On Lower-back Pain and Its Consequence to Productivity

Nur S. A. Ramdan, Ahmad Y. B. Hashim, Seri R. Kamat, Mohd N. A. Mokhtar, and Siti A. Asmai
Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka, Melaka, Malaysia
Email: sufiah.akmala@gmail.com; {yusairi, seri, najibali, azirah}@utem.edu.my

***Abstract*—Manual handling is the primary cause of musculoskeletal disorders, such as sprains and strains and joint disorders, which account for more than half of all injury claims. If motions are repeated frequently, such as in every few seconds, and for prolonged periods such as an eight-hour shift, fatigue and muscle strain can acquire. Working hours is lost every year by means of injury, and personal injury situations and compensation packets are costly. Employers could boost productivity by training their workers to handle loads the right way, or by providing materials-handling equipment to aid them with the job.**

***Index Terms*—manual handling, lower-back pain, productivity.**

I. Introduction

Manual handling is a major contributing factor to workplace injuries in manufacturing industries. Manual handling covers a wide variety of activities such as lifting, pushing, pulling, holding and carrying. It involves repetitive activities such as packaging, assembling, using hand tools and operating machinery and equipment. In the automotive industry, for example, manual handling is the primary cause of musculoskeletal disorders, such as sprains and strains and joint disorders, which account for more than half of all injury claims. If movements are repeated frequently, such as in every few seconds, and for prolonged periods such as an eight-hour shift, fatigue and muscle strain will likely to occur.

Figure. 1. The manual handling of a worker [1].

Effects of repetitive motions from executing the same work tasks are increased when awkward postures and forceful exertions are involucre. In industrial employments, the time to complete one unit of assembly or to inspect one point is defined as a cycle. This task is considered repetitive if cycle time is two minutes or less and is repeated during a shift. A repetitive activity has a cycle time of 30 seconds or less. Fig. 1 shows that the manual handling that must be done by a worker. These movements will cause back pain problem if it is repeated many cycles.

Further to the pain experienced by workers who are injured, these put cost to the industry. They can result in protracted pain, disability, medical remedy, financial pressure for those afflicted with them, and employers often find themselves paying the invoice, either entirely or by means of compensation insurance. At the same time, they must cope with the loss of the full ability of their employees. Scientific evidence suggests that efficient ergonomic interventions can reduce the physical demands of manual handling with work activities, thereby lowering the incidence and severity of the musculoskeletal injuries they can cause.

Their potential for reducing injury-related charges alone produces ergonomic interventions a helpful tool for improving a company's productivity, product quality, and overall business competitiveness. When employees perform lifting, or stacking, or moving things about, they are not just using their hands. In reality, they are using all the tools at their disposal, all the muscles, joints and ligaments in their body.

People with manual handling activities use these tools daily. Nevertheless, as whatever used typically, these is taken for granted. In truth, more than a third of all industrial accidents, once a year, are a cause of handling loads and just by pushing, pulling, or lifting. Most of these injuries are strains-to back, arms, hands, fingers-and sprains: to the wrist, the thumb, the ankle.

These accidents are often a cause of lifting heavy things frequently, or twisting around to stack things at the side, or pulling loads by the simple decision of bracing the back and giving a good heave. Some of these accidents might be prevented. It is in employers' legal interests to be sure their workers are coping with goods and loads safely. It is additionally in their economic interests.

II. Studies on Lower-back Pain

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Low back pain (LBP) gives the look to be associative with impaired trunk postural control, which could be a cause of proprioceptive deficits and is a radical public health concern with big human and economic burden [3]. In fact, LBP is the most predominant work-related musculoskeletal pathology [4]. Moreover, LBP is a serious trouble in manual work with high prevalence and impacts worker absenteeism [5]. Ever changing sitting is proposed to lower LBP [6]. Similarly, sit to stand (STS) may lower LBP where the activity requires variability of all body segments to accomplish the stability of the vital control variables such as the center of mass and head positions [7]. Fig. 2 shows the region of low back pain. It always happens at the lumbar vertebrae area.

Figure. 2. Low back pain region [8].

Symptoms surveys of work-related musculoskeletal disorders (WRMSDs) are performed principally using short-answer questionnaires [9]. There are databases and professional association websites that may be used as guidelines. The guidelines may comprise of multimodal, multidisciplinary programs that include psychological interventions where this has turned standard in the rehabilitation of patients with chronic LBP [10]. Studies indicate that a worldwide measurement tool might be developed based on the International category of Functioning Disability and Health (ICF) Core Sets for chronic conditions. The main challenge was the invariance in the responses in keeping with country [11]. An electronic systematic search may be conducted using Medline, Cumulative Index to Nursing and Allied Health Literature, EMBASE, and Scopus databases focusing on cohort and case-control studies [12], whereas, the quality of the studies may be assessed utilizing the PEDro scale [5].

Sayson *et al.* [13] explained that during spaceflight lots astronauts experience moderate to severe lumbar pain and deconditioning of paraspinal muscles. There is furthermore a significant incidence of herniated nucleus pulposus in astronauts post-flight being most prevalent in cervical discs. Relief of in-flight lumbar back pain is facilitated by assuming a knee-to-chest position. The knee-to-chest position may reduce lumbar back pain by redistributing stresses through compressive loading to the intervertebral discs, possibly reducing disc volume by fluid outflow across intervertebral disc endplates. They suggest the countermeasures for lumbar back pain may include in-flight utilization of:

1) An axial compression harness to prevent excessive intervertebral discs expansion and spinal column elongation;
2) The utilization of an adjustable pulley exercise created to prevent atrophy of spine muscle stabilizers; and
3) Other exercises that provide Earth-like annular stress with low-load repetitive active spine rotation movements.

Willigenburg *et al.* [2] studied on an upright trunk posture where they gathered twenty a-specific low back pain patients and 13 healthy controls maintained a self-chosen upright trunk posture. Initial frontal and sagittal plane angles of an opto-electronic marker on the 12th thoracic spinous process defined the center of a target ground on a monitor. They instructed the subjects to remain within that target and visual feedback was provided when they left the target. The exactness demand was manipulated by changing target size. The standard deviation of trunk angle quantified exactness and mean Euclidian distance to target center quantified precision. Ratios of antagonistic co-activation were calculated from trunk muscle electromyography recordings.

Similarly, Mehravar *et al.* [7] investigated the possible differences in the variability patterns of loads of body segments were investigated between 11 chronic LBP and 12 control subjects throughout STS task by ways of two kinds of variability analyses. It was done firstly by calculating the variability of seven limb angles, center of mass and head positions across 15 trials and secondly by leading component research of seven limb angles. They instructed the participants to perform the activity at three postural difficulty levels: inflexible surface, open eyes, inflexible surface, close by eyes and narrow surface, and close by eyes.

In investigating the trunk flexion, Nelson-Wong *et al.* [14] observed the continuous electromyography and kinematic data that they collected all through standing trunk flexion and extension on 43 participants (22 male) with an age variety of 18-33 years, prior to entering into the prolonged standing exposure. They instructed the participants to classify as pain developer or non-pain developer by their pain response (Age; 10 mm boost on a 100 mm visual analog scale) all through standing. Relative timing and sequencing data between muscle pairs were calculated and evaluated by ways of cross-correlation analyses (by group and gender).

In their study on the relationship between occupational factors and low back pain severity, Govindu *et al.* [4] recruited 36 LBP patients with a preceding MRI scan to look into the effects of individual and occupational reasons and their interactions on LBP severity. Individual and occupational reasons information was obtained by means of questionnaires. LBP severity ratings were obtained by means of a self-reported Visual Analog Scale (VAS) and the Oswestry Disability Index (ODI) questionnaire and served as the dependent variables.

Stepwise linear regression exploration was performed on the variables.

In another scenario, Devan *et al.* [15] looked into LBP prevalence and the relationship between LBP and physical task levels in a national sample of persons with nerve-racking trans femoral amputation. Questionnaires were mailed to a random sample of people with nerve-racking TFA (n =322) from the New Zealand unnatural Limb Board national database. Similarly, Miller *et al.* [15] compared trunk neuromuscular routine between individuals with no history of LBP and individuals who experience exercise-induced LBP (eiLBP) when pain free, and (2) check up on changes in trunk neuromuscular routine with eiLBP.

Seventeen youthful adult males participated this includes eight reporting recurrent, acute exercise induced LBP and nine control participants reporting no history of LBP. They determine the intrinsic trunk stiffness and paraspinal muscle reflex delay in both groups using sudden trunk flexion position perturbations 1-2 days going after exercise when the exercise induced LBP participants were experiencing an episode of LBP (termed post-exercise) and 4-5 days going after exercise when exercise induced LBP had subsided (termed post-recovery).

Similarly, Keawduangdee et al [5] conducted a cross-sectional survey study among textile fish net industrial employees using a structured questionnaire (hand delivered by researchers and independently completed by workers). The 7-day prevalence of LBP in this study was 68.6% (95% confidence interval: 65 to 72%). They suggested that work circumstances significantly relevant to LBP included prolonged standing and walking. Milosavljevic *et al.* [16] resolved whether whole-body vibration (WBV) and mechanical shock exposure from quad bike use are affiliated with the prevalence of neck and low back pain (LBP) in New Zealand farmers and rural employees. Full-day WBV and mechanical shock exposures were accumulated from 130 farmers and rural employees. They surveyed participants for a history of neck or LBP previously 7 days and previously 12 months. Anthropometric, personal, and workplace data were also accumulated.

III. The Effects to Productivity

Lower-back pain has created a major trouble in industrial productivity. In the United States, according to Tal *et al.* [18], LBP has been shown to be the second most frequent cause of missed workdays because of illness and the main cause of disability. The financial repercussions of these figures are meaningful with Americans investing at least $50 billion every year on medicine for LBP, often with little consequence. Correspondingly, in the UK back pain is liable for the loss of one in six working days, easily lessening employee productivity and efficiency.

In Sweden, on the other hand, according to Duthey *et al.* [19], a survey showed that LBP increases the amount of work days lost from 7 million in 1980 to 28 million by 1987. In the U.S., an estimated 149 million days of work per annum are lost because of LBP. The situation is therefore, pricey, with total expenses estimated from USD 100 to USD 200 billion yearly, two-third of which are due to reduced wages and productivity. LBP imposes a high socio-economic burden in modern western countries, since it not only effects the ancient population but in addition, the working population from 25-60 years.

A study done by Johnson *et al.* [20] said that through 1000 nurses in three hospitals in England completed questionnaires about LBP. The results indicated that of the participants who reported reduce back pain, 30% were reported missing at work due to it. A meaningful connection was also discovered between having low job safety and taking time off work. Since work absence and low productivity are so expensive, analysis under these circumstances is not just about placing workers out of pain. It is about improving the results in today's workplace. Fig. 3 shows two nurses moving a patient from her chair to the bed. This routine can allow the nurses to have low back pain throughout the day of their work.

Figure. 3. Nurses handling the patients will cause them to have low back pain in done with improper position [21].

One study of employees with LBP because of workplace injury uncovered five main themes [22]: justifying LBP at work; concerning about future ability to retain work; coping with flare-ups; reluctance to use medication; and concerning about sickness records. The researchers concluded that workers with LBP remained uncertain of how best to manage their condition in the workplace despite previous healthcare interventions, and they were concerned with the impact LBP might have on their job security and future work capacity. They were also concerned about how LBP was viewed by their employers and co-workers. They felt the need to justify their condition with a medical diagnosis and evidence. When they always need to go for medical check-up and take a day off, this is when the productivity goes down.

It was found that most nurses with LBP suffer from pain two hours after work and some during sleep. However, some nurses expressed that their back pain will be improved at rest. This shows that the productivity is hard to be focused by the workers, in this case, nurses because they only can give their best focus during the first two hours [23].

In addition, a study concluded that when estimating the overall burden of LBP, the measure of work-related loss of productivity should be complemented by measures of performance in household chores and limitations to leisure-time activities (LTAs) [24]. It was discovered that men are reported more disadvantage than women in work, household chores and LTAs. In workplace, the blue-collar workers are more disadvantage than the non-blue-collars. A good performance at work was reported by 81% of the women and 42.9% of the men. Because of LBP, majority of the respondents reduced their LTAs. Some respondents gave up at least one LTA. Overall, the patients had reduced the time spent doing a mean of LTA. The proportion of the reduction in LTA was considered high. The most commonly reduced were walking and different ball games.

Although LBP seems to be equally common in men and women, back and spine impairments have been shown to be more common in women than in men. However, the women who were still working could perform better than the men. When estimating the overall burden of LBP, the measure of work-related loss of productivity should be complimented by measures of performances in household chores and limitations to leisure-time activities. These are some effects how LBP lowers the productivity in everyday life. In the UK, the cost of LBP, mainly due to workdays lost amounts to £12.3 billion, which are equivalent to 22% of the UK healthcare expenditure and 1.5% of the UK GDP [25]. Fig. 4 shows that the economic cost of LBP in UK for the year 2013, which is a significant loss due to LBP.

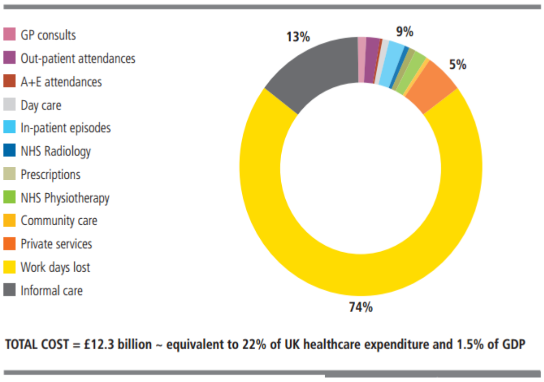
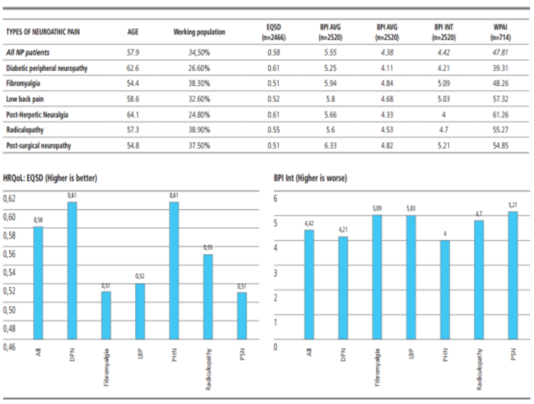


Figure. 4. Economic cost of back pain in the UK [25].



TYPES OF NEUROATHIC PAIN	AGE	Working population	EQ5D (n=2466)	BPI AVG (n=2520)	BPI AVG (n=2520)	BPI INT (n=2520)	WPAI (n=714)
All NP patients	*57.9*	*34,50%*	*0.58*	*5.55*	*4.38*	*4.42*	*47.81*
Diabetic peripheral neuropathy	62.6	26.60%	0.61	5.25	4.11	4.21	39.31
Fibromyalgia	54.4	38.30%	0.51	5.94	4.84	5.09	48.26
Low back pain	58.6	32.60%	0.52	5.8	4.68	5.03	57.32
Post-Herpetic Neuralgia	64.1	24.80%	0.61	5.66	4.33	4	61.26
Radiculopathy	57.3	38.90%	0.55	5.6	4.53	4.7	55.27
Post-surgical neuropathy	54.8	37.50%	0.51	6.33	4.82	5.21	54.85

Figure. 5. Patient reported quality of life and pain severity of different neuropathic pain subgroups [25].

Fig. 5 shows the reported quality of life and pain severity of different neuropathic pain subgroup. From the EQ5D bar chart, it dictates that LBP patients are among the patients with very low quality of life with the value of 0, 52. The BPI bar chart, on the other hand, shows that the pain severity experienced by LBP patients is very high, with the value 5, 03 from 6. These show how much productive work that the LBP patients can do during their working hours.

IV. Summary

There are factors that contribute to LBP. Employees suffered from LBP are those who do not regulate their work activities. Lower-back pain is one of the most common sicknesses attacking the workers. This is also true, even if they simply sit back at their chair. An employee with LBP usually takes a day offs from their work for medical check-ups. Consequently, a company's productivity will drop if it has a significant number of employees suffered from LBP.

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Nur S. A. Ramdan obtained her B. Eng. in Manufacturing Engineering from Universiti Teknikal Malaysia Melaka. She is currently a master's candidate at the same university. She finishes her bachelor degree program with the project related to robotic vision system. Now she is doing her masters project related to vision system for predicting back pain.

Ahmad Y.B. Hashim A. Y. Bani Hashim obtained his Ph.D. from University of Malaya, M.S. degree from Universiti Putra Malaysia, M. Ed. degree from Universiti Teknologi Malaysia, and B.S. degree from the Pennsylvania State University. He is senior lecturer in the Department of Robotics and Automation, Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka. He has been in the teaching profession since 1997. He is now working on bioengineering, robotics, and scientific computing.

Seri R. Kamat is senior lecturer in the Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka.

Mohd N. A. Mokhtar is lecturer in the Faculty of Manufacturing Engineering, Universiti Teknikal Malaysia Melaka.

Siti A. Asmai is senior lecturer in the Faculty of Computer and Information Technology, Universiti Teknikal Malaysia Melaka.