



# Investigation of Musculoskeletal Disorders and Their Associated Risk Factors Among Indian Railway Coolies - A Cross- Sectional Study

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**Abstract.** Coolies or train porters have always been ubiquitous at Indian Railway stations. The unofficial employees of the Indian Railways have been the go-to option for passengers looking for quick and easy transfer of their luggage between platforms. The onerous task of ferrying luggage to and from the trains takes a toll on their bodies and renders their employment period to just 15–20 years. The coolies have been found to be at high risk of developing musculoskeletal disorders. However, this problem has not received adequate attention of researchers and the exact reasons are poorly understood. The aim of this study is to assess the prevalence of musculoskeletal disorders (MSDs) and investigate the association between MSDs and risk factors among the coolies. The cross sectional study was conducted among 200 male full time railway coolies in Ahmedabad city. Direct Observations, Nordic Musculoskeletal Questionnaire (NMQ) and Rapid Upper Limb Assessment (RULA) method were used for this study. The overall 12 month period prevalence of MSDs was 91%. The major affected areas were lower back (91%), neck (90%) and knee (69%), followed by shoulder (56%), upper back (48%), elbow (44%) hand/wrist (40%), hip/thigh (33%) and ankle/foot (27%). By RULA method, it was found that postures of 93% of the coolies were in action levels 3 and 4, which indicate unnatural working posture and required soon or immediate changes. The findings of this study suggest high prevalence of MSD among coolies especially in lower back, neck and shoulder regions. Hence, different preventive measures, regular treatment and ergonomics intervention like use of trolleys and handcarts are strongly recommended.

**Keywords:** Ergonomics · Musculoskeletal Disorders (MSDs)  
Risk factors · Nordic Musculoskeletal Questionnaire (NMQ)  
Rapid Upper Limb Assessment (RULA)

## 1 Introduction

Indian Railway coolies or train porters have been serving the passengers ever since the inception of railways in India. They are the familiar figures at every city railway station who carry the passenger's luggage on their head and shoulders, making a living out of hard physical labor. The life of a coolie is certainly not very pleasant as they walk endlessly from one platform to another, sometimes by walking up and down the cross platform bridges with heavy bags and baggage. There are approximately 20,000 licensed railway coolies in India today. They are not official employees of the Indian Railways but are merely authorized by them to offer porter services to passengers in and near the station areas. They are bound by certain terms and conditions in addition to the monthly license fee that they have to give to the railways. While the red shirt that the coolies in India wear adds to the spiciness and liveliness of the stations, sadly their life is not as colorful.

Musculoskeletal disorders are injuries affecting muscles, bones, tendons, ligaments, and cartilage. Work-related musculoskeletal disorders (WMSDs) are multi-factorial in nature [1]. Work of individuals like the coolies involves subsequent durations of arduous physical activities such as pulling, pushing, lifting, carrying, picking or bending making them most susceptible to MSDs [2–4]. The burden of MSDs has become huge and looking at the seriousness of the situation WHO declared 2000–2010 as the Bone and Joint Decade [5]. In consideration with the above facts, the aim of the present study is to investigate the prevalence of MSDs in Indian railway coolies. This study also assessed the association of risk factors like personal characteristics, health factors and workplace factors with MSDs. Through the application of RULA method, postural analysis of the coolies has also been done.

## 2 Subject and Materials

### 2.1 Workplace and Participants

This study was conducted among 200 railway coolies of Ahmedabad city in the state of Gujarat, India. Ahmedabad has a total of three stations namely Kalupur, Maninagar and Sabarmati. The coolies were briefed about the aim and purpose of the study in their native languages, which are Hindi and Gujarati. The data was collected from January to February 2018. Coolie union heads are also licensed porters but were excluded from the study due to lack of physical work.

### 2.2 Data Collection

The data collected during this study was through a set of questionnaires and by field observation of the coolies. The first section of the questionnaire consisted of questions about age, height, weight, education, marital status, exercise/game activities, current health status, tiredness, previous history of accidents and smoking behavior. The second section of the questionnaire included questions about the work duration per day in hours, work experience in years, duration of standing, load carried per trip and work

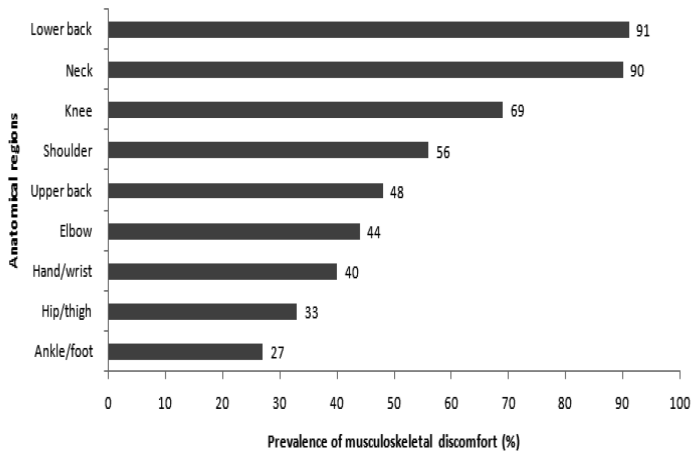
satisfaction. The third section consisted of a Standardized Nordic Questionnaire [6]. Participants were asked whether they experienced pain or discomfort in various anatomical sites in the body during the last 12 months. Supplementary questions were also asked to determine the severity and frequency of discomfort. Direct observations were made by studying the working postures of the coolies for the RULA method [7].

### 2.3 Data Analysis

Statistical analyses were performed by using SPSS version 20.0. Pearson's Chi square test was used to investigate the relationship between socio-demographic and workplace factors (independent variables) with self-reported MSDs (dependent variables) where  $p < 0.05$  was considered statistically significant.

## 3 Results

From the data collected by means of Nordic Questionnaire, it was evident that 91% of the coolies reported lower back pain, followed by neck pain (90%), knee pain (69%) and shoulder pain (56%). Discomfort in other anatomical regions namely upper back, elbow, hand/wrist, hip/thigh and ankle/foot was reported by less than 50% of the coolies. This information has been represented in Fig. 1.



**Fig. 1.** Prevalence of musculoskeletal disorders in coolies

Table 1 shows the severity of MSDs in different anatomical regions during the past 12 month period. Most of the coolies reported the severity of pain as moderate.

**Table 1.** Acuteness of pain in coolies

Anatomical regions	Coolies suffering from pain	%	Severe (%)	Moderate (%)	Slight (%)
Lower back	182	91	24	54	13
Neck	180	90	21	50	19
Knee	138	69	12	48	9
Shoulder	112	56	10	32	14
Upper back	96	48	8	28	12
Elbow	88	44	11	20	13
Hand/wrist	80	40	9	16	15
Hip/thigh	66	33	8	15	10
Ankle/foot	54	27	5	12	10

### 3.1 Risk Factors

**Socio-demographic factors.** Table 2 summarizes the socio-demographic factors affecting the prevalence of MSDs in coolies. By Pearson's Chi square test, it was found that factors like education level, marital status, BMI, exercise/game activities, tiredness at the end of work, smoking habit and previous history of accident had  $p > 0.05$ ; therefore not having any significant effect on occurrence of MSDs. Factors like age and current health status were found to have  $p < 0.05$ , so they were significant factors for prevalence of MSDs. In the current study, every coolie with an age greater than 40 years reported musculoskeletal pain. 97.78% of the coolies with poor health status suffered from MSDs.

**Workplace characteristics.** Workplace characteristics and its associated risk factors are represented in Table 3. It was found that work experience was a significant factor in indicating the prevalence of MSDs ( $p < 0.05$ ). All the coolies with work experience of more than 6 years reported discomfort in one or more anatomical regions. Working hours were also a strong indicator of MSDs ( $p < 0.05$ ). 99.01% of the coolies who worked for more than 8 h per day were found vulnerable to MSDs. Load lifted per trip was also found to be significant ( $p < 0.05$ ). All of the coolies who lifted more than 60 kgs of load suffered from MSDs. On the other hand, factors like prolonged standing and personal satisfaction at work were found to have no statistical significance for reported MSDs ( $p > 0.05$ ).

### 3.2 Prevalence of MSDs Among Varying Years of Work Experience

Table 4 presents the prevalence of MSDs (%) in coolies on the basis of work experience. Most of the coolies had a work experience of more than ten years and the self-reported MSDs were highest in them. They reported severe lower back pain and neck

**Table 2.** Socio-demographic risk factors

Risk factors			MSDs		Statistics		
	n	(%)	Yes	No	$\chi^2$	df	p value
<i>Age</i>							
≤ 20	11	5.5	45.45	54.55	37.36	3	p < 0.05
20–30	87	43.5	87.36	12.64			
30–40	59	29.5	98.31	1.69			
>40	43	21.5	100.00	0.00			
<i>Education</i>							
Illiterate	136	68	91.18	8.82	0.541	3	p > 0.05
Primary	45	22.5	91.11	8.89			
Secondary	16	8	87.50	12.50			
Higher secondary	3	1.5	100.00	0.00			
<i>Marital status</i>							
Married	154	77	90.91	9.09	0.0068	1	p > 0.05
Unmarried	46	23	91.30	8.70			
<i>BMI</i>							
Underweight	34	17	97.06	2.94	2.5987	2	p > 0.05
Average	146	73	89.04	10.96			
Overweight	20	10	95.00	5.00			
<i>Exercise/games activities</i>							
Yes	108	54	88.89	11.11	1.2776	1	p > 0.05
No	92	46	93.48	6.52			
<i>Current health status</i>							
Good	57	28.5	78.95	21.05	14.452	2	p < 0.05
Average	98	49	94.90	5.10			
Bad	45	22.5	97.78	2.22			
<i>Getting tired at end of the work</i>							
Yes	178	89	91.01	8.99	0.0002	1	p > 0.05
No	22	11	90.91	9.09			
<i>Previous history of accident</i>							
Yes	23	11.5	95.65	4.35	0.686	1	p > 0.05
No	177	88.5	90.40	9.60			
<i>Smoking</i>							
Yes	81	40.5	88.89	11.11	0.7408	1	p > 0.05
No	119	59.5	92.44	7.56			

pain (100%), knee pain (88.76%), shoulder pain (70.79%), upper back pain (60.67%), elbow pain (50.56%), hand/wrist pain (47.19%), hip/thigh pain (31.46%) and ankle/foot pain (23.60%). The coolies who reported no musculoskeletal pain were new to this occupation and had a work experience of less than a year indicating that the chances of MSDs increased with increase in work experience.

**Table 3.** Workplace risk factors

Risk factors			MSDs		Statistics		
	n	(%)	Yes	No	$\chi^2$	df	p value
<i>Work experience</i>							
≤ 1 yr	7	3.5	0	100.00	109.14	3	p < 0.05
1–5 yrs	34	17	67.65	32.35			
5–10 yrs	70	35	100.00	0			
>10 yrs	89	44.5	100.00	0			
<i>Daily working hours</i>							
≤ 4	21	10.5	47.62	52.38	56.329	2	p < 0.05
4–8	78	39	92.31	7.69			
>8	101	50.5	99.01	0.99			
<i>Load lifted per trip</i>							
≤ 20 kgs	8	4	0	100.00	106.747	3	p < 0.05
20–40 kgs	28	14	71.43	28.57			
40–60 kgs	52	26	96.15	3.85			
>60 kgs	112	56	100.00	0			
<i>Prolonged standing</i>							
Yes	152	76	92.76	7.24	2.404	1	p > 0.05
No	48	24	85.42	14.58			
<i>Personal satisfaction at work</i>							
Low	67	33.5	92.54	7.46	3.935	2	p > 0.05
Moderate	73	36.5	94.52	5.48			
High	60	30	85.00	15.00			

**Table 4.** Prevalence (n and %) of MSDs in different anatomical sites in coolies based on work experience

MSDs	≤ 1 yr		1–5 yrs		5–10 yrs		>10 yrs		Total	
	n = 7		n = 34		n = 70		n = 89		n = 200	
	n	%	n	%	n	%	n	%	n	%
Lower back pain	0	0	23	67.65	70	100.00	89	100.00	182	91
Neck pain	0	0	22	64.71	69	98.57	89	100.00	180	90
Knee pain	0	0	20	58.82	39	55.71	79	88.76	138	69
Shoulder pain	0	0	15	44.12	34	48.57	63	70.79	112	56
Upper back pain	0	0	14	41.18	28	40.00	54	60.67	96	48
Elbow pain	0	0	19	55.88	24	34.29	45	50.56	88	44
Hand/wrist pain	0	0	12	35.29	26	37.14	42	47.19	80	40
Hip/thigh pain	0	0	16	47.06	22	31.43	28	31.46	66	33
Ankle/foot pain	0	0	14	41.18	19	27.14	21	23.60	54	27

### 3.3 Prevalence of MSDs Among Different Categories of Load Lifted

Table 5 presents the prevalence of MSDs (%) in coolies on the basis of load carried. Most of the passengers who availed the services of coolies were travelling with multiple bags which resulted in the load carried by the coolies to frequently exceed 60 kgs. The self-reported MSDs were highest in coolies who carried more than 60 kgs in a single trip. They reported severe lower back pain (100%), neck pain (99.11%), knee pain (74.11%), shoulder pain (64.29%), upper back pain (57.14%), elbow pain (53.57%), hand/wrist pain (50.89%), hip/thigh pain (44.64%) and ankle/foot pain (39.29%). Only a few coolies lifted load less than 20 kgs and hence did not report any MSDs.

**Table 5.** Prevalence (n and %) of MSDs in different anatomical sites in coolies based on load lifted

MSDs	≤ 20 kgs n = 8		20–40 kgs n = 28		40–60 kgs n = 52		>60 kgs n = 112		Total n = 200	
	n	%	n	%	n	%	n	%	n	%
Lower back pain	0	0	20	71.43	50	96.15	112	100.00	182	91
Neck pain	0	0	19	67.86	50	96.15	111	99.11	180	90
Knee pain	0	0	16	57.14	39	75.00	83	74.11	138	69
Shoulder pain	0	0	11	39.29	29	55.77	72	64.29	112	56
Upper back pain	0	0	9	32.14	23	44.23	64	57.14	96	48
Elbow pain	0	0	10	35.71	18	34.62	60	53.57	88	44
Hand/wrist pain	0	0	8	28.57	15	28.85	57	50.89	80	40
Hip/thigh pain	0	0	5	17.86	11	21.15	50	44.64	66	33
Ankle/foot pain	0	0	2	7.14	8	15.38	44	39.29	54	27

### 3.4 Prevalence of MSDs Among Different Categories of Age

Table 6 presents the prevalence of MSDs (%) in coolies on the basis of their age. The self-reported MSDs were highest in coolies with an age of more than 40 years as they had spent nearly 10 to 15 years working under stringent conditions. This resulted in higher chances of suffering from MSDs. They reported severe lower back and neck pain (100%), knee pain (88.37%), shoulder pain (76.74%), upper back pain (69.77%), elbow pain (65.12%), hand/wrist pain (55.81%), hip/thigh pain (58.14%) and ankle/foot pain (55.81%).

### 3.5 Postural Analysis

The lifting posture adopted by each coolie was evaluated using Rapid Upper Limb Assessment method (RULA) [7]. In this method, a score is assigned to the working posture based on the position of each body part. Based on the position of upper arm, lower arm, wrist and wrist twist, RULA score A is evaluated. RULA score B is evaluated based on the position of neck, trunk and legs. Repeated movements, prolonged postures and load carried are incorporated into RULA A and B score and the Grand RULA score is calculated. The Grand RULA Score is categorized into four action levels which has been shown in Table 7 along with number of coolies belonging

**Table 6.** Prevalence (n and %) of MSDs in different anatomical sites in coolies based on age

MSDs	≤ 20 yrs n = 11		20–30 yrs n = 87		30–40 yrs n = 59		>40 yrs n = 43		Total n = 200	
	n	%	n	%	n	%	n	%	n	%
Lower back pain	5	45.45	76	87.36	58	98.31	43	100.00	188	94
Neck pain	4	36.36	75	86.21	57	96.61	43	100.00	184	92
Knee pain	4	36.36	44	50.57	52	88.14	38	88.37	138	69
Shoulder pain	3	27.27	34	39.08	42	71.19	33	76.74	112	56
Upper back pain	3	27.27	35	40.23	28	47.46	30	69.77	96	48
Elbow pain	3	27.27	31	35.63	26	44.07	28	65.12	88	44
Hand/wrist pain	2	18.18	29	33.33	25	42.37	24	55.81	80	40
Hip/thigh pain	1	9.09	19	21.84	21	35.59	25	58.14	66	33
Ankle/foot pain	0	0.00	9	10.34	21	35.59	24	55.81	54	27

**Table 7.** RULA action levels

Action level	RULA score	Action	Number	%
1	1–2	Posture is acceptable if it is not maintained or repeated for long periods	0	0
2	3–4	Further investigation is needed and changes may be required	15	8
3	5–6	Investigation and changes are required soon	40	20
4	7	Investigation and changes are required immediately	145	73

to each Action Level. Based on the RULA scores obtained in this study, it was found that working postures of 73% of the coolies had a Grand RULA score of 7, which corresponds to Action level 4 implying that majority of the coolies had working postures which demanded immediate changes. Failing to adopt safer working postures could result in higher probability of suffering from MSDs and working accidents. 20% of the coolies had working postures corresponding to Action level 3 and 8% coolies had working postures belonging to Action level 2. None of the coolies had working postures that belonged to Action level 1.

## 4 Discussion

To the best our knowledge, this is the first cross sectional study conducted among the Indian railway coolies to investigate their musculoskeletal disorders and risk factors associated with them [8]. The results of this study revealed an alarming rate of MSDs



among the coolies in three railway stations of Ahmedabad city. The use of NMQ showed the overall prevalence of MSDs during the last 12 months to be 91% which is relatively close to the study conducted by Sarkar *et al.* in Calcutta's central market on manual load carrying workers where overall prevalence during the last 12 months was 95% [1].

The most common anatomical regions for musculoskeletal discomfort were found to be lower back (91%), followed by neck (90%), knee (69%) and shoulders (56%) similar to the findings of the study conducted by Chakrabarty *et al.* on Chikan embroiders [9]. The 12 month prevalence of MSDs was 79% in a study conducted among 200 waste pickers in Mumbai by Singh *et al.* [10], 67.5% in a survey on 114 male commercial kitchen workers in South India by Subramaniam [11] and 73.3% in a study of 60 medical laboratory technicians by Maulik *et al.* [12], all of which are lower than the reported prevalence rate of MSDs in our study. The reason behind this is the hard physical labour done by the coolies during their working hours which involves lifting, lowering and carrying luggage from one railway platform to another.

In the present study, statistically significant relationship was found between MSDs and risk factors like age, current health status, work experience, daily working hours and load lifted per trip. Factors like education, marital status, BMI, exercise/game activities, tiredness at end of work, previous history of accident, smoking, prolonged standing and personal satisfaction at work were found to have a non significant relationship with MSDs.

From the reports of MSDs, coolies with an age of more than 40 years had the highest prevalence rate of 100%, followed by coolies within the age group of 30 to 40 years, with the prevalence rate being 98.31%. It is evident from results of the study that coolies having more than six years of work experience had a 100% prevalence rate of MSDs. Coolies who had worked for less than a year report a prevalence rate of 0% and coolies with 1–5 years of work experience reported higher rates of 67.65%. Prevalence rate of MSDs in coolies carrying more than 60 kg load was 100% being highest, followed by coolies carrying 40–60 kg load with 96.15%, 20–40 kg load with 71.43% and less than 20 kg load having a rate of 0%. The RULA score for most of the coolies was 7 which was found to be in agreement with an ergonomic assessment study carried out on women moulders in West Bengal by Bandyopadhyay *et al.* [13] and also a study of workers in manual brick laying kiln by Qutubuddin *et al.* [14].

## 5 Conclusion

This study revealed an alarmingly high prevalence rate of musculoskeletal pain in railway coolies in Ahmedabad city, India. Lower back, neck and shoulder regions were most affected. The study also investigated the association of various risk factors with MSDs where factors like age, work experience and load lifted were found to have a significant relationship with reported MSDs. Action levels evaluated by RULA method indicated unsafe working postures and demanded immediate changes. It is extremely important to spread awareness among coolies as to how their musculoskeletal pain can lead to dangerous accidents on the platforms and could also result in long term effects on their bodies. Use of handcarts and trolleys to transport heavy loads should be promoted. As an alternative to stairs, inclined platforms should be constructed in

railway stations to facilitate ease and speed of movement of luggage. Further ergonomic research should be done to improve the current status of Indian coolies.

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