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Musculoskeletal disorders and work assessment in pharmaceutical distribution units: A case study

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Abstract

The pharmaceutical supply chain serves as an intermediary between a pharma company and consumers/patients. Distribution units or Carrying and Forwarding Agent (CFA) is one of the connecting links in the pharma supply chain that connects manufacturer to wholesaler or stockist. The job of workers at the CFA level is to pack medicines in customized packages for wholesalers. Packing work necessitates these workers to do repetitive activities and assume awkward postures, which can trigger work-related musculoskeletal disorders (WMSD). Musculoskeletal disorders (MSD) are painful disorders resulting due to constant body movements and prolonged postures. This study was carried to evaluate the MSD prevalence among pharmaceutical supply chain workers and understand their work pattern. Data for 112 subjects (88 male and 24 female) from 11 CFAs were obtained using observation, a general questionnaire, and a modified Nordic Musculoskeletal Questionnaire (NMQ). Results indicated MSD prevalence among male and female workers, with the maximum number of workers reporting pain in the lower back, knee, and ankle/feet. The findings can be attributed to the postures adopted while working as it was noticed that bent and twisted back, bent and twisted legs, squatting, and kneeling on the floor were the most common work postures. The results of this study highlight a need for posture assessment and the creation of a workstation to eliminate harmful postures and consequently reduce MSDs among pharmaceutical packing workers.

Keywords: CFA, pharmaceutical supply chain, posture, MSD, WMSD

Introduction

According to Ergo Plus ^[15], "Musculoskeletal Disorders or MSDs are injuries and disorders that affect the human body's movement or musculoskeletal system (i.e. muscles, tendons, ligaments, nerves, discs, blood vessels, etc.)." CCOHS ^[18] says that Work-related Musculoskeletal Disorders (WMSD) occur due to common everyday body movements such as bending, straightening, gripping, holding, twisting, clenching, and reaching. However, these everyday movements become hazardous in work situations due to continual repetition, forceful exertion, and fast speed. A report by Centres for Disease Control and Prevention's (CDC) National Institute for Occupational Safety and Health (NIOSH) ^[16] pointed out the relationship between work conditions and MSDs of the neck, shoulder, elbow, hand and wrist, and back. Work-related musculoskeletal disorders (WMSD) are disorders that are contributed or made worse due to work conditions, says CDC ^[19]. Small scale industries are important to the economy in countries like India and form a large workforce, but hardly any attention is given to the workplace design and postures adopted by the workers in these industries, which lead to WMSD among them (Mali and Vyavahare, 2015; Sain and Meena, 2016) ^[7, 11]. 59.4% of 631 workers from small and medium-sized enterprises located in Delhi reported musculoskeletal disorders in different parts of their body depending upon their work (Joshi *et al.*, 2001) ^[4]. It was found out that 20.33%, 34.33%, and 45.32% of the workers were under high, medium, and low risk of MSDs, respectively, in a study of the work of 102 workers in a forging industry (Singh J, Lal H, Kocher G, 2012) ^[12]. Velaga and Telaprolu (2013) ^[14] while studying the workstation of pharmaceutical packing workers postulated that packing activities being static as well as repetitive demand both, fixed position and continued repetition of movements. Varmazyar *et al.* (2009) ^[13], used Nordic Musculoskeletal Questionnaire (NMQ) to assess MSD prevalence among 38 pharmacy packaging workers and also assessed the correlation of MSD prevalence with posture, age, weight, height, and work history in a study to evaluate

pharmaceutical packing workstation. Similar studies were done using NMQ to assess MSD among pharmaceutical packaging workers and work postures adopted by them. (Pourmahabadian *et al.*, 2008; Kheiri, 2012; Ghasemkhani *et al.*, 2008)^[10, 5, 2].

Pain in the low back, wrist, and knee was reported to be the highest among workers involved in lifting, lowering, and carrying boxes and bulky body packages in a food manufacturing company in Tehran-Iran (Naeini, 2015)^[8]. When MSD prevalence and working postures of brick kiln workers were studied, the common postures adopted for the maximum working time were squatting (67%), stooping (19%), and standing (14%) (Inbaraj *et al.*, 2013)^[13]. Etemadinezhad *et al.* in 2013^[1], did research on work posture and MSD prevalence among workers of a tobacco factory and found out the presence of critical postures and MSD, mainly in the lumbar region, knee, and shoulder. Pal *et al.* (2015)^[9], while studying WMSD and postural stress among female potato cultivators identified three main work postures: squatting, stooping, and walking and discovered high MSD prevalence in the lower back, upper back, shoulder, waist, hip, and elbow.

Rationale

Inference from the past studies is that the prevalence of MSD among workers in small and medium-sized industries is widespread in India and other countries. Work in the pharmaceutical packing industry requires workers to do repetitive actions and assume uncomfortable postures, which eventually result in MSDs. Workers in supply chain units of the pharmaceutical industry are involved in picking and packing medicines. These activities demand them to walk, bend while sitting and standing, kneeling on the floor, and squat too often. Previous researches were done on the

musculoskeletal problems of the pharmaceutical packing industry and identified MSD prevalence and poor workstation design. This study, however, focuses on the work pattern of the pharmaceutical supply chain industry specifically and musculoskeletal problems among its workers.

Objective of this study are

1. To evaluate the work pattern of pharmaceutical distribution workers.
2. To evaluate the prevalence of musculoskeletal disorders among pharmaceutical distribution workers.

Delimitation

Pharmaceutical supply chain workers and work at CFA level only is considered in this study.

Methodology

It was descriptive research designed to assess the work pattern and prevalence of MSD among pharmaceutical packing workers. Observation, survey, and descriptive statistics were used to explore the situation.

About CFA

Distribution units in the pharmaceutical supply chain are called Clearing and forwarding agents (CFAs). The role of these organizations is to maintain the stock of a company's products and forward it to stockists/ wholesaler on request. Pharmaceutical companies keep 1-3 CFAs in each Indian state. Manufactured products pass through the company-owned central warehouse to the CFA. From the CFA the stocks are supplied either to stockists or hospitals. The retail pharmacy obtains products from the stockist, and from the retailer, it finally reaches the consumers (patients) (Langer and Kelkar, 2008)^[17].



Fig 1: A typical pharmaceutical supply chain

Sample

112 workers, 88 males and 24 females, from 11 CFAs were chosen using purposive sampling technique. The age of workers was between 18 to 42 years, and their work experience was between 1 to 12 years.

Data collection tool

Observation: Workers in the distribution units were observed while doing their work. Video recordings and photographs were taken. **General questionnaire:** Information about the subjects' age, background, education was collected using a questionnaire. **Nordic Musculoskeletal Disorder Questionnaire:** along with the general information, prevalence of MSD in body parts was also assessed using a modified NMQ. A group of Nordic people designed a standardize questionnaire to record the musculoskeletal disorder symptoms among the workforces from different types of occupations. NMQ contains a set of structured questions and a body map that shows nine body parts prone to musculoskeletal injuries: the body parts are neck, shoulder, upper back, elbows, low back, wrist/hands, hips/ thighs, knees, and ankle/feet (Kuorinka *et al.*, 1987)^[6]. **Vital statistics**

of the workers such as height weight hip/ waist ratio were taken using anthropometric kit, weighting scale, and measuring tape.

Results

The main objective of the study was to assess the work pattern and prevalence of MSD.

Assessment of work

A pharmaceutical company manufactures medicines but doesn't provide them to the patients directly. It sends them to an agent called the distribution unit or CFA. CFA receives packed medicines from the manufacturer, stores them in its go down, and supplies them to the individual stockiest. Packing workers in the distribution unit of the supply chain in the pharmaceutical sector are called pickers. Pickers receive an order from a stockist or wholesaler and pack medicines as per specifications given in that order. The job of pickers typically covers four main activities: Picking, Checking, Packing, and Carrying. Table 1 shows the four main activities, sub-activities or task, and postures adopted by the workers to do those tasks.

Table 1: Activities and tasks done and postures adopted by Pharmaceutical distribution workers

Activity	Description of the activity	Sub-activity/ tasks	Posture adopted
Picking	As soon as pickers receive an order or pick list, they refer to the list and start assembling medicines at one place in the quantity specified in the order.	Referring list of medicines	Standing Back bent and twisted Neck bent
		Gathering medicines	Standing Walking Reaching with one or both elbows extended
		Placing medicines on floor	Standing with bent back Standing with one or both knees bent
Checking	After picking or gathering medicines, they check if the quantities and names are correct.	Checking while sitting on floor	Sitting on stool Sitting on stool with bent back or bent and twisted neck or both
Packing	Pickers then pack the medicines in cardboard cartons and wrap the cartons to be dispatched.	Picking medicines from floor	Sitting on floor squatting or kneeling with bent back, bent or twisted back. Standing with bent back. Standing with bent and twisted one or both legs
		Putting medicines in the boxes	Sitting on floor squatting or kneeling with bent back, bent or twisted back. Standing with bent back. Standing with bent and twisted one or both legs
		Wrapping and marking up cartons	Sitting on floor squatting or kneeling with bent back, bent or twisted back. Standing with bent back. Standing with bent and twisted one or both legs
Carrying	Ready cartons are lifted and carried to a place where they would be dispatched to the stockist by transporters.	Lifting weight	Standing with bent back to lift load
		Carrying weight	Walking with load.
		Lowering weight	Standing with bent back to lower load

One order is packed in 45-60 minutes, and one picker repeats 6-8 such packing cycles on a working day. The work time per day is 8 hours with three breaks, one 30-minute lunch break, and two 10-minute tea breaks. The maximum weight that workers lift is 10-14 kg.

Demographic details

Table 2 shows the demographic and anthropometric data of the subjects.

Table 2: General information about workers

Parameter	Total (n=112)			Male workers (n=88)			Female workers (n=24)		
	Mean	S.D.	Range	Mean	S.D.	Range	Mean	S.D.	Range
Age (year)	27.95	5.94	18-42	26.51	4.95	18-41	33.21	6.40	20-42
Work experience (year)	3.93	2.89	1-12	4.07	2.98	1-12	3.42	2.51	1-9
Height (cm)	162.21	7.65	144.5-179.3	164.73	6.01	153.5-179.3	152.95	5.65	144.5-168.5
Weight (kg)	57.64	9.34	29.4-86.3	59.14	9.08	39-86.3	52.15	8.33	29.4-64.9
BMI (kg/meter ²)	21.88	3.06	13.24-30.58	21.77	2.98	16.55-30.58	22.29	3.37	13.24-28

Prevalence of musculoskeletal disorders

Table 3 shows the prevalence of MSD as the percentage of workers who reported pain in various body parts. It shows

total MSD prevalence percentage and MSD prevalence percentage for male and female workers separately.

Table 3. Prevalence of MSD

Body parts	Percentage of workers reporting MSD	Percentage of Male workers reporting MSD	Percentage of Female workers reporting MSD
Lower back	64.29	64.77	62.50
Knees	33.04	27.27	54.17
Ankles/ feet	17.86	13.64	33.33
Shoulder	14.29	13.64	16.67
Upper back	10.71	9.09	16.67
Neck	8.04	6.82	12.50
Elbows	5.36	4.55	8.33
Wrist	5.36	4.55	8.33
Hips/ thighs	0.89	1.14	0.00

As explained in the table 3 and figure 1, pain is highest in lower back, knee, and ankle/ feet as 64.29%, 33.04%, and 17.86%, respectively. It was followed by pain in the shoulder

(14.29%), upper back (10.71%), neck (8.04%), and elbow and wrist (5.56% each). Pain in the hips/ thighs was negligible.

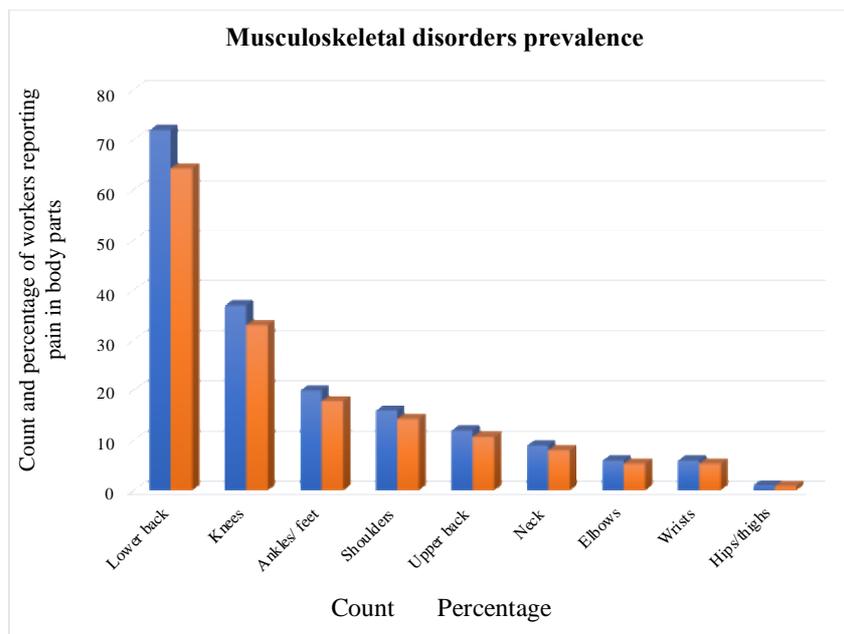


Fig 2: Prevalence of Musculoskeletal disorders among workers (n=112)

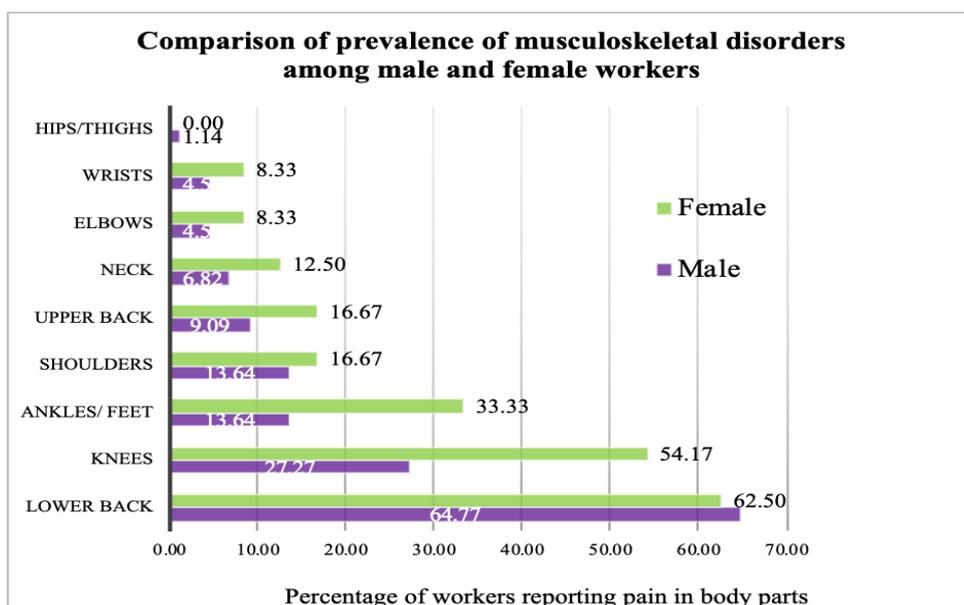


Fig 3: Prevalence of Musculoskeletal Disorders among male and female workers

As explained in figure 2, pain is highest in the lower back, knee, and ankle/ feet among women as 62.50%, 54.17%, and 33.33%, each. Pain in the same body parts was highest for men also. However, MSD prevalence was on a higher side among women for all the body parts.

Discussion

In this study, pain in the lower back, knee, and ankle/ feet was reported to be 64.29%, 33.04%, and 17.86%, respectively. Previously, in a study of 38 pharmaceutical packaging workers, 44.7% knee pain, 36.8% back pain, and 31.6% neck pain was reported. Repetitive movements, bending with more than 60-degree angle, twisting neck and trunk while working were identified to be the main risk factors (Varmazyar *et al.*, 2009) [13]. 270 women working in the pharma packing industry reported pain in the neck, shoulder, upper limb, back, and lower limb to be 74%, 73%, 74%, 59%, and 60%, respectively. The presence of poor workstation and posture was identified (Vegala and T, 2013).

84 female and male workers in pharma packing operations reported pain in the upper back (54.8%), low back (47%), and knee (43%), and a relationship between MSD and postural score calculated using RULA technique was seen (Pourmahabadian *et al.*, 2008) [10]. In another study of MSD and working conditions in pharma packaging using NMQ and RULA, 28.5% pain and discomfort in the neck, 23.7% in the shoulder, 27.9% in haFnd and wrist, and 33.2% in the back were noticed (Kheiri *et al.*, 2012) [5]. Investigation of MSD among 75 packing workers using NMQ revealed musculoskeletal disorder symptoms in the low back (44.0%), shoulders (33.3%), and neck (32.0%) (Ghasemkhani *et al.*, 2008) [2]. Workers of a tobacco factory reported complaints in the lumbar region (55%), knee (45%), and shoulders (37%) where the presence of postural risk was identified using visual posture assessment technique OWAS (Etemadinezhad *et al.*, 2013) [1]. In a potato cultivation plant where workers had to squat, stoop, keep back and legs bent, MSD prevalence of

lower back (92.26%), upper back (65.16%), shoulder (61.94%), waist (57.42%), hip (55.48%) and elbow (50.57%) was reported (Pal *et al.*, 2015) ^[9].

Conclusion

Work-related musculoskeletal disorders are common among workers in small and medium-scale industries as no attention is given to the ergonomic aspect of work in these industries. The pharmaceutical industry is one of the biggest industries in the world and the Indian pharmaceutical industry occupies a high rank globally. Manufacturing units of pharma companies are ergonomically designed and follow international standards when it comes to workplace design and practices. The pharmaceutical supply chain still is an informal agency where hardly any consideration is given to ergonomics. This study assessed the typical work pattern of pharmaceutical distribution unit workers and found out a significant level of musculoskeletal disorders present among workers.

Scope

There is the scope to assess the MSD risk exposure due to the factors such as age, gender, BMI level of workers, and work posture and do an intervention in terms of a workstation design. A comparison of posture and MSD prevalence pre and post-intervention can be done to see the effectiveness of the intervention in reducing MSD risk.

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