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Pervasiveness of work-related Musculoskeletal Disorders on Indian construction workers

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Abstract: Indian construction involves a large number of organized and unorganized workers. There is always a risk of accidents, injuries and disability due to working in an awful, inconvenient workplace and unfavourable conditions. Construction workers work in static, dynamic and awkward postures throughout the day. The work duration, frequency of working and working technique has led to the development of Work-related musculoskeletal disorders in construction workers in India. The study was conducted to corroborate the feeling of pain in different body parts by construction workers and its association with an individual risk factor, physical risk factors and psychosocial risk factors. Information was collected from four-hundred and sixty-five workers doing various construction works. The statistical analysis (Pearson correlation and Binary Logistic Regression Analysis) was performed to confirm the feeling of pain with individual, physical and psychosocial risk factors. The result shows that there is a significant relationship between pain and working in an awkward posture, age, and years of experience. Workers are exposed to the lower back (72.90%), shoulders (49.68%), arms/hands (47.31%), wrists (30.75%), legs (26.67%), neck (24.09%), fingers/thumbs (23.23%) and knees (16.13%). The result also shows that construction workers work in stressful, painful, tedious conditions and awkward postures. For the development of musculoskeletal disorders, working in an awkward posture, year of experience, doing pervasive jobs, traumatic incidents and age are more responsible for which detailed investigation is required.

Introduction

An injury or disorder of the muscles, nerves, tendons, joints, cartilage, and spinal discs is known as a Musculoskeletal disorder (MSD) related to a manual task. This chronic disease develops over time and is known as a source of significant pain, disability, disorders and disadvantage for the injured person. The literature found that most occupational injuries to muscles are due to manual tasks (Jahanbanifar and Akhavian, 2018; Antwi-Afari et al., 2017; Peppoloni et al., 2014). Construction work is a temporary nature of work where there is no relation between employees and employers. Working at a construction site is a risky, unsafe, vulnerable and dangerous task where there is always a chance of accident or mishap. There is neither a fixed working hour nor maintenance of the records of workers and accidents.

Millions of workers from organized and unorganized sectors engage in construction work in India. These construction workers are economically weak and lack proper medical facilities, risk cover facilities and statutory facilities. The available statutory facilities are apathetic, complex and complicated, hence beyond the limit of these people to approach some statutory bodies. In India, most workers migrate to other states like U.P., Bihar, Madhya Pradesh, Chhattisgarh and other economically weaker states. These people are from rural areas and migrate to metros or urban cities in search of either employment or to add their earnings in the lean

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time when there is no work in agriculture or other sectors in rural areas.

An Indian construction worker always works for a prolonged period. An individual risk factor (poor work practice, bad health profile, bad habits, fitness, nutrition, improper hydration, recovery, non-recognition of WRMSD at an early stage in addition to this age, over or underweight, height, BMI, experience and gender), physical risk factors (working in awkward postures, bending, forceful exertion, insufficient rest, physically exhausting, lifting/lowering, pushing/pulling, the pace of work, compression, contact stress, lighting, vibration, temperature) and psychosocial risk factors (pervasive jobs, high workload, relation with supervisor and colleagues, tight deadlines, monotonous work, stressful work, lack of control on the task and working methods, social support, job insecurity, loneliness, marriage status, social disruption, bereavement, work environment, social grade, social integration, dissatisfaction with the work, job demand, job control) are responsible for the development of work-related musculoskeletal disorders (Nahit et al., 2003; Jensen et al., 2002; Hughes et al., 2007).

The constant work like manual handling, repetition, lifting of materials, inconvenient workplace, overwork, forceful exertion, insufficient rest, environmental effect, as well as other factors like specks of dust, noise, vibration, lack of safety protections, chemicals and unawareness makes construction work hazardous (Maiti, 2008). Besides, these workers work in a different awkward postures during prolonged working hours throughout life, which is also responsible for developing musculoskeletal disorders. There is a strong confirmation of the relationship between these factors and WRMSD. Also, stress, lack of use of protective equipment, poor hygiene and health awareness, poverty, improper diet, Infectious diseases, poor sanitation and lack of education are responsible for poor health and Work-related musculoskeletal disorders (Biswas et al., 2016). The postures adopted by the workers depended upon the workplace, work type, individual habits, personality of the individual and tools required.

Works in awkward postures, wrong bending, manual material handling, repetition, lifting/lowering, inconvenient workplace, overwork, forceful exertion, insufficient rest, environmental effect, dust, lack of safety protections, illiteracy of work, noise, vibration and cold/hot working condition, temperature making construction work hazardous**.** Therefore, Work-related musculoskeletal disorders are increasing rapidly due to improper knowledge among the workers. Besides this, the workers are happy with conventional working methods and tools and always resist adopting a new technological aspect.

The objective of this study is to find the pervasiveness of work-related musculoskeletal disorders due to an individual, physical and psychosocial risk factor on different parts of the body of the construction workers using a statistical tool. Another aim is to find these risk factors' effects at the day's various progressions.

Methodology

Participants

The survey was carried out at different construction sites. Four hundred and sixty-five construction workers performing various tasks were interviewed, observed, and video recorded with permission from house owners, contractors and individual workers to conduct the study.

Data Collection and Self-reported Questionnaire

For data collection, simple questions were prepared and responses were recorded as "Yes" and "No". The question framed "Where do you perceive pain in the different body (at which body parts) and when (during Working or after work or during sleeping or in the morning)?" asked to record pain in the different body parts at various times. Personal information like name, age, working experience, education, marital status, native place and habits were asked and noted down. Height and weight were measured using an anthropometric scale and a digital weighing machine respectively. BMI was calculated from these data. The average working hours and duration of rest are 8.5 hours, 1.20 hours, respectively. The number of working days in a week is seven days.

Data and Statistical analysis

The data on prevalence for each body part, four-time zone analysed by considering the response of "Yes" and "No" to the questions. The "Yes" denoted by "1" and "No" by "0". Also, a male is represented by "1" and a female is represented by "0". The somatic characteristics data are expressed as a mean ± standard deviation [SD]. Initially, a correlation was carried out using a Pearson correlation with a few factors of individual, physical and psychosocial risk factors with different body parts and at the various progression of the day.

Then the logistic regression analysis was carried out by evaluating Chi-square value, p-value and odds ratio with 95% confidence intervals by taking a level of significance as $P < 0.05$ (Bhattacharya, 2006). Minitab 17 software was used for analysis.

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Table 1. Somatic characteristics of construction workers

Participant characteristics		Male	Female	Total
Sex, n (%)		414 (89.03%)	51 (10.97%)	465
Age (Mean ±SD)		41.33±9.62	36.37±8.78	40.84 ±9.57
Height (Mean ±SD)		163.46±5.07	157.02±5.99	162.75±5.55
Weight (Mean ±SD)		61.82±5.82	50.27±4.46	60.55±6.74
BMI (Mean ±SD)		23.13±1.86	20.38±1.31	22.83±2.00
Year of Experience (Mean ±SD)		17.59±9.12	13.06±8.98	17.09±9.21
Experiencing pain		334 (71.82%)	51 (10.97%)	385 (82.80%)
Marital Status, n (%)				
	Single	36 (7.74%)	03(0.65%)	39(8.39%)
	Married	378 (83.29%)	48(10.32%)	426(91.61%)
Education level				
	Illiterate	19 (4.09%)	16(3.44%)	35(7.53%)
	Primary	284(61.08%)	29(6.24%)	313(67.31%)
Secondary		94(20.22%)	6(1.29%)	100(21.51%)
Intermediate/Diploma		10(2.15%)	-	10 (2.15%)
ITI		7(1.51%)	-	7 (1.51%)
Migrate				
	Yes	247(53.12%)	43(9.25%)	290(62.37%)
	No	167(35.91%))	8(1.72%)	175(37.63%)
Addiction to Alcohol /Tobacco/ Smoking				
	Yes	255(54.84%)	34(7.31%)	289(62.15%)
	No	159(34.19%)	17(3.66%)	176(37.85%)
Pain				
	Yes	334 (71.83%)	51 (10.97%)	385 (82.80%)
	No	80 (17.20%)	0	80 (17.20%)
Working in awkward posture		314 (67.53%)	42 (9.03%)	356 (76.56%)

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Table 2. Number of males and females feel pain in different body parts

Body Parts	Male	%	Female	%	Total	%
Head	13	3.14	13	25.49	26	5.59
Neck	81	19.57	31	60.78	112	24.09
Shoulders	193	46.62	38	74.51	231	49.68
Chest	36	8.70	10	19.61	46	9.89
Elbow	37	8.94	7	13.73	44	9.46
Arms/Hands	194	46.86	26	50.98	220	47.31
Wrists	135	32.61	8	15.69	143	30.75
Fingers/Thumbs	94	22.71	14	27.45	108	23.23
Upper back	12	2.90	5	9.80	17	3.66
Lower back	307	74.15	32	62.75	339	72.90
Thigh/ hip/ buttocks	18	4.35	7	13.73	25	5.38
Legs	94	22.71	30	58.82	124	26.67
Knees	64	15.46	11	21.57	75	16.13
Ankles/ feet/toes	16	3.86	11	21.57	27	5.81

Table 3. Feeling pain at various progression of the day

Different time	Male	%	Female	%	Total	%
During working	39	9.42	14	27.45	53	11.40
After working	170	41.06	25	49.02	195	41.94
During sleeping	40	9.66	0	0.00	40	8.60
In the Morning	90	21.74	7	13.73	97	20.86

Results and discussion

The somatic characteristics of construction workers (Male and Female) having pain with mean ± SD of age, height, weight, experience, BMI and their distribution concerning gender are presented in Table 1. Table 2 and Figure 1 show the number of males and females experiencing pain in body parts. Table 3 and Figure 2 show the number of male and female pain experienced during the day's various progression.

During the survey, out of 465, 385 (82.80%) workers reported pain in different body parts. Amongst 385, 334 (71.82%) are male similarly, 51 (10.97%) are female. Table 1 revealed that 76.56% of workers are working in an awkward posture, 91.61% are married, 7.53% are illiterate, and 62.37% migrated, while 62.15% are workers addicted to alcohol/smoke/tobacco. Females were found more illiterate (31.37%), not taken more than secondary education and found more addicted to alcohol/smoke/tobacco than males. The female is not much more addicted to alcohol but consumes tobacco. It also revealed that 67.31 % of workers completed primary education and 21.51 % received secondary education. The workers working in the construction sector leave their education at the primary level.

From Table 2, the highest pervasiveness of pain is observed in the lower back (72.90%), followed by shoulders (49.68%), arms (47.31%), wrists (30.75%), legs (26.67%), neck (24.09%), fingers (23.23%) and knees (16.13%). The highest pervasiveness of pain in the

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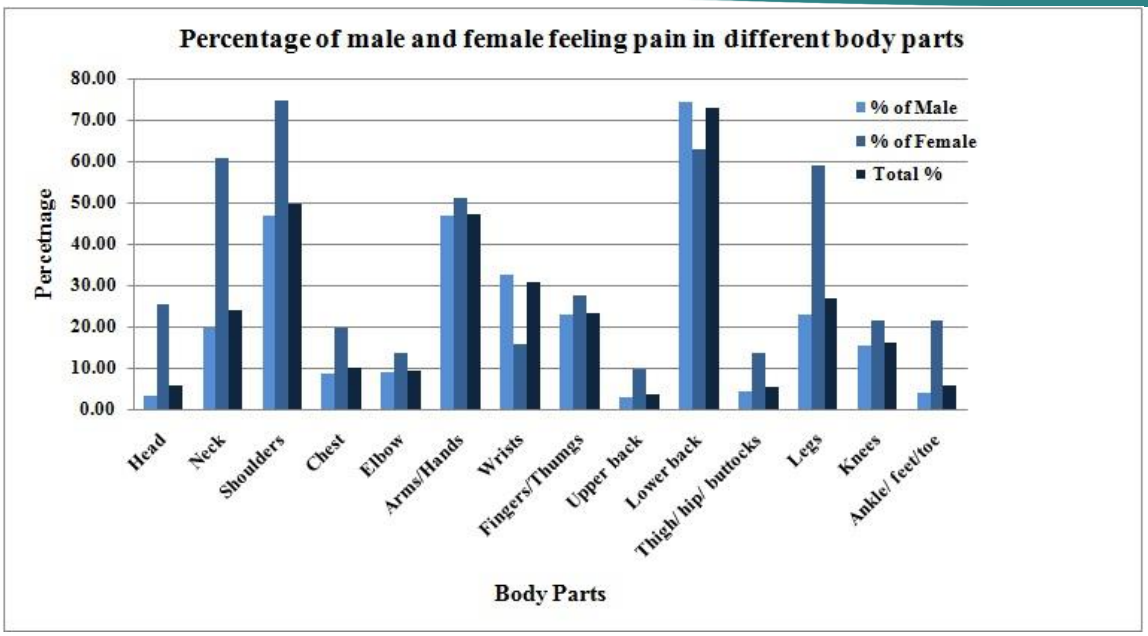

Figure 1. Percentage of Males and Female feeling pain in different body parts

lower back (74.15%) is observed in males, while the shoulders (74.51%) in females. The male complaints pain in arms/hands (46.86%), Shoulder (46.62%), wrists (32.16%), fingers/thumbs (22.71%), legs (22.71%), neck (19.57%), knees (15.46%), elbows (8.94%), chest (8.7%), thigh/hip/buttock (4.35%), ankle/feet/toe (3.86%), head (3.14%) and upper back (2.9%) while female complaints pain in lower back (62.75%), neck (60.78%), legs (58.82%), arms/hands (50.98%), fingers/thumbs (27.45%), head (25.49%), knees and ankle/feet/toe (21.57%), chest (19.61%), wrists (15.69%), elbows and thigh/hip/buttocks (13.73%) and upper back (9.8%).

found to be high (41.94%) in both males and female. However, females complain of more pain than males. In males, it is 41.06% and in females, 49.02%, followed by pain in the morning. During working time, women (27.45%) experienced more pain than males (9.42%).

Pearson analysis for WRMSD occurrence

The Pearson correlation between pain in different body parts concerning age, height, weight, BMI, year of experience and gender are derived. The Pearson correlation result shows that the year of

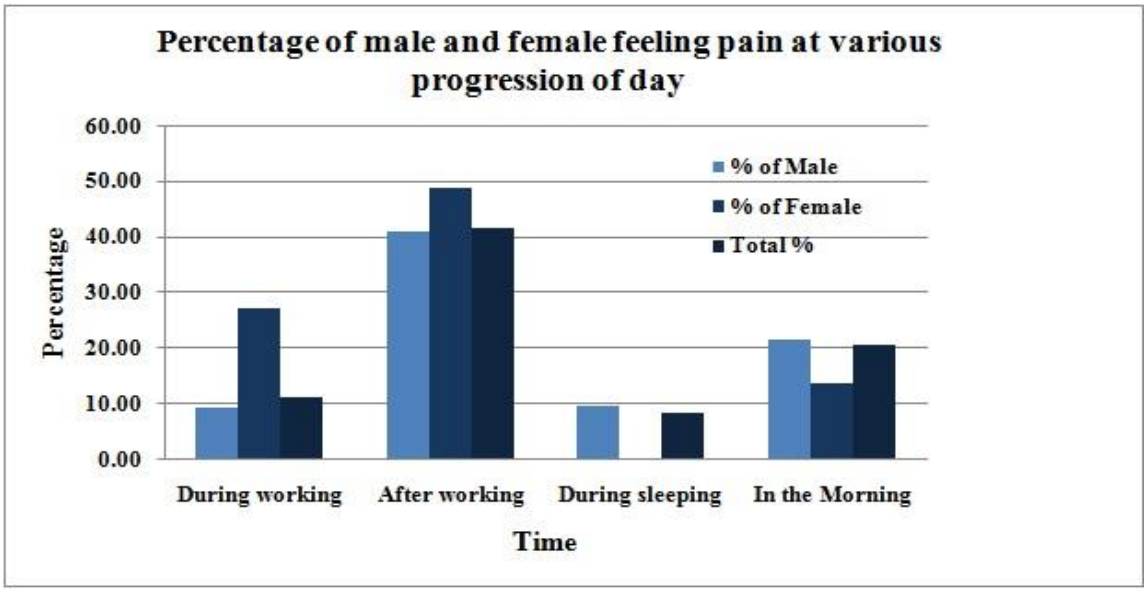

Figure 2. Percentage of males and females feeling pain at various progression of a day

Table 3 shows the pervasiveness of pain in the various progression of the day. From table 3, it observed that the complaints of pain after work were

experience factor shows a significant association between pain and related disorders in different body parts followed by gender, age and weight. More the

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Table 4. Result of Pearson correlation between Pain in different body parts due to age, height, weight, BMI, experience and Gender

Body parts	Age	Height	Weight	BMI	Year of Experience	Gender
Head	-0.058 (0.216)	**-0.129(0.005)**	**-0.250 (0.000)**	**-0.227 (0.000)**	-0.042 (0.364)	**-0.304 (0.000)**
Neck	**-0.177(0.000)**	-0.070(0.132)	**-0.252(0.000)**	**-0.273(0.000)**	**-0.185 (0.000)**	**-0.301(0.000)**
Shoulders	**-0.104 (0.025)**	0.007 (0.872)	-0.056 (0.228)	-0.086 (0.065)	**-0.106 (0.023)**	**-0.174 (0.000)**
Chest	**-0.172 (0.000)**	-0.001 (0.988)	**-0.110 (0.018)**	**-0.137 (0.003)**	**-0.163 (0.000)**	**-0.114 (0.014)**
Elbow	-0.014 (0.756)	0.016 (0.733)	-0.002 (0.963)	-0.018 (0.702)	-0.024 (0.604)	-0.051 (0.271)
Arms/ Hands	-0.084 (0.069)	0.069 (0.137)	-0.025 (0.588)	-0.084 (0.070)	**-0.114 (0.014)**	-0.026 (0.579)
Wrists	**-0.153 (0.001)**	0.042 (0.369)	0.004 (0.925)	-0.025 (0.594)	**-0.155 (0.001)**	**0.115 (0.013)**
Fingers/ Thumbs	**-0.173 (0.000)**	-0.002 (0.968)	**-0.111 (0.016)**	**-0.141 (0.002)**	**-0.164 (0.000)**	-0.035 (0.450)
Upper back	-0.082 (0.078)	**-0.107 (0.021)**	**-0.101 (0.030)**	-0.064 (0.170)	**-0.105 (0.023)**	**-0.115 (0.013)**
Lower back	**0.133 (0.004)**	**0.143 (0.002)**	0.060 (0.197)	-0.035 (0.453)	**0.104 (0.025)**	0.080 (0.084)
Thigh/ hip/ buttocks	0.049 (0.292)	**-0.130 (0.005)**	**-0.107 (0.021)**	-0.034 (0.460)	0.048 (0.298)	**-0.130 (0.005)**
Legs	**0.133 (0.004)**	-0.051 (0.273)	**-0.154 (0.001)**	**-0.164 (0.000)**	**0.129 (0.005)**	**-0.255 (0.000)**
Knees	**0.278 (0.000)**	-0.024 (0.613)	-0.004 (0.932)	0.012 (0.790)	**0.254 (0.000)**	-0.052 (0.264)
Ankles/ feet/toes	**0.131 (0.005)**	-0.082 (0.078)	**-0.110 (0.018)**	-0.087 (0.061)	**0.104 (0.024)**	**-0.237 (0.000)**

Table 5. Result of Pearson correlation between various progression of day due to age, height, weight, BMI, experience and Gender

Different time	Age	Height	Weight	BMI	Year of Experience	Gender
During working	**-0.247 (0.000)**	-0.101 (0.152)	**-0.223 (0.000)**	**-0.210 (0.000)**	**-0.245 (0.000)**	**-0.177 (0.000)**
After working	**-0.126 (0.007)**	0.004 (0.937)	-0.057 (0.220)	-0.079 (0.090)	**-0.154 (0.001)**	-0.050 (0.278)
During Sleeping	0.036 (0.442)	0.075 (0.108)	**0.111 (0.017)**	0.085 (0.067)	0.050 (0.280)	**0.108 (0.020)**
In the morning	**0.467 (0.000)**	0.079 (0.087)	**0.140 (0.002)**	**0.115 (0.013)**	**0.474 (0.000)**	0.062 (0.185)

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experience, the problem of pain/deformities is more. Pain/disorders in the neck, chest and legs are associated with age, weight, BMI, year of experience and gender. The factors of age, year of experience and gender affect the neck, shoulders, chest, wrists, legs, and ankle/feet/toe. Pain in the head is associated with height, weight, BMI and gender. Fingers/thumbs are associated with age, weight, BMI, and year of experience, while pain in the lower back is associated with age, height and year of experience. The association of pain in the upper back and thigh/hip/buttock is due to height, weight and gender. Upper back also shows an association of pain with a year of experience, followed by knees and arms/hands. Pains in the knees are also showing an association with age. Result also shows pain/discomfort during work, after work and in the morning is associated with a year of experience, age and weight.

The association of pervasive jobs and pain is found in the head, neck, shoulders, chest, arms/hands, wrists, fingers/thumbs, lower back, thigh/hip/buttocks and legs. The pace of work affects the neck, shoulders, arms/hands, wrists, fingers/thumbs, lower back, thigh/hip/buttocks during the physical exhausting affecting neck, shoulders, upper back, lower back, legs and knees.

Working in an uncomfortable position has been linked to pain or discomfort in the neck, shoulders, elbows, arms/hands, wrists, fingers/thumbs, lower back, legs, and knees. The construction industry has a disproportionately high rate of injuries to the shoulders, fingers, and thumbs, and lower back. Working in an unnatural position appears more dangerous, which causes pain after work both at night and in the morning. The pain/discomfort due to pervasive jobs shows a high correlation with during working time, after working time and at sleeping time. If age and years of experience are more and you get physically exhausted, the pain is in the sleeping time and morning. The workers gone through traumatic incidents are experiencing pain during sleeping and in the morning. The details of the results are shown in tables (4-7).

Logistic Regression analysis for WRMSD occurrence:

All the variable data evaluated using logistic regression analysis, body parts and time, where and when pain occurred are dependent variables. While individual, physical and psychosocial risk factors are independent variables. The logistic regression analysis examines the effect of independent variables on dependent variables to evaluate the association of pain and WRMSD in different body parts and at various times. Table 8-11 reveals the occurrence of pain in the different body parts and at various times. The logistic regression analysis's chi-square and p-value show the significance level in different body parts and at various times with respect to individual, physical and psychosocial risk factors.

The regression analysis results reveal that working in an awkward posture, year of experience, age, gender and pervasive jobs shows a significant association between the intensity of pain in the different body parts and on various occasions with individual, physical and psychosocial risk factors. The result of logistic regression and Pearson correlation of the given data shows the same result in all respect. The pain in the neck, shoulders, elbows, arms/hands, wrists, fingers/thumbs, lower back, thigh/hip/buttocks, legs, and knees show significant association with working in an awkward posture, year of experience, age, gender and doing pervasive jobs. These factors also influence pain during, after, and in the morning.

The intensity of pain due to age is associated with the neck, shoulders, chest, arms/hands, wrist, fingers/thumbs, lower back, legs, knees and ankles/feet/toes. The age factor affects the wrist, lower back, legs, knees and ankles/feet/toes more. Age is also directly associated with WRMSD or pain during work, after, and in the morning. From the odds ratio (Table 13-15), head (OD =1.0143, 95%CI 0.9682 - 1.0625), lower back (OD =1.0324, 95%CI 0.9967 - 1.0694), legs (OD =1.0335, 95%CI 0.9794 - 1.0907), knees (OD = 1.0572, 95%CI 1.0295 - 1.0857) and ankles/feet/toes (OD =1.1084, 95%CI 1.0696 - 1.1486) times high risk to meet work-related musculoskeletal disorders or pain in the future. The odds ratio of various time zone shows (OD =1.1794, 95%CI 1.1328 - 1.2280) times more risk of WRMSD or pain in the morning.

The association of WRMSD or pain and height, weight, BMI are found only with a lower back. Pain in other body parts is not associated with height, weight and BMI, as well as pain in the various progression of the day. However, from Table 12 and 13, risk of WRMSD is more in the heighten workers in the body parts like head, chest, arms/hands, thigh/hip/buttocks and knees by (OD = 1.0183, 95%CI 0.4872 - 2.1283), (OD = 1.7580, 95%CI 0.8475 - 3.6467), (OD = 1.1084, 95%CI 0.7157 - 1.7165), (OD

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= 1.6749, 95%CI 0.7477 - 3.7522) and (OD = 1.2137, 95%CI 0.6803 - 2.1654) times respectively but showing no association of pain in any progression of day time.

On other hand, change in BMI increases risk of WRMSD in chest, arms/hands, thigh/hip/buttocks, and knees by (OD = 7.4619, 95%CI 0.4896 - 113.7198), (OD

Table 6. Result of Pearson correlation between pain in different body parts due to working in awkward posture, pace of work, pervasive jobs, physically exhausting, lack of social support and

Body parts	Awkward Posture	Pace of work	Pervasive jobs	Physically exhausting	Social support from	Traumatic incident on
Head	0.068 (0.141)	0.010 (0.830)	**0.127 (0.006)**	-0.004 (0.939)	-0.010 (0.836)	0.072 (0.122)
Neck	**0.193 (0.000)**	0.090 (0.053)	**0.117 (0.012)**	**0.196 (0.000)**	0.020 (0.668)	0.034 (0.460)
Shoulders	**0.367 (0.000)**	**0.206 (0.000)**	**0.214 (0.000)**	**0.204 (0.000)**	0.055 (0.236)	**0.124 (0.008)**
Chest	0.081 (0.080)	-0.031 (0.501)	**0.223 (0.000)**	0.050 (0.286)	0.024 (0.606)	-0.001 (0.987)
Elbow	**0.162 (0.000)**	-0.084 (0.069)	0.018 (0.699)	0.064 (0.166)	0.003 (0.946)	-0.060 (0.194)
Arms/ Hands	**0.311 (0.000)**	**0.203 (0.000)**	**0.410 (0.000)**	0.059 (0.202)	0.024 (0.601)	0.002 (0.969)
Wrists	**0.204 (0.000)**	**0.102 (0.028)**	**0.160 (0.001)**	-0.010 (0.834)	-0.076 (0.103)	-0.010 (0.822)
Fingers/ Thumbs	**0.172 (0.000)**	**0.116 (0.012)**	**0.155 (0.001)**	0.065 (0.162)	0.009 (0.854)	**0.118 (0.011)**
Upper back	0.054 (0.248)	0.011 (0.816)	-0.042 (0.371)	**-0.114 (0.014)**	-0.020 (0.665)	-0.042 (0.369)
Lower back	**0.668 (0.000)**	**0.219 (0.000)**	**0.408 (0.000)**	**0.301 (0.000)**	0.087 (0.060)	**0.122 (0.008)**
Thigh/ hip/ buttocks	0.087 (0.061)	**0.118 (0.011)**	**-0.154 (0.001)**	0.044 (0.349)	0.027 (0.565)	-0.008 (0.865)
Legs	**0.196 (0.000)**	0.036 (0.439)	**0.107 (0.021)**	**0.106 (0.022)**	0.018 (0.694)	0.054 (0.247)
Knees	**0.215 (0.000)**	-0.006 (0.890)	0.068 (0.145)	**0.150 (0.001)**	0.029 (0.538)	0.020 (0.665)
Ankles/ feet/toes	0.072 (0.120)	0.023 (0.621)	0.056 (0.229)	0.080 (0.085)	-0.045 (0.335)	**0.094 (0.042)**

Increase in weight shows association of WRMSD in neck by (OD = 1.3184, 95%CI 0.6738 - 2.5798), shoulders OD = (1.5598, 95%CI 0.8184 - 2.9729), elbows (OD = 1.1490, 95%CI 0.4719 - 2.7976), wrists (OD = 1.4282, 95%CI 0.7375 - 2.7660), fingers/thumbs (OD = 1.3521, 95%CI 0.7056 - 2.5910), upper back (OD = 1.6655, 95%CI 0.7208 - 3.8482), lower back (OD = 8.8544, 95%CI 2.5192- 31.1214), legs (OD =1.1926, 95%CI 0.6265 - 2.2702) and ankle/feet/toes (OD = 1.5311, 95%CI 0.6063 - 3.8661) times. An Increase in weight also shows association and possibility of WRMSD or pain, having pain after working and pain in the morning by (OD = 1.3713, 95%CI 0.7518 - 2.5011) and (OD = 1.0679, 95%CI 0.4675 - 2.4393) times respectively. Table 12 also revealed that the higher the weight, the higher is a risk of WRMSD in the lower back by (OD = 8.8544, 95%CI 2.5192 - 31.1214) times.

= 1.3206, 95%CI 0.2673 - 6.5231), (OD = 9.4908, 95%CI 0.4935 - 182.5375), (OD = 2.1562, 95%CI 0.2650 - 17.5441) times respectively. Increasing BMI also increases the risk of WRMSD by (OD = 1.0337, 95%CI 0.1109 - 9.6367) times during working time.

The associations of pain caused by years of experience are found in the neck, shoulders, chest, arms/hands, wrist, fingers/thumbs, lower back, legs, knees and ankles/feet/toes. The maximum association was found between the neck, shoulders, chest, fingers/thumbs and knees. Also, there is a close association between the intensity of pain during working and pain in the morning. Odds ratio shows that there is (OD = 1.0198, 95%CI 0.9960 - 1.0442), OD = 1.0227, 95%CI 0.9778 - 1.0697), OD = 1.0317, 95%CI 1.0080 - 1.0560), (OD = 1.0839, 95%CI 1.0517 - 1.1170), (OD = 1.0503, 95%CI 1.0045 -

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1.0983) times risk of work-related musculoskeletal disorders in lower back, thigh/hip/buttocks, legs, knees and ankles/feet's/toes respectively. The result of odds ratio shows a high correlation of pain with years of experience and morning pain by (OD = 1.1607, 95%CI 1.1208 - 1.2019) times.

Table 7. Result of Pearson correlation between various progression of day due to working in awkward posture, pace of work, pervasive jobs, physically exhausting, lack of social support and traumatic incidents on site

Different time	Awkward posture	Pace of work	Pervasive jobs	Physically exhausting	Social support from employee	Traumatic incident on site
During working	0.071 (0.128)	0.024 (0.603)	**0.119 (0.010)**	0.083 (0.072)	0.032 (0.496)	0.021 (0.652)
After working	**0347 (0.000)**	**0.095 (0.040)**	**0.241 (0.000)**	0.066 (0.154)	**-0.095 (0.040)**	-0.046 (0.320)
During Sleeping	**0.115 (0.013)**	0.031 (0.498)	**0.091 (0.050)**	**0.096 (0.038)**	0.067 (0.150)	**0.108 (0.020)**
In the morning	**0.222 (0.000)**	**0.127 (0.006)**	0.073 (0.115)	**0.228 (0.000)**	**0.214 (0.000)**	**0.161 (0.000)**

The association of pain and gender is also seen in the neck, shoulder, wrist, lower back, thigh/hip/buttocks, legs, ankles/feet/toes, more a wrist, lower back, thighs/hips/buttocks followed by legs and ankles/feet/toes. There is no association between WRMSD or pain in the different time zone of the day. The odds ratio result shows that the association of risk of WRMSD or pain in the lower back, wrist, fingers/thumbs and arms/hands are (OD = 12.0282, 95%CI 3.8493 - 37.5854), (OD = 7.1509, 95%CI 2.4052 - 21.2606), (OD = 2.1655, 95%CI 0.8365 - 5.6057) and (OD = 1.8541, 95%CI 0.7810 - 4.4020) times more than other parts. From the odds ratio, a male has (OD = 1.5859, 95%CI 0.6631 - 3.7928) times the risk of work-related musculoskeletal disorders than a female.

A significant relation of pain is found in all body parts due to working in awkward postures. Working in an awkward posture affects the neck, shoulders, elbows, arms/hands, wrist, fingers/ thumbs, upper back, lower back, thighs/hips/buttocks, legs and knees but more association is found in the neck, shoulders, elbows, arms/hands, wrists, fingers/thumbs, lower back, legs and knees.

The pain in the morning and after working is more associated with working awkward postures. The odds ratio results reveal that working in awkward postures is more hazardous for developing work-related musculoskeletal disorders or pain. It shows risk of WRMSD in head, neck, shoulders, elbows, arms/hands, wrists, fingers/thumbs, upper back, lower back, thighs/hips/buttocks, legs, knees, ankles/feet/toes are (OD = 2.3816, 95%CI 0.6009 - 9.4387), (OD = 3.9335, 95%CI 1.7607 - 8.7876), (OD = 7.0945, 95%CI 3.7381 - 13.4646), (OD = 23.4921, 95%CI 2.9695 - 185.8471), (OD = 3.4078, 95%CI 1.8200 - 6.3809), (OD = 4.0473, 95%CI 2.0223 - 8.0999), (OD = 3.1443, 95%CI 1.4679 - 6.7350), (OD = 9.0988, 95%CI 1.6741 - 49.4529), (OD = 23.5021, 95%CI 11.5930 - 47.6446), (OD = 9.3976, 95%CI 1.8046 - 48.9380), (OD = 4.0534, 95%CI 1.9078 - 8.6119), (OD = 16.2428, 95%CI 3.5631 - 74.0439), (OD = 2.6665, 95%CI 0.6417 - 11.0794) times higher. This result also shows during working, it is (OD = 1.6562, 95%CI 0.6455 - 4.2495) times, after working (OD = 9.6127, 95%CI 4.6818 - 19.7369) times and in the morning (OD = 5.6318, 95%CI 1.9092 - 16.6129) times higher.

The significant relation between pain and pace of work is found in shoulders, chest, elbow, arms/hands, thigh/hip/buttocks. Table 11 shows no association between the pace of work and different time zone. Table 14 and 15 show the risk of WRMSD or pain due to the pace of work (OD = 3.2441, 95%CI 1.1781 - 8.9333) time higher in thigh/hip/buttocks. It is found that risk of WRMSD or pain in head are (OD = 1.0517, 95%CI 0.4162 - 2.6575), neck (OD = 1.2042, 95%CI 0.7336 - 1.9766), shoulders (OD = 1.8843, 95%CI 1.2099 - 2.9345), arms/hands (OD = 1.8847, 95%CI 1.2018 - 2.9558), wrists (OD = 1.3488, 95%CI 0.8587 - 2.1184), fingers/thumbs (OD = 1.4338, 95%CI 0.8931 - 2.3016), upper back (OD = 1.4149, 95%CI 0.4160 - 4.8122), lower back (OD = 1.5627, 95%CI 0.7863 - 3.1056) and after working (OD = 1.1338, 95%CI 0.7368 - 1.7447) as well as in the morning time (OD = 1.2754, 95%CI 0.7125 - 2.2829) times higher.

The statistical analysis shows that pervasive jobs have a closed association with WRMSD or pain in the chest, arms/hand, wrists, upper back, lower back, thigh/hip/buttocks. WRMSD or Pain in these body parts, is found after working hours. The odds ratio shows that the risk of WRMSD or pain in head (OD = 2.0313, 95%CI 0.5110 - 8.0748), chest (OD

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= 20.4925, 95%CI 4.2259 - 99.3726) , arms/hands (OD = 5.2092, 95%CI 3.1704 - 8.5593) and lower back (OD = 4.4354, 95%CI 2.2358 - 8.7989) are times higher. The odds ratio also shows that risk of WRMSD or pain in wrists (OD = 1.7522, 95%CI 1.0560 - 2.9075), fingers/ thumbs (OD = 1.5649, 95%CI 0.8932 - 2.7416), during working (OD = 1.6869, 95%CI 0.7330 - 3.8824) and after working (OD = 1.6225, 95%CI 1.0044 - 2.6211) times.

Table 8. Logistic regression results between the feeling of pain versus age, height, weight, BMI and gender at various time zone in different body parts with other parameters

	Chi-square value (p- value)					
Body Parts	**Age**	**Height**	**Weight**	**BMI**	**Year of Experience**	**Gender**
Head	0.35 (0.551)	0.00 (0.962)	0.03 (0.858)	0.00 (0.947)	1.28 (0.259)	3.36 (0.067)
Neck	**9.02 (0.003)**	0.65 (0.419)	0.65 (0.419)	0.93 (0.335)	**18.91 (0.000)**	**8.06 (0.005)**
Shoulders	**11.95 (0.001)**	1.66 (0.197)	1.87(0.171)	1.61 (0.205)	**8.66 (0.003)**	**5.24 (0.022)**
Chest	**11.33 (0.001)**	2.47 (0.116)	2.40 (0.122)	2.23 (0.136)	**14.48 (0.000)**	0.25 (0.619)
Elbow	0.50 (0.482)	0.06 (0.805)	0.09 (0.761)	0.07 (0.790)	0.16 (0.689)	1.12 (0.289)
Arms/ Hands	**4.10 (0.043)**	0.21 (0.645)	0.17 (0.682)	0.12 (0.733)	**7.00 (0.008)**	1.94 (0.164)
Wrists	**15.28 (0.000)**	1.25 (0.264)	1.11 (0.291)	1.18 (0.278)	**9.98 (0.002)**	**15.24 (0.000)**
Fingers/ Thumbs	**11.62 (0.001)**	0.94 (0.333)	0.82(0.364)	1.06 (0.304)	**16.62 (0.000)**	2.66 (0.103)
Upper back	1.98 (0.160)	1.36 (0.243)	1.48 (0.223)	1.93 (0.165)	2.68 (0.102)	0.01 (0.911)
Lower back	**4.31 (0.005)**	**14.40 (0.000)**	**13.30 (0.000)**	**13.58 (0.000)**	**4.92 (0.027)**	**18.16 (0.000)**
Thigh/ hip/ buttocks	1.47 (0.225)	1.67 (0.196)	2.46 (0.117)	2.40 (0.121)	0.96 (0.327)	**14.88 (0.000)**
Legs	**17.92 (0.000)**	0.28 (0.599)	0.29 (0.591)	0.53 (0.466)	**7.03 (0.008)**	**11.26 (0.001)**
Knees	**38.18 (0.000)**	0.44 (0.509)	0.59 (0.442)	0.52 (0.469)	**30.29 (0.000)**	3.18 (0.074)
Ankles/ feet/toes	**15.47 (0.000)**	0.88 (0.348)	0.80 (0.370)	0.87 (0.352)	**4.74 (0.029)**	**10.75 (0.001)**

From Table 10 and 11, no association was found between pain and social support in different body parts, while pain occurs in different progressions. However, the odds ratio shows that there is a correlation between pain in the neck, shoulders, chest, elbows, arms/hands, fingers/thumbs, upper back, lower back, thigh/hip/buttocks. It is found that (OD = 1.4833, 95 % CI 0.6675 - 3.2963), (OD = 1.4519, 95% CI 0.7198 - 2.9286), (OD = 1.9615, 95 % CI 0.6505 - 5.9145), (OD = 1.3557, 95% CI 0.4312 - 4.2622), (OD = 1.4091, 95%CI 0.7128 - 2.7855), (OD = 1.0524, 95% CI 0.4567 - 2.4249), (OD = 1.1999, 95 % CI 0.1368 - 10.5208), (OD = 1.6188, 95% CI 0.6397 - 4.0965) and (OD = 1.3373, 95% CI 0.3548 - 5.0403) times risk of WRMSD or pain due to poor social support in neck, shoulders, chest, elbows, arms/hands, fingers/thumbs, upper back lower back and thigh/hip/buttocks

The relation of pain in the body parts because of physically exhausting is found in the neck, arms/hands and lower back. There is no relation between physical exhaustion for the development of WRMSD or pain in body parts in various progression of the day. However, the odds ratios reveal that the risk of WRMSD caused by physically exhausting is very lower, since some body parts and time of progressive zone show some risk. The body parts like neck, shoulders, chest, elbows, knees, ankles/feet/toes are (OD = 1.9445, 95%CI 1.1606 - 3.2578), (OD = 1.3340, 95%CI 0.8570 - 2.0766), (OD = 1.2328, 95%CI 0.6242 - 2.4347), (OD = 1.0843, 95%CI 0.5560 - 2.1147), (OD = 1.2693, 95%CI 0.7061 - 2.2817) and (OD = 1.3509, 95%CI 0.5239 - 3.4834) times risk of WRMSD respectively. There is (OD = 1.6059, 95%CI 0.8211 - 3.1383) and (OD = 1.6741, 95%CI 0.9243 - 3.0321) times possible association of WRMSD or pain during working and pain in the morning.

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Table 9. Logistic regression results between the feeling of pain versus age, height, weight, BMI and gender at various time zone in different body parts with other parameters

Chi-square value (p- value)						
Body Parts	**Age**	**Height**	**Weight**	**BMI**	**Year of Experience**	**Gender**
During working	**20.03 (0.000)**	**0.00 (0.993)**	**0.02 (0.878)**	**0.00 (0.977)**	**36.98 (0.000)**	**0.04 (0.848)**
After working	**11.03 (0.001)**	**1.18 (0.278)**	**1.08 (0.299)**	**1.13 (0.288)**	**8.74 (0.003)**	**1.08 (0.299)**
During Sleeping	-	-	-	-	-	-
In the morning	**94.57 (0.000)**	**0.02 (0.901)**	**0.02 (0.876)**	**0.02 (0.897)**	**97.17 (0.000)**	**0.27 (0.605)**

Table 10. Logistic regression results between the feeling of pain versus age, height, weight, BMI and gender at various time zone, in different body parts with other parameters

Chi-square value (p- value)						
Body Parts	**Awkward Posture**	**Pace of work**	**Pervasive jobs**	**Physically exhausting**	**Social support from employee**	**Traumatic incident on site**
Head	1.72 (0.189)	0.01 (0.915)	1.11 (0.291)	1.98 (0.160)	0.22 (0.640)	2.86 (0.091)
Neck	**12.81 (0.000)**	0.54 (0.464)	1.33 (0.249)	**6.53 (0.011)**	0.90 (0.342)	1.35 (0.246)
Shoulders	**41.58 (0.000)**	**8.00 (0.005)**	0.00 (0.963)	1.63 (0.202)	1.09 (0.296)	**7.98 (0.005)**
Chest	0.18 (0.669)	**5.20 (0.023)**	**25.93 (0.000)**	0.37 (0.546)	1.31 (0.253)	0.05 (0.830)
Elbow	**19.48 (0.000)**	**6.89 (0.009)**	2.37 (0.124)	0.06 (0.812)	0.26 (0.612)	2.02 (0.155)
Arms/ Hands	**15.40 (0.000)**	**7.74 (0.005)**	**46.08 (0.000)**	**4.77 (0.029)**	0.97 (0.324)	0.05 (0.826)
Wrists	**17.57 (0.000)**	1.68 (0.195)	**4.82 (0.028)**	2.84 (0.092)	1.42 (0.233)	0.39 (0.534)
Fingers/ Thumbs	**9.81 (0.002)**	2.21 (0.137)	2.52 (0.112)	0.00 (0.978)	0.01 (0.905)	**9.16 (0.002)**
Upper back	**8.48 (0.004)**	0.30 (0.582)	**5.51 (0.019)**	0.00 (0.955)	0.03 (0.872)	0.46 (0.500)
Lower back	**92.44 (0.000)**	1.66 (0.197)	**18.37 (0.000)**	**10.35 (0.001)**	1.12 (0.290)	**4.80 (0.028)**
Thigh/ hip/ buttocks	**9.73 (0.002)**	**5.35 (0.021)**	**34.20 (0.000)**	0.63 (0.428)	0.18 (0.676)	0.19 (0.662)
Legs	**15.12 (0.000)**	0.08 (0.775)	0.79 (0.374)	0.31 (0.575)	0.13 (0.714)	0.55 (0.459)
Knees	**23.30 (0.000)**	3.61 (0.058)	0.76 (0.382)	0.64 (0.424)	0.31 (0.580)	0.18 (0.670)
Ankles/ feet/toes	2.05 (0.152)	0.11 (0.737)	0.97 (0.326)	0.39 (0.531)	3.53 (0.060)	3.23 (0.072)

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Table 11. Logistic regression results between the feeling of pain versus age, height, weight, BMI and gender at various time zone, in different body parts with other parameters

Chi-square value (p- value)						
Body Parts	**Awkward Posture**	**Pace of work**	**Pervasive jobs**	**Physically exhausting**	**Social support from employee**	**Traumatic incident on site**
During working	1.15 (0.283)	0.26 (0.611)	1.58 (0.208)	1.95 (0.163)	2.19 (0.139)	0.78 (0.378)
After working	**49.09 (0.000)**	0.33 (0.568)	**3.93 (0.047)**	2.22 (0.136)	1.98 (0.159)	0.01 (0.910)
During Sleeping	-	-	-	-	-	-
In the morning	**12.25 (0.000)**	0.67 (0.414)	0.03 (0.873)	2.92 (0.087)	3.61 (0.057)	1.75 (0.186)

Table 12. Odds ratio and 95% Confidence Interval for the feeling of pain versus age, height, weight, BMI and gender at various time zone in different body parts with other parameters

Odds Ratio (95% CI)						
Body Parts	**Age**	**Height**	**Weight**	**BMI**	**Year of Experience**	**Gender**
Head	**1.0143 (0.9682, 1.0625)**	**1.0183 (0.4872, 2.1283)**	0.9064 (0.3085,2.6628)	0.9066 (0.0517, 15.8931)	0.9744 (0.9310, 1.0197)	0.3176 (0.0940, 1.0729)
Neck	0.9598 (0.9339,0.9863)	0.8176 (0.5008, 1.3347)	**1.3184 (0.6738, 2.5798)**	0.4100 (0.0665, 2.5296)	0.9464 (0.9224, 0.9711)	0.2727 (0.1101, 0.6754)
Shoulders	0.9588 (0.9358, 0.9825)	0.7316 (0.4522, 1.1836)	**1.5598 (0.8184, 2.9729)**	0.3273 (0.0569, 1.8823)	0.9692 (0.9490, 0.9899)	0.3301 (0.1237, 0.8809)
Chest	0.9367 (0.8998, 0.9752)	**1.7580 (0.8475, 3.6467)**	0.4620 (0.1682, 1.2686)	**7.4619 (0.4896, 113.7198)**	0.9320 (0.8971, 0.9683)	0.7501 (0.2426, 2.3187)
Elbow	0.9861 (0.9482, 1.0255)	0.9200 (0.4765, 1.7763)	**1.1490 (0.4719, 2.7976)**	0.7198 (0.0650, 7.9752)	0.9929 (0.9585, 1.0284)	0.4979 (0.1400, 1.7710)
Arms/ Hands	0.9757 (0.9526, 0.9993)	**1.1084 (0.7157, 1.7165)**	0.8839 (0.4900, 1.5946)	**1.3206 (0.2673, 6.5231)**	0.9726 (0.9526, 0.9930)	**1.8541 (0.7810, 4.4020)**
Wrists	0.9521 (0.9283, 0.9765)	0.7544 (0.4603, 1.2362)	**1.4282 (0.7375, 2.7660)**	0.3704 (0.0618, 2.2215)	0.9642 (0.9423, 0.9866)	**7.1509 (2.4052, 21.2606)**
Fingers/ Thumbs	0.9558 (0.9307, 0.9816)	0.7894 (0.4893, 1.2736)	**1.3521 (0.7056, 2.5910)**	0.3966 (0.0682, 2.3066)	0.9489 (0.9245, 0.9740)	**2.1655 (0.8365, 5.6057)**
Upper back	0.9538 (0.8917, 1.0202)	0.1948 (0.0782, 0.4854)	**1.6655 (0.7208, 3.8482)**	0.0029 (0.0001, 0.0840)	0.9361 (0.8806, 0.9952)	0.8814 (0.0968, 8.0269)
Lower back	**1.0324 0.9967, 1.0694)**	0.6971 (0.3757, 1.2932)	**8.8544 (2.5192, 31.1214)**	0.2107 (0.0221, 2.0085)	**1.0198 (0.9960, 1.0442)**	**12.0282 (3.8493, 37.5854)**
Thigh/ hip/ buttocks	**1.0335 (0.9794, 1.0907)**	**1.6749 (0.7477, 3.7522)**	0.4207 (0.1366, 1.2951)	**9.4908 (0.4935, 182.5375)**	**1.0227 (0.9778, 1.0697)**	0.0218 (0.0021, 0.2263)
Legs	**1.0572 (1.0295, 1.0857)**	0.8802 (0.5468, 1.4169)	**1.1926 (0.6265, 2.2702)**	0.5232 (0.0914, 2.9938)	**1.0317 (1.0080, 1.0560)**	0.2216 (0.0899, 0.5465)
Knees	**1.1084 (1.0696, 1.1486)**	1.2137 (0.6803, 2.1654)	0.7394 (0.3403, 1.6065)	**2.1562 (0.2650, 17.5441)**	**1.0839 (1.0517, 1.1170)**	0.3562 (0.1158, 1.0952)
Ankles/ feet/toes	**1.1064 (1.0479, 1.1683)**	0.7259 (0.3729, 1.4130)	**1.5311 (0.6063, 3.8661)**	0.3039 (0.0251, 3.6801)	**1.0503 (1.0045, 1.0983)**	0.0866 (0.0198, 0.3787)

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Table 13. Odds ratio and 95% Confidence Interval for the feeling of pain versus age, height, weight, BMI and gender at various time zone in different body parts with other parameters

Odds Ratio (95% CI)						
Body Parts	**Age**	**Height**	**Weight**	**BMI**	**Year of Experience**	**Gender**
During working	0.9205 (0.8849, 0.9574)	0.9972 (0.5492, 1.8106)	0.9367 (0.4053, 2.1646)	**1.0337 (0.1109, 9.6367)**	0.8932 (0.8576, 0.9302)	0.9027 (0.3174, 2.5674)
After working	0.9610 (0.9383, 0.9842)	0.7824 (0.5004, 1.2233)	**1.3713 (0.7518, 2.5011)**	0.4167 (0.0817, 2.1246)	0.9688 (0.9484, 0.9896)	**1.5859 (0.6631, 3.7928)**
During Sleeping	-	-	-	-	-	-
In the morning	**1.1794 (1.1328, 1.2280)**	0.9612 (0.5151,1.7937)	**1.0679 (0.4675, 2.4393)**	0.8627 (0.0919, 8.0965)	**1.1607 (1.1208, 1.2019)**	0.7080 (0.1934, 2.5923)

Table 14. Odds ratio and 95% Confidence Interval for the feeling of pain versus age, height, weight, BMI and gender at various time zone, in different body parts with other parameters

Odds Ratio (95% CI)						
Body Parts	**Awkward Posture**	**Pace of work**	**Pervasive jobs**	**Physically exhausting**	**Social support from employee**	**Traumatic incident on site**
Head	**2.3816 (0.6009, 9.4387)**	**1.0517 (0.4162, 2.6575)**	**2.0313 (0.5110, 8.0748)**	0.5177 (0.2054, 1.3047)	0.6976 (0.1458, 3.3372)	**2.5441 (0.9186, 7.0461)**
Neck	**3.9335 (1.7607, 8.7876)**	**1.2042 (0.7336, 1.9766)**	0.7201 (0.4133, 1.2546)	**1.9445 (1.1606, 3.2578)**	**1.4833 (0.6675, 3.2963)**	**1.4854 (0.7698, 2.8664)**
Shoulders	**7.0945 (3.7381, 13.4646)**	**1.8843 (1.2099, 2.9345)**	0.9888 (0.6164, 1.5862)	**1.3340 (0.8570, 2.0766)**	**1.4519 (0.7198, 2.9286)**	**2.3053 (1.2751, 4.1681)**
Chest	0.7922 (0.2761, 2.2729)	0.4384 (0.2100, 0.9153)	**20.4925 (4.2259, 99.3726)**	**1.2328 (0.6242, 2.4347)**	**1.9615 (0.6505, 5.9145)**	**1.1159 (0.4129, 3.0160)**
Elbow	**23.4921 (2.9695, 185.8471)**	0.3788 (0.1745, 0.8221)	0.5604 (0.2711, 1.1584)	**1.0843 (0.5560, 2.1147)**	**1.3557 (0.4312, 4.2622)**	0.4394 (0.1266, 1.5255)
Arms/ Hands	**3.4078 (1.8200, 6.3809)**	**1.8847 (1.2018, 2.9558)**	**5.2092 (3.1704, 8.5593)**	0.6015 (0.3798, 0.9526)	**1.4091 (0.7128, 2.7855)**	**1.0658 (0.6038, 1.8814)**
Wrists	**4.0473 (2.0223, 8.0999)**	**1.3488 (0.8587, 2.1184)**	**1.7522 (1.0560, 2.9075)**	0.6741 (0.4258, 1.0672)	0.6090 (0.2619, 1.4159)	**1.2214 (0.6532, 2.2838)**
Fingers/ Thumbs	**3.1443 (1.4679, 6.7350)**	**1.4338 (0.8931, 2.3016)**	**1.5649 (0.8932, 2.7416)**	0.9933 (0.6098, 1.6180)	**1.0524 (0.4567, 2.4249)**	**2.7046 (1.4402, 5.0789)**
Upper back	**9.0988 (1.6741, 49.4529)**	**1.4149 (0.4160, 4.8122)**	0.2063 (0.0534, 0.7973)	0.1204 (0.0273, 0.5300)	**1.1999 (0.1368, 10.5208)**	0.5081 (0.0601, 4.2950)
Lower back	**23.5021 (11.5930, 47.6446)**	**1.5627 (0.7863, 3.1056)**	**4.4354 (2.2358, 8.7989)**	0.9808 (0.4981, 1.9311)	**1.6188 (0.6397, 4.0965)**	**2.2893 (1.0336, 5.0704)**
Thigh/ hip/ buttocks	**9.3976 (1.8046, 48.9380)**	**3.2441 (1.1781, 8.9333)**	0.0196 (0.0025, 0.1544)	0.6591 (0.2354, 1.8458)	**1.3373 (0.3548, 5.0403)**	0.7561 (0.2083, 2.7450)
Legs	**4.0534 (1.9078, 8.6119)**	0.9323 (0.5760, 1.5089)	0.7869 (0.4647, 1.3323)	0.8702 (0.5351, 1.4153)	0.8701 (0.4114, 1.8402)	**1.2608 (0.6861, 2.3170)**
Knees	**16.2428 (3.5631, 74.0439)**	0.5642 (0.3086, 1.0315)	0.7552 (0.4040, 1.4118)	**1.2693 (0.7061, 2.2817)**	0.7818 (0.3225, 1.8955)	0.8498 (0.3990, 1.8099)
Ankles/ feet/toes	**2.6665 (0.6417, 11.0794)**	0.8537 (0.3374, 2.1602)	0.5809 (0.1991, 1.6948)	**1.3509 (0.5239, 3.4834)**	0.1989 (0.0248, 1.5941)	**2.5179 (0.9729, 6.5161)**

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Table 15. Odds ratio and 95% Confidence Interval for the feeling of pain versus age, height, weight, BMI and gender at various time zone in different body parts with other parameters

Odds Ratio (95% CI)						
Body Parts	**Awkward Posture**	**Pace of work**	**Pervasive jobs**	**Physically exhausting**	**Social support from employee**	**Traumatic incident on site**
During working	**1.6562 (0.6455, 4.2495)**	0.8426 (0.4340, 1.6359)	**1.6869 (0.7330, 3.8824)**	**1.6053 (0.8211, 3.1383)**	**2.3710 (0.7941, 7.0792)**	**1.5419 (0.6030, 3.9425)**
After working	**9.6127 (4.6818, 19.7369)**	**1.1338 (0.7368, 1.7447)**	**1.6225 (1.0044, 2.6211)**	0.7177 (0.4635, 1.1112)	0.5897 (0.2774, 1.2535)	0.9665 (0.5358, 1.7434)
During Sleeping	-	-	-	-	-	-
In the morning	**5.6318 (1.9092, 16.6129)**	**1.2754 (0.7125, 2.2829)**	0.9507 (0.5113, 1.7677)	**1.6741 (0.9243, 3.0321)**	**2.1757 (0.9813, 4.8236)**	**1.6016 (0.8027, 3.1955)**

respectively. But Table 15 shows strong association between WRMSD or pain during various progression times and poor social support. It shows that (OD = 2.3710, 95 % CI 0.7941 - 7.0792) times and (OD = 2.1757, 95% CI 0.9813 - 4.8236) times risk of WRMSD, if pain occurs during working and if pain occurs in the morning.

The result shows the association of pain between shoulders, fingers/thumbs, and lower backs when a traumatic incidence occurs at construction sites. Odds ratio result shows that when traumatic incidence occurs the risk of WRMSD increases in head, neck, shoulders, chest, arms/hands, wrists, fingers/thumbs, lower back, legs and ankle/feet/toes by (OD = 2.5441, 95 % CI 0.9186 - 7.0461), (OD = 1.4854, 95 % CI 0.7698 - 2.8664), (OD = 2.3053, 95 % CI 1.2751 - 4.1681), (OD = 1.1159, 95 % CI 0.4129 - 3.0160), (OD = 1.0658, 95 % CI 0.6038 - 1.8814), (OD = 1.2214, 95 % CI 0.6532 - 2.2838), (OD = 2.7046, 95 % CI 1.4402 - 5.0789), (OD = 2.2893, 95% CI 1.0336 - 5.0704), (OD = 1.2608, 95 % CI 0.6861 - 2.3170), (OD = 2.5179, 95 % CI 0.9729 - 6.5161) times but more in head, shoulders, fingers/thumbs, lower back and ankle/feet/toes. The risk of WRMSD is also found in the workers who had complaints about pain during working and in the morning time by (OD = 1.5419, 95 % CI 0.6030 - 3.9425), (OD = 1.6016, 95 % CI 0.8027 - 3.1955) times respectively.

In this study, only a few risk factors associated with construction workers were considered from individual, physical and psychosocial risk factors. For individual risk factors include age, height, overweight or underweight, body mass index (BMI), years of experience and gender, physical risk factors include working in an awkward posture, the pace of work, physically exhausting and psychosocial risk factors pervasive jobs, social support and traumatic incident on-site are taken and evaluated.

These factors are considered only for the reason directly related to workers and can be easily countable from observation, video recording, analysis, and personal interview. Personal observation and video analysis show work with poor working habits, an individual bad habits, working in awkward postures including bending, forceful exertion, less rest time, physically exhausting, pushing/pulling, the high pace of work, high compression, contact stress, improper or inadequate lighting, vibration, working in cold and hot temperature, pervasive jobs, heavy workload, working environment, lack of control on the work. Worker's deficit health problem, year of experience, the reason for bad habits, social relation/support, relation with supervisor and colleagues, trauma, dissatisfaction with jobs etc. learned from a personal interview. Most of the risk factors are very close to the factors considered for this study are abandoned.

This study revealed that the variables of individual, physical and psychosocial risk factors considered for this statistical analysis study were responsible for the development of work-related musculoskeletal disorders (WRMSD) and pain in approximately all body parts. The result shows that there is a significant association between WRMSD and these factors.

The result obtained from Pearson's correlation and logistic regression analysis showed from an individual, physical and psychosocial risk factors, age, years of experience and working in awkward postures were significantly associated with work-related musculoskeletal disorders symptoms in all body parts. The result of a feeling of pain during the day's various

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progression also shows that age, year of experience and working in awkward postures are significantly associated with work-related musculoskeletal disorders. However, among these three variables working in awkward postures is more significant. Other variables also show a significant association between feeling of pain and WRMSD in all body parts and at various times zone. The physical observation also reveals the same result. Most of the working time, construction workers worked awkwardly, whether they were young, old, experienced or inexperienced.

The odds ratio results also revealed that the probability of work-related musculoskeletal disorders in construction workers is due to working in awkward postures and associated with almost all body parts.

Odds ratio's results of various time zone also showed the same. Construction workers will lead to work-related musculoskeletal disorders due to working in awkward posture by lower back (OD = 23.5021, 95 % CI 11.5930 - 47.6446), elbows (OD = 23.4921, 95 % CI 2.9695 - 185.8471), knees (OD = 16.2428, 95 % CI 3.5631 - 74.0439), thigh/hip/buttocks (OD = 9.3976, 95 % CI 1.8046 - 48.9380), upper back (OD = 9.0988, 95 % CI 1.6741 - 49.4529), shoulders (OD = 7.0945, 95 % CI 3.7381 - 13.4646), legs (OD = 4.0534, 95 % CI 1.9078 - 8.6119), wrists (OD = 4.0473, 95 % CI 2.0223 - 8.0999), neck (OD = 3.9335, 95 % CI 1.7607 - 8.7876), arms/hands (OD = 3.4078, 95 % CI 1.8200 - 6.3809), fingers/thumbs (OD = 3.1443, 95 % CI 1.4679 - 6.7350), ankle/feet/toes (OD = 2.6665, 95 % CI 0.6417 - 11.0794), head (OD = 2.3816, 95 % CI 0.6009 - 9.4387) times. The same result also found with the various time zone. It is after working (OD = 9.6127, 95 % CI 4.6818 - 19.7369), in the morning (OD = 5.6318, 95 % CI 1.9092 - 16.6129), during working (OD = 1.6562, 95 % CI 0.6455 - 4.2495) times.

Odds ratio also showed that varying weight affects WRMSD or pain in the lower back by (OD = 8.8544, 95 % CI 2.5192 - 31.1214) times. Variations in BMI also affect thigh/hip/buttocks, chest and knees by (OD = 9.4908, 95% CI 0.4935 - 182.5375), (OD = 7.4619, 95% CI 0.4896 - 113.7198), and (OD = 2.1562, 95 % CI 0.2650 - 17.5441) times respectively. It is also found that doing pervasive jobs also increases the possibility of work-related musculoskeletal disorders in the chest, arms/hands, lower back and head by (OD = 20.4925, 95% CI 4.2259 - 99.3726), (OD = 5.2092, 95 % CI 3.1704 - 8.5593), (OD = 4.4354, 95% CI 2.2358 - 8.7989) and (OD = 2.0313, 95% CI 0.5110 - 8.0748) times respectively.

The risk of work-related musculoskeletal disorders among construction workers is found because of the occurrence of traumatic incidences like slipping or falling from a scaffold, or ladder, falling from a height, being struck by an object, electric shocks, injury due to tools/equipment/materials etc. at a construction site with individual workers. Workers can have (OD = 2.7046, 95% CI 1.4402 - 5.0789), (OD =2.5441, 95 % CI 0.9186 - 7.0461), (OD =2.5179, 95 % CI 0.9729 - 6.5161), (OD =2.3053, 95 % CI 1.251 - 4.1681) and (OD =2.2893, 95 % CI 1.0336 - 5.0704) times probability of work-related musculoskeletal disorders in fingers/thumbs, head, ankle/feet/toes, shoulders and lower back. If workers do not get social support from colleagues or employees, the result shows that the risk of work-related musculoskeletal disorders increases by nearly 2.4 and 2.2 times.

Since male has more physical strength than female, it is evident that as the gender changes, the feeling of pain or risk of work-related musculoskeletal disorders changes and be more in a female. Simultaneously, after a certain age, height stops increasing. Therefore, these factors neglect the cause of work-related musculoskeletal disorders.

Since the last three decades, WRMSD becomes a vital problem in the world. (Pavlovic-Veselinovic et al, 2016). It is observed that the construction workers habitual to some poor working habits and forcefully work in awkward postures, as working such kind of tasks for prolong time, they turned into skilled workers. It is noted that orders are highly skilled than the younger ones. The construction work includes the work like carrying of the sand, brick, cement bag, mortar, making mortar, filling into a vessel, lifting vessel from the ground, excavation of soil and many more which are physically exhausting, stressful and tedious job. The workers have to work for nearly 8 to nine hours every day since their financial conditions are deprived.

Construction work is considered to be dynamic, but repetitiveness, heavy lifting and lowering, carrying overhead or back, manual material movement at the different floors using under construction staircase, repetitive bending, working kneeling, working in squatting position, working overhead, working in the cold and hold temperature etc makes this job hazardous. Continuously working in an awkward posture, dynamic postures and standing or sitting in an awkward posture enforce stress on the muscles, ultimately leading to fatigue. The maximum number of male and female workers have pain in the neck, shoulder, arms/hands, wrists, fingers/thumbs, lower back, legs and knees but most in the lower back because of repetitive flexion

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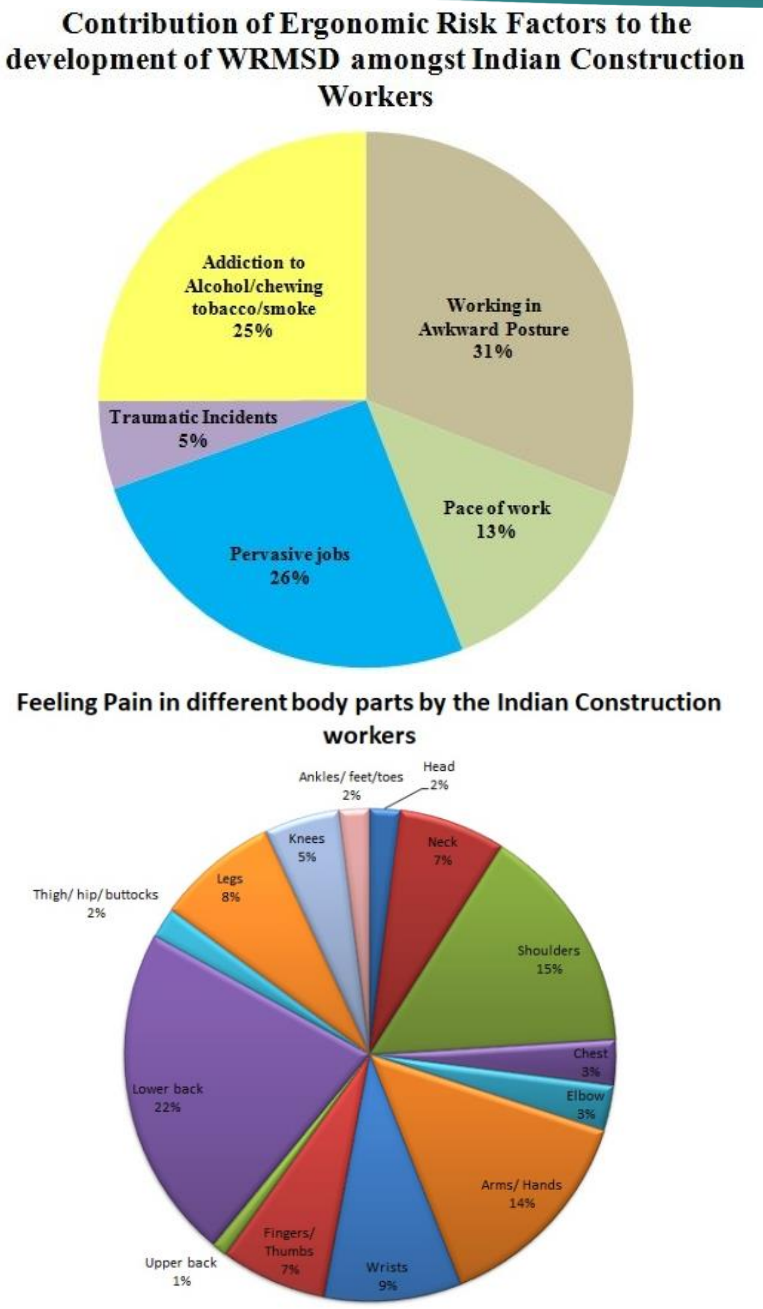

Figure 3. (a & b). Percentage of body parts affected

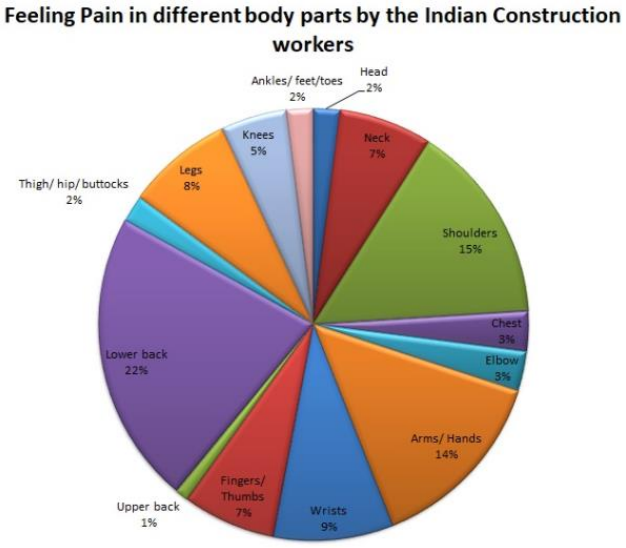

Figure 4. Contribution of other factors for the development of WRSMD

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(bending forward) at lumbar and overexertion, stress and strain.

Figure 3 shows the percentage of body parts exposed to the WRMSD. From Figure 3, it has been revealed that construction workers are more prone to work-related musculoskeletal disorders related to the lower back (22%), shoulder (15%) and arms/hands (14%). Overall, working in an awkward posture (31%), a Pervasive job (26%), and addiction to alcohol/smoke/tobacco (25%) contribute to the development of WRMSD among construction workers (Figure 4).

Studies show that the most hazardous task is bricklaying (19%), scaffolding (18%) and manual material handling (14%). Study also reveals that tiles perform more than 80% of work on their kneeling/squatting/stooping postures and 93% of the time they work in flexion and twisting posture. Also, the most ergonomic risk factors for developing work-related musculoskeletal disorders are prolonged working time, working in an awkward posture, particularly in flexion and twisting posture at the lower back, working with injuries and handling heavy material for transportation. (Valero et al., 2016).

Significantly, all work and postures of the workers adopted for working are hazardous and unsafe, leading to the development of work-related musculoskeletal disorders at in early age. The most affected body parts are lower back, shoulder, neck, arms/hands, wrist and legs. Both males and females work in awkward posture throughout the day due to which WRMSD or pain developed which requires necessary action to improve working postures or provide equipment or machinery or tools, so that problem should not be faced by the workers in construction work.

Hence, it is necessary to investigate the working postures of construction workers using ergonomic methods like HARM (Douwes and de Kraker, 2012), REBA (Hignett and McAtamney, 2000), MAC (Anon, 2002), ART (Ferreira et al., 2009) OWAS (Karhu and Kuorinka, 1977), PLIBEL (Kemmlert, 1995), WERA (Rahman et al., 2011), manTRA (Moussavi–Najarkola and Mirzaei, 2012), QEC (Li and Buckle, 1999), ACGIH (Radwin et al., 2014), ERIN (Rodriguez and Montero, 2013) NERPA (Sanchez-Lite et al., 2013), NIOSH (Waters et al., 1993), RULA (McAtamney and Corlett, 1993) and other methods to avoid such strenuous postures, lowering down the working hours, designing of equipment, machinery, tools, personal protection equipment and intervention of ergonomics.

Conclusion

Studies have shown that construction workers work in extremely painful and tedious working conditions. All the work on the construction site is strenuous and body parts are affected by working in different awkward postures. Another factor contributing to more fatality is the stress of getting work done as soon as possible to earn more money. Construction workers receive no support from employers and statutory bodies. They are not provided health care and life-saving facilities. Also, they do not have life insurance, so their family can survive after their mishap. The illiteracy is higher among women than men.

The absence of older aged workers is higher than that of young due to frequent health problems. Older workers may experience work-related musculoskeletal disorders over time. The main causes of work-related musculoskeletal disorders are working in an awkward posture, years of experience and age. Other major factors include awareness of working technique, the pace of work, pervasive jobs, ignorance of symptoms in early-stage and medication, inadequate diet, lack of exercise, traumatic incidence, duration of the task, environment effect, poverty and poor work sites etc. Therefore, construction workers should be provided with some ergonomically designed equipment, machinery, tools, safety majors and training to reduce the incidence of work-related musculoskeletal disorder. Further detailed investigation is required based on the age and nature of the construction work, based on the complaints and results obtained from statistical analysis.

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Conflicts of interest

The authors of this scientific work have confirmed that there are no conflicts of interest to report.

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