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Prevalence of Work- Related Musculoskeletal Discomfort (WRMSDs) among delivery agents of e-commerce

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Abstract

The rapid growth of the e-commerce sector has increased the demand for delivery agents, exposing them to physically demanding work conditions. This cross-sectional study aimed to assess the socio-demographic profile and prevalence of musculoskeletal discomfort among e-commerce delivery agents. A sample of 200 delivery agents working in urban areas of Uttarakhand's kumaun region was selected using a structured questionnaire and the Cornell Modified Musculoskeletal Discomfort Questionnaire (CMDQ). The majority of respondents were young adults aged 18–38 years, belonged to nuclear families and possessed intermediate to graduate-level education, with delivery work often serving as a supplementary or transitional occupation. CMDQ findings revealed a high prevalence of musculoskeletal discomfort, particularly in the lower back and neck, followed by the hips, shoulders and upper back. Moderate discomfort was also reported in the wrists and lower limbs. Despite the relatively young age of the workforce, the results indicate significant occupational musculoskeletal risk. The study highlights the need for ergonomic interventions, postural training, workload regulation and regular musculoskeletal health monitoring to promote sustainable work practices in the e-commerce delivery sector.

Keywords: Delivery agents, musculoskeletal discomfort, cornell modified musculoskeletal discomfort questionnaire (CMDQ)

Introduction

In today's rapidly changing and highly competitive business environment, companies range from small startups to established corporations. They often outsource specific services to remain agile and cost-efficient. Traditionally, this outsourcing has been associated with Business Process Outsourcing (BPO) operations, such as call centers, where agents handle tasks like customer complaints and service inquiries. In a similar vein, the e-commerce sector relies heavily on outsourcing labor through gig-based delivery networks, where independent delivery agents play a critical role in last-mile logistics by transporting purchased goods from warehouses directly to customers' doorsteps. An e-commerce delivery agent is typically a blue-collar job that falls under the logistics and supply chain management sector. It involves manual labor and physical tasks, as opposed to the office-based, administrative work of a white-collar job (Team AamDhanE, 2024) [7].

Delivery agents in the e-commerce industry work under demanding conditions that involve repetitive tasks, prolonged working hours, carrying heavy loads and navigating complex urban traffic, which can exacerbate both physical and psychological strain (Kallu and Sushmitha, 2025; Srinivasan *et al.*, 2023) [5, 3]. These occupational factors have been linked to a high prevalence of work-related musculoskeletal disorders (WRMSDs) a category of

acute and chronic conditions affecting muscles, tendons and nerves (Shinde and Jeswani, 2023) [6]. Common WRMSDs include tension neck syndrome, tendinitis and low back pain, all of which are frequently reported among delivery workers due to repetitive motion, awkward postures and extended periods of riding or walking (Srinivasan *et al.*, 2023; Shinde and Jeswani, 2023) [3, 6].

Physical discomfort and ergonomic risks not only diminish the concentration and motivation of delivery agents, but also threaten their productivity and job sustainability. In the e-commerce delivery context, musculoskeletal pain has been shown to be prevalent in multiple body regions, particularly the lower back and shoulders, due to continuous handling of parcels and long work shifts (Shinde and Jeswani, 2023) [6]. Additionally, irregular hours, exposure to environmental stressors like heat and traffic and limited access to occupational health services further compound these health problems among delivery agents (Kallu and Sushmitha, 2025) [5]. If left unaddressed, these issues can decrease individual performance and ultimately hinder the operational efficiency of e-commerce logistics systems.

Given the dual pressures of meeting consumer demand and maintaining workforce health, it is crucial for e-commerce firms to adopt ergonomic interventions and supportive workplace practices that enhance comfort, reduce physical strain and protect the well-being of their delivery workforce.

Review of Literature

Across diverse occupational settings, a growing body of research demonstrates that workers engaged in delivery, packing and parcel-handling activities face a substantial burden of work-related musculoskeletal disorders (WMSDs). Early evidence from packing workers showed that musculoskeletal discomfort was common, particularly in the lower back, shoulders and neck, that cumulative work exposure significantly increased the risk of symptoms in multiple body regions (Ghasemkhani *et al.*, 2008) [8]. Subsequent studies in parcel and postal delivery work have reinforced these findings, reporting widespread pain in the shoulders, lower back, hands and knees, alongside biomechanical risk factors such as repetitive motions, cervical protrusion, trunk flexion and postural strain, especially among taller workers (Silva *et al.*, 2022) [9]. Among light duty vehicle drivers in mail and parcel fleets, frequent manual handling, prolonged driving and route characteristics were associated with elevated prevalence of low back pain and upper-extremity disorders, highlighting the combined effects of parcel handling and vehicle-related ergonomic stressors (Radauceanu *et al.*, 2023) [10]. Evidence from corrugated box factories further illustrates the broader relevance of these patterns, nearly all workers reported WRMSDs with marked reductions in health-related quality of life, underscoring the systemic impact of repetitive and forceful physical demands (Kulkarni and Shaikh, 2024) [11]. More recent research focusing specifically on app-based and e-commerce delivery riders indicates an alarming rise in musculoskeletal morbidity driven by prolonged riding, heavy parcel loads and increasingly intense work schedules. Studies among food and parcel delivery workers across several geographic contexts consistently report high prevalence of WMSDs, particularly affecting the neck, shoulders and lower back, with whole-body and hand-arm vibration emerging as important ergonomic stressors (Yang *et al.*, 2021) [4]. Delivery personnel working more than eight hours per day, handling heavier parcels or riding extensively reported significantly higher pain, activity limitation and injury rates (Srinivasan *et al.*, 2023) [3]. Among riders in Malaysia and India, chronic lower and upper-back pain, shoulder complaints, absenteeism and reduced well-being were frequently documented, alongside risk behaviours such as dehydration and skipped meals that further compounded health outcomes (Ahmad *et al.*, 2023; Benson *et al.*, 2024) [2, 12]. Large community surveys also reveal broader comorbidities, including headaches and ocular problems linked to environmental exposures, traffic conditions and irregular work schedules, with older workers showing greater vulnerability due to cumulative strain (Kallu and Sushmitha, 2025) [5]. Collectively, these studies highlight that delivery-related occupations are characterized by multifactorial ergonomic hazards such as repetition, vibration, awkward posture, prolonged riding and extended working hours, reinforcing the urgent need for targeted ergonomic redesign, workload regulation and preventive occupational health programs.

Objectives

1. To understand the demographic profile of the delivery agents of e-commerce
2. To analyze the prevalence of musculoskeletal

- discomfort experienced with the help of Cornell Musculoskeletal Disorder Questionnaire (CMDQ)
3. To provide strategies to mitigate its occurrence.

Methods and Materials

A survey-based exploratory study was carried out among 200 delivery agents working for e-commerce in two cities of Uttarakhand i.e. Rudrapur and Haldwani. Data was collected using a self-constructed, pre-validated questionnaire administered through structured interviews with randomly selected participants. The questionnaire comprised two sections: Demographic information and a body map based on the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). The CMDQ is an open-access instrument developed by Dr. Alan Hedge and colleagues at Cornell University (<https://ergo.human.cornell.edu/ahmsquest.html>). Data was analyzed using simple descriptive statistics in MS Excel (version 2009) and the results were summarized using tables.

Results and Discussion

Demographic profile of the delivery agents n=200

Criteria	Category	Frequency and Percentage
Age (Years)	18-28	113(56.5)
	28-38	69 (34.5)
	>38	18 (9)
Civil Status	Married	114 (72)
	Unmarried	86 (43)
	Other	-
Education Attainment	High School	36 (18)
	Intermediate	69 (34.5)
	Graduate	87 (43.5)
	Diploma	8 (4)
Family Type	Nuclear	182 (91)
	Joint	18 (9)
	Extended	-

Note: Value in parenthesis indicates percentage

The majority of the respondents belonged to the younger working-age group. More than half (56.5%) were between 18–28 years of age, followed by 34.5% in the 28–38 years range, while only 9% were above 38 years. This indicates that e-commerce delivery work is largely undertaken by younger adults, likely due to the physical demands of long riding hours, loading, unloading and time-bound deliveries. With respect to marital status, most respondents were reported as married (72%), while 43% were unmarried, the table suggests that a considerable proportion of workers shoulder family responsibilities along with work obligations. This may increase financial pressure and influence job stability and stress levels among delivery agents.

Educationally, the largest proportion of the respondents was graduates (43.5%), followed by those with intermediate education (34.5%). Only 18% reported education up to high school and 4% possessed a diploma qualification. This pattern shows that even individuals with higher education are engaged in delivery work, possibly due to limited employment opportunities in other sectors or the easy entry nature of gig-economy jobs.

Most respondents belonged to nuclear families (91%), while

only 9% lived in joint families. The predominance of nuclear households indicates limited shared financial and social support, which may intensify economic vulnerability when income becomes irregular or during illness and injury.

Musculoskeletal Discomfort Experienced

The assessment of musculoskeletal discomfort among the delivery agents was conducted using the Cornell Modified Discomfort Questionnaire (CMDQ), developed by Cornell

University in 1999. The CMDQ is a validated tool designed to systematically document the presence, frequency and severity of musculoskeletal symptoms across different body regions. It has been widely applied in occupational health research by providing a standardized method for data collection the CMDQ facilitates a comprehensive evaluation of musculoskeletal disorders (MSDs), thereby supporting evidence-based planning of ergonomic interventions and preventive strategies.

Total discomfort felt by delivery agents for different body parts (n: 200)

S. No	Body Part	Frequency	Discomfort	Interference	Discomfort Score	Percentage
1	Neck	842	374	373	117460684	20.7
2	Right Shoulder	460.5	262	296	35712696	6.29
3	Left Shoulder	478.5	244	305	35609970	6.28
4	Upper back	298	299	245	21829990	3.85
5	Right Upper Arm	193.5	158	227	6940071	1.22
6	Left Upper Arm	180	151	218	5925240	1.04
7	Lower Back	875	404	369	130441500	22.99
8	Right Forearm	115.5	77	247	2196694.5	0.39
9	Left Forearm	64.5	43	243	673960.5	0.12
10	Right Wrist	288	267	286	21992256	3.88
11	Left Wrist	280	234	242	15855840	2.79
12	Hip/Buttocks	588	353	385	79912140	14.09
13	Right Thigh	305.5	201	279	17132134.5	3.02
14	Left Thigh	307.5	208	279	17844840	3.15
15	Right Knee	251	277	270	15383790	2.71
16	Left Knee	267	229	270	16508610	2.91
17	Right Lower leg	238.5	166	235	9303885	1.64
18	Left Lower Leg	256.5	168	253	10902276	1.92
19	Right Foot	118.5	79	243	2274844.5	0.4
20	left foot	145.5	97	244	3443694	0.61

The musculoskeletal discomfort reported by delivery agents shows distinct patterns across body regions. The lower back emerged as the most severely affected area, contributing the highest discomfort score (22.99%), followed closely by the neck (20.7%). These findings indicate that prolonged riding posture, repetitive forward flexion, lifting and twisting movements impose substantial strain on the spinal region, particularly the lumbar and cervical segments.

Significant discomfort was also observed in the hip and buttocks region (14.09%), likely attributable to extended sitting on two-wheelers combined with inadequate seat ergonomics and vibration exposure. Shoulders (right: 6.29%, left: 6.28%) and upper back (3.85%) also demonstrated notable symptom prevalence. These complaints may reflect repetitive steering control, handling of parcels and awkward upper-body postures maintained during delivery activities.

Discomfort in distal extremities such as wrists and thighs showed moderate representation, with right and left wrists accounting for 3.88% and 2.79% respectively. These values suggest cumulative strain from gripping the handlebar and frequent smart phone or device usage for navigation and delivery confirmation. Meanwhile, the knees and lower legs showed comparatively lower percentages (ranging from 1.64%–2.91%), though persistent discomfort in these joints may indicate cumulative effects of frequent mounting and dismounting, walking on uneven surfaces and load-bearing movements. Overall, the pattern of discomfort highlights that e-commerce delivery work exposes workers to substantial biomechanical loads, especially in the spinal,

pelvic, and upper-body regions. These results underscore the need for ergonomic interventions, including posture education, improved vehicle seat design, optimized delivery loads, and scheduled rest periods.

Conclusion

The study indicates that e-commerce delivery work is predominantly undertaken by young adults, many of whom carry family responsibilities and belong to nuclear households with limited support systems. Despite relatively high educational attainment, delivery work appears to function largely as a supplementary or transitional source of income within the gig economy. Assessment using the Cornell Modified Discomfort Questionnaire revealed a high prevalence of musculoskeletal discomfort, particularly in the lower back, neck, hips and shoulders, reflecting sustained postural strain, prolonged riding and repetitive work demands. These findings highlight the need for targeted ergonomic interventions, posture training, workload regulation and regular musculoskeletal health monitoring to promote the long-term well-being of delivery agents.

Suggestions Based on the Results of the Study

- Structured work and rest schedules should be implemented to minimize cumulative musculoskeletal fatigue caused by prolonged riding and repetitive tasks.
- Standard limits on delivery load weight should be enforced and ergonomically designed backpacks with proper load distribution should be provided.
- Short pre-shift warm-up and post-shift stretching

exercises should be encouraged to improve musculoskeletal flexibility and reduce injury risk.

- Awareness programs should be organized to educate delivery agents on early recognition and reporting of musculoskeletal discomfort.
- Employers and platform-based organizations should incorporate musculoskeletal health protection into workplace safety policies.
- Preventive ergonomic interventions should be prioritized to improve long-term health, work efficiency, and quality of life among e-commerce delivery agents.

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