive handling tasks, and cumulatively, this leads to fatigue, which is one of the risk factors for MSDs [45]. During peak times, cashiers are more likely to deal with lots of

customers and grocery items. Therefore, more than one risk factor, namely a combination of a high rate of repetition during handling and scanning of items with less rest time is present, which is associated with a greater risk of developing a disability/disorder due to cumulative microtrauma [16, 23].

### ***2.1. Musculoskeletal Disorders of the Shoulder and Neck***

Shoulder and neck pain is most common in people who work in repetitive or monotonous jobs [32], the job of a cashier is such a job. Shoulder and neck pain is more prevalent in supermarket cashiers due to various reasons. The nature of their job has some inherent risk factors for high prevalence of MSDs in shoulder and neck [34]. During physical examination of 212 supermarket workers, it was found that 28% of them had pain in the neck, shoulder, or both, with 33% greater prevalence among cashiers; 14% were diagnosed with tension neck [46]. A previous study in Saudi Arabia found that 67% and 55% of cashiers were experiencing neck and shoulder pain; respectively, at the time of the study [10].

When a questionnaire was administered to 67 female supermarket cashiers, 53.7% reported neck pain and 43.3% reported shoulder pain [12]. Moreover, the prevalence of shoulder and neck pain was up to 70% in supermarket cashiers [15]. This is consistent with findings reported in previous studies conducted in the same population [47]. In fact, these higher percentages are triggering the importance of making more investigations in order to identify the causes and risk factors of such disorders among cashiers.

Shoulder and neck postures, muscles, and ligament alignment are influenced by several factors, which guide the ideal cashier posture and workstation ergonomics, which will be discussed later in this chapter. Neck and shoulder muscle activity levels increase on whole spine flexion, while levels decrease when the trunk is slightly inclined backwards and the neck is in a vertical position, rather than the spine being in a straight and vertical position [48, 49]. In addition, working in a sitting position requires greater muscle activation in the neck and shoulders than working in a standing position. Thus working in a standing position makes mobility easier, allowing for equal body weight distribution between the legs and easier positioning of arms in order to perform tasks [23]. This can be used as a preventive instruction in order to avoid neck and shoulder disorders.

Peak load is one of these factors has an impact on the cashier. Constant muscle activity of the shoulder and neck leads to fatigue. Cumulative muscle fatigue may cause development of MSDs [50]. Likewise, working at high speed increases muscle activity levels [51]. In addition, working with flexed and/or abducted shoulders also leads to elevated levels of activity in the descending part of the trapezius and the cervical and thoracic erector spinae [48, 49, 52, 53]. Unfortunately, such factors cannot be controlled or avoided among cashiers. Preventive methods and ergonomic intervention may help diminish the impact of these factors.

Depending on the posture of the cashier, either standing or sitting, a variation in ROM and muscle activation is required. The ROM required for flexion and extension of the shoulders

is higher in a sitting position for cashiers [54], while higher degree of neck flexion is required during standing. It is recommended that shoulder abduction should not exceed 20 degrees during repetitive work [55, 56]. Recommendations also suggest that neck flexion should not exceed 20 to 30 degrees for prolonged periods, and that 15 degrees is acceptable during static work [56, 57]. Therefore, the position of the cashier whether sitting or standing plays an important role in predisposition to MSDs.

Static postures in congested areas for long hours involve constant and extensive muscle activation and poor posture, making cashiers more prone to fatigue. Neuromuscular fatigue is commonly felt by cashiers in the shoulders, lower back, and neck muscles [58].

In this job, most of the stress load is borne by the upper limbs as compared to other body parts [11]. Due to the nature of the job, supermarket cashiers are at a high risk of developing MSDs in the upper extremity [18, 19, 59, 60]. In addition, all three identified factors leading to development of work-related shoulder disorders are present (flexion and/or abduction of shoulders, performing repetitive arm work tasks, and work at high speed) [23] in cashiers. Most of the activities of daily living involve the upper limbs. Therefore, Any MSDs affecting the upper limbs affect the quality of life.

Workstation ergonomics has an impact on the prevalence of MSDs among cashiers. Previous studies have reported an increase in MSDs, especially in the upper extremities, among cashiers using laser scanning at workstations for long periods [18, 20]. Laser scanners make work easier than conventional techniques, generating more speed and more load in a short span of time.

Niedhammer et al. 1998 studied 210 female cashiers, 35% of whom reported a disorder in the left shoulder and 33% in the right shoulder. This may be due to the fact that 81.0% of cashiers received groceries coming through the conveyor belt which was from the right to the left, which put more load for pushing towards the packing area. They further reported that significant risk factors for developing shoulder problems were duration of employment, age, using a laser scanner, working while stooping, moving arms above shoulder level, and pushing and holding heavy weights in an awkward position, along with bagging [13].

Lannersten and Harms-Ringdahl (1990) conducted a study to analyze levels of neck and shoulder muscle activity in supermarket cashiers using electromyography (EMG) and showed that all subjects had symptoms of neck, shoulder, arm, and back pain, after working during peak times. The authors found that use of a pen scanner to read barcodes leads to higher activity in the trapezius muscle than using a conventional cash register. This indicates a higher level of activity in the muscles in a sitting position than in a standing position [23]. Studies have reported that constant sitting has the greatest effect on the neck and lower back area [34, 61]. Those cashiers who work in a sitting position showed higher prevalence of neck pain of about 56.7% [62].

An Italian article [63] described a study involving 173 supermarket cashiers (99 of whom were also responsible for

filling shelves, while 74 were cashiers only). The aim of the study was to investigate prevalence of upper-limb WMSDs among cashiers. The results indicated a history of upper limbs-WMSDs in about 64% of the cashiers. The most frequent symptom was pain, especially in the shoulder. Some of them suffered from one or more upper limb-WMSDs about (37%). Additionally, the author reported prevalence of upper limb-WMSDs in even part-time cashiers, and not only those working exclusively as cashiers. High prevalence is associated with full-time work, less job rotation and poor ergonomics of cashier work stations [63], making them more prone for acquiring upper limb disorders.

## **2.2. Musculoskeletal Disorders of the Elbow**

While reviewing the previous studies, upper limb MSDs in supermarket cashiers have been discussed. The elbow is one of the most susceptible regions of the body due to the nature of the work. However, it has not been sufficiently evaluated. Sirge et al. 2014. studied supermarket cashiers while they were working in a sitting position, and found that the lowest prevalence of MSDs was in the elbow, at 16.4% in previous 7 days [12]. A very close to finding by another study that targeted supermarket workers showed that the prevalence of elbow pain was 14% in previous 7 days among cashiers, which was higher than that among those performing work involving picking objects [46]. A recent study reported that 24% of cashiers in Saudi Arabi had elbow pain [10].

A previous study done in Thailand showed that the prevalence of elbow pain was the lowest (3%) in comparison with other body regions among saleswomen working in a standing position for a long time [64]. The difference between studies in prevalence of elbow pain is the working position, with standing requiring a lesser range of motion (ROM), whereas the sitting position requires more ROM in the elbow joint.

The prevalence of ulnar nerve entrapment of the elbow was 8.3% in a study that examined about 128 female supermarket cashiers [65]. Studies have reported the prevalence of elbow pain among Swedish female cashiers to be 1.7 times higher than other female workers with more varied and mobile work [31, 66]. Any work characterized by repetitive arm movements is associated with the occurrence of elbow disorders [67]. If elbow muscles are exposed to constant activity, it may lead to fatigue and elbow disorders. Moreover, cumulative muscle fatigue may cause development of MSDs [50]. Minimizing the risk of development of MSDs in the elbow joint is important for the enhancement of wrist and hand performance.

## **2.3. Musculoskeletal Disorders of the Hand and Wrist**

Observation of supermarket cashiers during handling and scanning of grocery items revealed maximum movement and repetition at the wrist and hand level, which poses a high risk for development of MSDs in these areas. Factors such as repetition, force and bad posture are significant in the occurrence of MSDs in the upper extremities, which is evident

by numerous studies [32, 68, 69]. Supermarket cashiers can handle 500–1000 grocery items per hour [35]. There are more than 600 movements per hour involving flexion and extension of the wrist [9].

Highly repetitive work is also associated with WMSDs in the hand/wrist and carpal tunnel syndrome [3, 70]. Marras et al. 1995 suggest that using one hand for scanning may lead to increased wrist acceleration and finger tendon forces [71]. In addition, using pinch grip is associated with increased stress and load on the flexor tendons of fingers [72], which may eventually lead to disorders affecting hand performance.

Studies have reported 1.8 times higher prevalence of wrist or hand pain among Swedish female cashiers than in other female workers with more varied and mobile work [31, 66]. Sirge et al. 2014 conducted a study on female supermarket cashiers, which detected a 47.8% prevalence of pain in the wrist and hand [12]. This is reasonably close to the results of the study done by Anton and Weeks 2016 who reported that about 42% of cashiers had hand and wrist pain [8]. This is consistent with previous evidence found that cashiers who had hand/wrist joint pain were 40% at the time of data collection [10]. Balogh et al. 2016 studied female supermarket workers, and found that during the previous 7 days, prevalence of hand symptoms among cashiers was about 34%, higher than other workers [46]. The presence of symptoms in the hand and wrist is associated with long working hours [73], which may present with high load and repetition. Many problems can occur at the hand and wrist level, nerve entrapment being one of them.

Carpal tunnel syndrome (CTS) is caused by a compression of the median nerve in the carpal tunnel at the wrist level [74]. Carpal tunnel syndrome involves symptoms such as presence of pain and paresthesia in the first four fingers and wrist, and arm pain, causing weakness during fine movements [73, 75]. Carpal tunnel syndrome occurs more frequently among females compared to males [4]. In addition, it occurs more frequently in the dominant hand [76, 77].

Morgenstern et al. 1991 studied female supermarket cashiers in order to investigate the prevalence of hand/wrist symptoms and CTS and to evaluate the extent to which these symptoms are occupation related. The study found that 63% of the cashiers had at least one symptom, with a strong positive association between age and the prevalence of CTS symptoms [60], which is in accordance with age being a risk factor for CTS [78]. In addition to age, the predictors for CTS are number of work hours per week, and number of years of working as a cashier [60]. Association between CTS and work hours is supported by a study, which showed that prevalence of CTS was 8% among full-time female supermarket cashiers and 4% among part-time female supermarket cashiers. Additionally, cashiers working full-time are 2.3 times more likely to develop CTS than the control group in the study [16].

The occurrence of CTS in supermarket cashiers has been associated with some factors, which include the use of a laser scanner being an important one [13, 18]. On the contrary, this association is not supported by other studies [60]. Nevertheless, use of a laser scanner, grasping and turning groceries items plays an important role in the pathophysiology

of CTS.

#### **2.4. Musculoskeletal Disorders of the Lower Back**

The lower back is subject to injury, as most of the trunk twisting and bending movements occur at that level. Lower back pain (LBP) is one of the most frequent, most common musculoskeletal pain [79-83]. LBP is also considered to be one of the main causes of disability and sick leave according to the European Agency for Safety and Health at Work [84]. Back pain is one of the most common problems among supermarket cashiers, in particular [19].

When supermarket cashiers perform their regular job, handling items from a conveyor belt, swiping them over the laser scanner and placing the items in the bagging area, involves trunk forward flexion, lateral leaning and rotation movements [11]. The combination of flexion, lateral leaning, and rotation of the trunk are considered main factors associated with development of back problems [85]. The spine, particularly the lower part, is loaded and stressed by upper body weight.

The load on the spinal column is varied. Excessive biomechanical stress on the spine can occur depending on the location and weight of the item, and the posture of the cashier while lifting the item [86]. When the supermarket cashier has to reach out and handle light items, the movement is mostly performed by the upper segments of the body and does not require great effort [11]. Thus, it is associated with lesser biomechanical stress on the spine. However, lifting heavier items involves movements of the trunk [11]. Handling intermediate and heavy items requires more ROM in the trunk, which may be the reason behind high prevalence of lower back disorders among supermarket cashiers [87].

When cashiers attempt to reach a heavy item in the shopping trolley for scanning, flexion of the trunk may be required. Performing tasks with the trunk flexed forward causes more intervertebral disc compression, which may result in the development of back pain [88]. Attempting to reach things which are too far away may lead to excessive movement in the trunk, which will increase the risk of pain in the back and shoulders [89]. With greater flexion of the trunk, higher muscle activation is required to extend the trunk. Thus, the erector muscles are excessively strained and greater compression forces are exerted on the intervertebral discs [90] and zygapophyseal joints [91]. During laboratory task performance, the muscle demands were affected by some factors related to cashiers, including the height of the checkout station, extent of the workload peak, and the packaging type [25]. Therefore, future studies investigating cashiers need to pay more attention on such factors.

Furthermore, most of the rotation in the trunk of the supermarket cashiers is to one side. This affects postural deviations, and all forces performed by the upper limbs will be absorbed by the spinal column [11]. Trunk rotation is considered as a serious factor in development of MSDs of the spine [92]. In addition, lateral bending of the trunk can lead to lumbar intervertebral disc prolapsed, mainly of the nucleus pulposus [93, 94], which results in disorders in the lower back

area. Therefore, avoiding trunk rotation may help in minimizing the development of MSDs in the spine.

Positioning of supermarket cashiers may be associated with development of back disorders. Cashiers spend most of their time at work in a sitting or standing position. Sitting for a long time increases the likelihood of LBP by 1.5 times; even prolonged standing in the same position is associated with LBP [95]. Waddell and Burton 2001 reported that repetitive work and standing for long periods could be related to the increased prevalence of LBP [96].

The prevalence of LBP among female supermarket cashiers working in a sitting position in a six month period was 67.2%, and in the last 7 days was 44.8% [12]. Another study showed that the prevalence of LBP among supermarket cashiers over a span of one year was 57% [97]. Diniz and Ferreira Junior 1998 found a high prevalence of back pain, with as much as 77.0% of cashiers feeling pain and muscle fatigue at the time of finishing work duty [87]. In addition neuromuscular fatigue is commonly felt by cashiers in the lower back muscles [58]. Among cashiers, there was a high incidence rate 60–77% of MSDs affecting the trunk [98]. According to a recent study, Saudi cashiers reported upper and lower back pain with comparable prevalence (58% and 66%; respectively) [10].

The lower back area is subjected to excessive biomechanical stress in supermarket cashiers due to some work-related factors, workstation ergonomics, handling grocery items, and others. LBP is the most common type of MSD [79-83] and lead to disability [84]. Moreover, LBP is highly prevalent among cashiers [12, 87, 97].

In order to decrease the incidence of back symptoms among supermarket cashiers, modifying the checkout workstation was suggested as a means to decrease excessive ROM during handling and scanning of items. Modifications may include using a continuous conveyor belt to transport items and placing them facing the cashier for scanning, and after that directly moving items to the bagging area without the effort of the cashier [11].

### **2.5. Musculoskeletal Disorders of the Lower Limbs**

Most studies conducted in supermarket cashiers focused on MSDs in the upper extremities, neck, and trunk. A cashier, while working in a standing position, has his upper-body weight transferred through the spine, down his pelvic area, and is finally distributed in the lower limbs, thus resulting in discomfort [12]. In addition, swelling of the feet and legs, varicose veins, and lower extremity discomfort can occur in both sitting and standing work positions [99-101]. Consequently, whether the impact of prolonged standing on lower limbs among cashiers is not sufficiently investigated. However, a few studies did investigate lower limbs among cashiers. In Saudi Arabia, it has been found that 33%, 37%, and 39%; respectively, of cashiers reported hip joint/thigh, knee joint, and ankle joint/foot [10].

The common body regions affected, following the lower back, are the ankles, feet, knees and hips among salespersons as mentioned by previous study [64]. About 39% of female cashiers, mostly working in a sitting position, were found to be

suffering from knee pain in the previous 6 months [12]. A study conducted in Thailand on saleswomen found a significant association between prevalence of lower extremity symptoms and the number of working hours in a day and the week. Long hours in the standing position requires constant contraction of the leg muscles [102], leading to fatigue. Although a clear job description is obvious between sales workers and cashiers, these findings cannot be ignored.

Cumulative muscle fatigue may cause development of MSDs [50]. Anton and Weeks 2016 studied all supermarket workers, and found that prevalence of foot pain was higher among those spending most of their time in a standing position, rather than walking around [8]. This was in accordance with the results of other studies [103]. Thus, cashiers may be at a higher risk to experience MSDs in the lower extremities, especially the foot. In fact, more studies are needed to investigate MSDs in the lower limbs among cashiers. According to the previously mentioned studies whether the cashier is working in a standing or sitting position is a matter of concern.

### **3. Standing Versus Sitting Work Position of Cashiers**

Supermarket cashiers during working hours spend long time in standing, sitting or both positions. Each position has some effects on the body. Working in a sitting position was found to place more stress on the neck muscles [104], and require more neck and shoulder muscle activation than working in a standing position [23]. According to a report done by EU-OSHA (2008), shoulder and back muscular strain is due to working in a sitting posture. Low back muscles of cashiers are subject to high pressure due to working in sitting position for a long time [105]. Thus, sitting posture increases the risk of LBP [106-108] and increases the disc pressure [23, 109].

Sitting for a long time at work is a forced position [12]. Cashiers complain of MSDs because their muscles are forced into one position during entire work shifts [43, 110]. In general, ROM in a sitting work position is higher than that in a standing position, except for flexion, extension and lateral bending of the trunk, and left and right shoulder horizontal abduction-adduction [54]. Still, working in a sitting posture requires lesser energy consumption and places lesser stress on the lower extremities than standing [56, 108]. Some cashiers prefer the sitting position as they feel less tired [34]. This explains the reason for MSDs in the neck and shoulders in cashiers in a sitting position [47, 111-113].

Nevertheless, those working in a sitting position will feel fatigue at the end of the workday. This is due to a decrease in the blood circulation to the muscles [12]. This may occur because keeping a specific posture for a long time requires more muscles in the body to contract isometrically which is considered a huge effort [114, 115]. As a result, blood circulation to muscles can be insufficient due to absence of the muscle pump/contractions [116, 117]. This leads to oxygen

insufficiency, with the accumulation of metabolic by products and resulting in metabolic fatigue [115, 118].

On the other hand, working in a standing posture may be associated with lesser negative effect on cashiers compared to working in a sitting position. Working in a standing position significantly helps in reducing muscle activity and excessive ROM in the shoulders and upper limbs [54]. In addition, activation level of most muscles is lower in the standing position in comparison to in the sitting position [54]. This is also supported by a study which states that working in a standing posture, evaluated with the help of a vertical scanner, requires lesser neck and shoulder muscle activation during work than when working in a sitting posture [23]. This may be explained by some previous findings. In the standing position, the cashiers are able to cover a large area during their work, which minimizes the extension of the body to reach items [104], which is because working in a standing position allows for greater mobility, body weight distribution alternating between the legs in order to position the arms to perform tasks [23].

For biomechanical considerations, the standing posture is suggested, as standing helps in increasing stability of the lower back during work, which helps maintaining the natural lordosis of the lumbar spine [119]. Nevertheless, MSDs among cashiers do occur and have been reported even in those working in the standing position [18-20, 33, 70, 120]. In addition, with standing 17.7 degrees more ROM of neck flexion is required than in a sitting posture [104]. According to a report by EU-OSHA (2008), in the standing posture, there will be more load on the neck and back due to the cashier looking downwards for most work tasks, and repeatedly bending forward [105]. The changes in work positions are recommended to decrease fatigue [106, 107]. Every position, whether it is standing or sitting, has its advantages and disadvantages.

Alternation between standing and sitting positions, are recommended by previous studies [19, 23]. When a cashier changes his posture from sitting to standing, the ROM for median shoulder abduction is clearly reduced by approximately 20 degrees [104]. In addition, there is a reduction in the shoulder movement by approximately 30% in the sagittal plane, in elbow movement by approximately 35%, and in trunk rotation by approximately 55% [54]. On the contrary, neck flexion will increase by 7.5 degrees in standing position compared to the sitting position [104]. Whether sitting or standing, a combination of more than one movement increases stress on the body.

Working involves flexion of the trunk and shoulders and a combination of shoulder flexion and trunk rotation during handling of items, as well as flexion and extension of the wrist. These have been identified as highly stressful postures in a supermarket cashier job [43].

Sitting or standing position of cashiers during work are not the only factors that play an important role in prevalence of MSDs among cashiers. High ROM is required in such a profession. This demands muscle activation and biomechanical changes in specific positions. According to the

previous studies, working as a cashier in the standing position may have lesser negative impacts. However, rest and changing to a sitting position from time to time are important in order to decrease the stress on lower limbs. Other factors such as psychological and social factors may have impact on the prevalence of MSDs among cashiers.

#### 4. Psychosocial Stress Among Cashiers

The supermarket cashier job requires performing tasks in front of customers and other employees, mostly in open areas, an important cause of psychosocial stress among cashiers. It has been found that mental fatigue is associated with the job of a cashier [121-123]. As cashiers deal with money, which requires a high level of accuracy, 76% of cashiers feel mentally fatigued after the work shift [12], which is not associated with the physical workload in cashiers [14].

When Lundberg et al. 1999 studied female supermarket cashiers, it was found that stress hormone levels significantly increased when working for two hours, compared to during rest time [14]. Some hormones are released when the body is under extreme stress. Epinephrine hormone is released when under mental stress and norepinephrine is released which indicates physical demands [124]. Therefore, a significant increase in both hormone levels are an indicator of the mental and physical stress felt by the cashier [14]. As the job of a cashier requires limited positions and repetitive physical activity for a long time it is considered monotonous and repetitive work. Consequently, mental stress can elevate muscle tension [125].

Monotonous and repetitive work has a relationship with the prevalence of some MSDs, such as LBP, shoulder pain, and neck pain [32, 126]. Cashiers face some restrictions during work hours, as they cannot leave the workplace to make a phone call or for other personal tasks without being excused or replaced by another person. These restrictions increase psychosocial stress [124, 127], which may contribute to the development of MSDs [73].

Psychosocial factors related to the job of a cashier may have an impact upon them. Some previous studies attempted to find a relationship between the occurrence of LBP and psychosocial factors. The evidence was conflicted about supporting this relationship, some were considered as psychosocial factors such as low job- satisfaction risk factors for the development of LBP [128-131]. The relationship between psychological factors and MSDs in the neck and shoulders was found by other studies [132, 133]. Satisfaction level of cashiers was investigated and found to be good in about 74.6% of female cashiers while about 62.7% of them felt their jobs were monotonous [12].

When a study conducted, a questionnaire survey for 105 supermarket cashiers (103 female, 2 male), it revealed that cashiers did not like some aspects of their job such as the stress of dealing with tough customers (reported by 47.6% of cashiers), prolonged sitting at the workstation (8.7%), monotony (7.8%), working time shifts (5.8%), and the small workstations (5.8%) [134]. They complained about some

psychosocial factors which differed from cashier to cashier. Organization of job and training of cashiers can help in minimizing these factors.

Cashiers did not only have physical difficulties. Psychosocial factors related to their job are present too. Supermarket cashier jobs include social interaction as they deal with a high number of people and co-workers. In addition, accuracy and mental focus are required. Therefore psychosocial factors may lead to increased prevalence of MSDs.

## 5. Age and Gender Factors Affecting the Prevalence of MSDs Among Supermarket Cashiers

Gender and age are considered factors contributing in the prevalence of MSDs. Gender is a significant factor in predicting symptoms in the upper back, hands, and wrists [8]. Moreover, prevalence of MSDs in the upper back, hands and wrists occurs in females twice as much as in males. [8]. However, male had higher incidence of work related injuries and illness requiring sick leave than female according to bureau of Labor Statistics report [135].

Females have a small muscle mass and less strength in upper-limb than males [136]. The size of muscles is associated with muscle strength [137]. This may explain the difference in muscle activation level between male and female cashiers during the handling of items [25]. When the grocery items on a conveyor belt approach from right to left, female cashiers require more muscle activation on the right side than males, while the same muscle activation is required for both sexes on the left side [25]. As cashiers reach items with their right hand and pick up with their left hand, they slide items to the packing area with less effort. Moreover, there is a greater prevalence of MSDs in females including those of the upper limb, except for disc herniation and knee disorders [138]. CTS is more prevalent in females than males [60]. Therefore gender has an important role in the prevalence of specific disorders in males or females.

Age is one of the factors playing a role in the prevalence of MSDs. Ageing is associated with structural and degenerative changes in muscles, tendons, joints, and articular cartilage, and may even lead to calcification, which has adverse effects in the general population as well as in cashiers, with a higher rate of pain reported among cashiers [6]. Prevalence of rotator cuff calcific tendinopathy of the shoulder increases with age [139]. The high prevalence of MSDs in the shoulders among supermarket cashiers is associated with increased age [6, 140-142]. In addition, there is a strong positive association between age and the prevalence of CTS symptoms [60]. Thus, age may be considered as an important risk factor of MSDs among cashiers [78].

Some structural changes in the human body have been found to be associated with factors such as age [6] and gender [136]. According to some previous studies conducted on supermarket cashiers, they showed that these factors have an

association in the prevalence of MSDs in cashiers. Moreover, when such factors combine with work related factors, the risk of developing MSDs also increases.

## 6. Job Rotation for Supermarket Cashiers

As has been reported, monotonous and repetitive work has an association with the prevalence of MSDs [32, 126]. Moreover, variation in job task activities are assumed to provide a reduction in the likelihood of developing MSDs [143]. Although the benefits of job rotation are still questionable [144], previous evidence has shown that job rotation leads to more biomechanical stress on workers [145]. In contrast, another study reported the existence of benefits of job rotation on muscular activity [146], thus reducing the prevalence of MSDs among cashiers at work due to introduction of job rotation [147]. Job rotation has been found to be suitable for some activities [148]. Whether this is beneficial for cashiers or not, this still needs more investigations.

Supermarket workers were studied by Balogh et al. 2016 [46] wherein subjects were classified as cashiers, pickers, delicatessen workers, and a mixed group who performed all these tasks. Results showed that the rate of prevalence of neck and shoulder symptoms within seven days was between 44% and 56%. Those who did mixed work had the lowest prevalence, while cashiers exhibited a significantly high rate of such symptoms. During measurement of physical workload, it was highest in the mixed work and picker work groups, who demonstrated significantly fewer neck and shoulder symptoms compared to the delicatessen or cashier work groups [46].

Rissén et al. 2002 examined the effects of the job rotation model in 31 female supermarket cashiers. After introduction of job rotation, 40% of their time working as a cashier and 60% of their time working in different departments of the supermarket, results showed that most cashiers experienced a reduction in neck or/and shoulder pain compared with cashiers who were not having job rotation. However, pain intensity in both situations did not significantly change, this may be attributed to the small sample size and/or the heterogeneous sample. This study supported the positive effect of work rotation on the activation level of muscles in the neck and shoulders, measured by EMG [15]. Although pain was mildly affected and many psychophysiological variables were not changed with the introduction of job rotation [15], the rotation of supermarket workers may be considered better than the work as a cashier only. However, this recommendation still needs investigation.

Job rotation has served as an introduction between cashiers and shop assistants, and clearly reduces the level of stress and strain in some parts of the body [47]. Job rotation helps to change working postures, which may decrease the chance of developing MSDs [47]. Job rotation may have a good effect on supermarket cashiers. Future studies should not ignore this point.

## 7. Cashier Workstation (Checkout) Design and Some Features

Supermarket cashiers spend most of their work time at a checkout station, thus its design may have some effects on them. The checkout design is important, as it is a potential determinant for the prevalence of MSDs among supermarket cashiers as have been reported [26, 29, 149, 150]. Many studies have been conducted on workstation ergonomics and its effect on the cashiers; however, it is out the scope of this literature review.

Hinnen et al. 1992 compared the cashiers who work using a laser scanner and those who work at conventional checkout counter, without a scanner reader. The subjects were 46 cashiers working with laser scanners (scanner on the left side) and 106 cashiers working with traditional checkout counters (keyboard at the right side). All of them were females working in the sitting position. The study reported a high prevalence of problems in the neck, left shoulder, left arm, and back. In addition, use of laser scanner was considered more beneficial than the traditional system because of less stress on the right arm [47]. This is a very important message to enhance using laser scanners in order to reduce the neck and shoulder symptoms.

Using laser scanners without job rotation still has the highest prevalence of pain in the neck, shoulders and left arm [47], which may be due to the task becoming faster, more repetitive, and generally increasing the workload in the shift by use of a scanner reader. The study showed that those working part-time do not have fewer symptoms of MSDs than those working full-time, except with regard to back problems. This may be due to part-time cashiers' work shifts occurring during peak load times [47]. A combination of scanning and job rotation should be suggested for cashiers because of a beneficial impact on the decrease in the prevalence of MSDs [47].

Grant and Habes 1995 conducted a study to examine the relationship between WMSDs and different checkout-stand designs. They used two checkout-stand designs (front-facing with vertical scanner and right-hand takeaway with horizontal scanner), and studied 10 cashiers using each design. In the front-facing design items are passed parallel to the cashier and they always use their right hand to reach and grasp items. In the right-hand takeaway, items are passed perpendicular to the cashier and they always reach for items with their left hand. Significant differences were found in the posture and movement of cashiers during scanning, according to the checkout design. While all cashiers tended to shift items from one hand to another during scanning, cashiers using the right-hand takeaway mostly used only one hand during scanning because of the assistance provided by this design, which allowed a swimming motion [26]. Therefore, using only one hand during scanning can lead to MSDs in this hand.

Cashiers in both checkout-stand designs had an inappropriate shoulder position (60 degrees in flexion or abduction), observed during the initial reach for grocery items. The percentage of inappropriate shoulder positions seen in

both designs were (front facing = 34.8% and right-hand takeaway = 51.1 %) smaller in the front-facing design. The grasping technique was unaffected by the design of the checkout-stand. During scanning, the percentage of pulling items without lifts was slightly more among cashiers using the front-facing design with a vertical scanner. In general, the study supports the front-facing check stand design with vertical scanner, which reduces awkward trunk postures during scanning [26].

A study examined 12 supermarket cashiers who were unloading grocery items from the cart as a new service for customers. In addition, the study involved 10 cashiers who did not unload any items. The results showed that cashiers receiving items from a cart for scanning had a significant increase in the amount of awkward trunk postures and awkward shoulder postures, compared to cashiers receiving items from a conveyor belt for scanning [86]. Awkward posture along with repetition over time will lead to MSDs.

The effect of standard and modified checkout work station on trunk postures among supermarket cashiers during scanning was studied by Rodacki and Vieira 2010 [45]. The standard workstation included a conveyor belt, an optical scanner, and a packing area. The conveyor belt had an electronic sensor which controlled the movement of the grocery items. The belt was located at a 45-degree angle to the right of the cashier's mid-line and about 0.30m from the cashier's mid-line. This meant that grocery items were placed below the level of the cashier's right hand. After handling and reading the barcode with the optical scanner in front of the cashier, the items needed to be manually placed in the packing area. The modified workstation included a continuous conveyor belt, with an electronic sensor to stop the items in front of the cashier's mid-line. After being scanned by the optical scanner, the items will be moved directly towards the packing area [45]. The modified design seemed to reduce the effort by cashiers, therefore may help in minimizing the occurrence of MSDs.

The results showed that movement of the trunk in the sagittal plane is the same in both designs, but there was significantly more anterior flexion of the trunk during scanning in the modified checkout workstation than in the standard design workstation. As cashiers reached for products/items, the lateral bending of the trunk was significantly greater in the standard workstation than the modified workstation. Most cashier movements while using the modified workstation have minimal deviations from neutral posture. No significant effects were found on trunk rotation due to workstation design, either standard or modified. This study concluded that using workstations with continuous conveyor belts may be a method to reduce ROM of the trunk [45], thus reducing the prevalence of MSDs.

Another study conducted on 25 supermarket cashiers, focused on the service provided by cashiers, which is packing items into plastic bags, reusable bags, or bins with different levels of workstation heights (low, medium, high). The study found that a lower height of the surface of the workstation has an effect on reducing muscle activation in the shoulders, and

lower elevation of arms during lifting items for packing. Use of bins with a low height, compared to plastic or reusable bags, will decrease the distance of lifting items from the workstation surface to the packaging area. In addition, packing items into bins was associated with less effort as the rigidity of the bin minimized the need to stabilize with the other hand [25]. Even small things in the area around the cashier can lead to changes in performing a tasks.

In all workload and packaging types, during low workload, lesser muscular activation level is required than during the high workload intensity tasks. Packaging type has a significant effect on EMG measures, as use of a bin requires a lower level of muscle activation compared to plastic bags and reusable bags. Use of plastic bags and reusable bags requires a high level of muscle activation during both high and low workloads. In general, the height of the workstation does not have any effect on muscles during low workload. Whereas during high workload and a high workstation surface, high muscle level activation is required [25]. Bagging is associated with the prevalence of shoulder pain [151] when the grocery items come from left to right by the conveyor belt, in relation to the cashier. Bagging associated with increase the risk of developing right shoulder disorders [13].

The type and location of the laser scanner has an effect on task performance of cashiers. Bi-optic scanners include both horizontal and vertical laser scanners for reading items' barcodes on four or five sides of a product, which leads to a reduction in the turning or manipulating time required to read the barcode. Bi-optic scanners provide benefits in the reduction of wrist deviation, lifting and difficulty, compared with the use of a single-window scanner [98, 152]. Using the bi-optic scanner in a standing position showed that lesser muscle activation level was required than in using the vertical scanner in a standing position. The same effect could be seen in a sitting position. In addition, using a bi-optic scanner is considered 18% faster than using the vertical scanner [34]. The percentage of speed may be due to the decreased turning times during reading the barcode.

The front-facing checkout stand with a vertical scanner is considered as the best design to reduce posture stress during scanning [26]. The use of a vertical scanner is advantageous, as it helps the cashier to slide grocery items across the barcode reader, rather than lifting the items [86]. The study supports the benefits of the use of a bi-optic scanner in reducing risk factors which may lead to MSDs in the hand and wrist. It also increases the productivity of the cashiers [152].

## 8. Recommendations Related to Cashier Workstations

Prevention is better than cure, thus some studies report some recommendations aimed to help cashiers. Modifications in the work area and staff training can minimize and prevent the risk of developing MSDs [9]. First, there are some recommendations and suggestions regarding cashier workstations, many of which were collected and reported by

one article [26]. The work surface for cashiers should be at or just below elbow height [149]. The checkout station should have the option to work in a standing or sitting position [18-20].

Specific ROM and muscle activation is required, according to the height of checkout workstations. The UNI EN ISO 14738 standards (UNI 2009) has a few recommendations. A workstation's height for a standing position should be within 86.7–110.5 cm, and 79.5–132.7 cm for a sitting position. Furthermore, a specific national standard for checkout counters, the ON A5910/2004 (FNA 2004), reports that a checkout stand's surface height should be 90 cm. To achieve both of these standards, the height of the checkout stand is designed to be 90 cm [54]. The height of the cashier's chair should be adjustable [54], to meet the checkout height, therefore minimizing the ROM and muscle activation required during the handling of grocery items.

Second, the height of the bagging area should be level with the checkout stand surface. An adjustable bagging surface should be available [120, 150, 153]. The guidelines of the Occupational Safety and Health Administration (OSHA) have set the height of bagging areas. This should be at least 50.8 cm from the ground [25], as when the height is above 114.3 cm more demand is placed on the shoulder and elbow, which puts the cashier in an awkward position for most of the work shift [26]. Lower height of the surface of the workstation may have an effect in reducing shoulder muscle activation, along with lower elevation of the arm to lift items for packing [25].

Third, the location of the scanner, keyboard and cash drawer that are very frequently used by cashier, also have recommendations aimed at putting these in locations easier to deal with. The scanner and scale should be located in front of the cashier. The scale should be at the level of the conveyor belt [150, 154]. The keyboard should be located in the front of the cashier, above the scanner, and the height of the keyboard should be adjustable for any cashier who is using the workstation [20]. The cash drawer should be located at the side of the cashier, no more than 18 inches away from him [20].

Fourth, the position of the cashier should be face to face with the customer [154]. The movement of grocery items over the scanner must be parallel to the cashier's shoulder level in order to avoid high wrist deviation, and the design should allow the hand to move easily [86, 154]. The conveyor belt width should be minimized, not very large, in order to ensure that items can be reached with little effort [150]. Moreover, to help cashier during prolonged standing, something should be available as a foot rest for cashiers, along with anti-fatigue mats [120]. Job rotation can help in breaking up a prolonged static standing position in a supermarket cashier.

Finally, NIOSH guidelines propose that handling, lifting, and repetitive tasks with light items should be performed at a level below elbow height. A heavy task, should be performed 10.2–15.2 cm below elbow height [155]. Rotating cashiers in express lanes is suggested to allow more rest breaks [25]. More rest breaks help in decreasing chance of development of MSDs. There are

recommendations that were made by Peter et al. 2012 to modify the techniques during scanning of EAN codes to register grocery items by printing more EAN codes on the sides of items and asking customers to place the side of EAN codes towards the scanner. This would lead to a decrease in the repetitive movements of the wrist [156].

## 9. Gaps in Literature Review

Most studies in the literature review were conducted in Sweden, Italy, or the USA. No studies have been conducted about supermarket cashiers in Arabic countries except one study in Saudi Arabia. The majority of previous studies recruited female cashiers only. However, in those studies that recruited both sexes, the number of males was significantly lower than that of the female cashiers. According to previous studies [157-161], the prevalence of musculoskeletal pain is higher among females compared to males in terms of the occupational and general population. The elbow joint appeared to be a region affected by the nature of the cashiers' work; however, no enough studies have investigated this body region previously. Additionally, previous studies did not use functional outcome measurements for extremities in order to measure the impact of MSDs on cashier's activity in day-to-day life.

Due to the fact that no enough number of studies have been done among supermarket cashiers, old studies have been used in this literature review. Thus, most of these older studies were used here as well as the recent studies. Old and recent studies used in this review have the similar situations with regard to features in supermarket cashiers and checkout stations.

## 10. Conclusion

The role of a supermarket cashier is not as simple as it first appears. People working in this job are at a risk of suffering MSDs, which may be related to work. The prevalence of symptoms varies among different body regions such as the spine, upper limbs, and lower limbs. However, the spinal and upper limb regions are more susceptible to have such disorders. Moreover, some of these symptoms may develop or exaggerate due to psychosocial factors. The supermarket cashier job has several risk factors that may be related to ergonomic workstations, a person's characteristics, and some related to the nature of work, which involves repetitive movements. Most of the studies conducted on supermarket cashiers have focused on the prevalence of MSDs among cashiers and occupational repetitive movements in the neck, upper limbs, and spine. In addition, some studies have focused on ergonomics and some other aspects. Finally, future studies on supermarket cashiers should recruit more males than females, because previous studies focused on females only.

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