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Health Risk Factors in Different Seasons of Carpet Industry in Kashmir, India

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Carpet workers are exposed to different types of health risk factors in different seasons of the year. As the environmental conditions become harsh, risk for developing various types of diseases increases. These problems are further aggravated when the environmental conditions at the workplace deteriorate. An attempt has been made to study the health risk factors in the carpet industry in different seasons of the year. It has been concluded that in winter weavers are affected by several types of health risk factors as compared to the other seasons.

carpet industry health problems ergonomics seasonal variation Kashmir

1. INTRODUCTION

Humans can tolerate a range of thermal environments with both physiological and behavioural strategies. However, from a clinical perspective, body core temperature must be held within a very narrow range, and it is normal at ~36.7 ± 0.3 °C [1]. Workers, soldiers and travellers are often exposed to severe environmental heat stress, which may deteriorate work efficiency and productivity and may even threaten survival [2, 3, 4, 5, 6, 7]. Both metabolic heat production and the capacity of the thermal environment to support evaporative cooling will dictate the extent to which humans can maintain homeostasis. When either heat production or evaporation adversely affects thermal homeostasis, the operational conditions are said to be uncompensable. The World Health Organization stated, already in the 1980s, that up to 30% of employees in new or renovated buildings reported an unusually high number of complaints concerning the working environment, enabling classification of those buildings as "sick" [8]. This appears to be a problem especially in countries with a colder climate. Working in problem buildings may lead to respiratory symptoms (stuffy and irritated nose, rhinitis, cough, sore throat and shortness of breath), skin symptoms and even general symptoms (fatigue, headache and fever), all of which are typical of the sick building syndrome. Jaakkola and Miettinen [9] and Pienimaki [10] showed that musculoskeletal symptoms are more frequent in cold store work and in related conditions than in neutral temperature and the symptoms seem to increase when cold temperature decreases. The economic loss due to such disorders affects not

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only the individual but also the organization and the society as a whole. In many countries, preventing work-related musculoskeletal disorders (WMSDs) has become a national priority. Various researchers have investigated the relation between feeling cold at work and the risk of symptoms in muscles, skin and airways in industrial workers [11, 12].

In Kashmir, India, it is extremely cold in winter with the temperature dropping to 3.79 ± 0.69 °C, which affects the productivity and efficiency of carpet weavers. The working environment in most carpet units is unsafe and unhealthy. This means poorly designed workstations; unsuitable furniture; no ventilation; inappropriate lighting, heating and cooling arrangements in different seasons; excessive amount of suspended particulate matter; insufficient safety measures and no personal protective equipment. People working in such an environment are prone to occupational diseases. The high rate of injury among young workers is a pressing health issue in small-scale industry of the Kashmir valley, especially in carpet units. Young and new workers experience the highest rates of occupational injuries. This study was undertaken to investigate the health risk factors of carpet weavers in different seasons of the year.

2. MATERIALS AND METHODS

The study was carried out in two districts of Kashmir, Anantnag and Pulwama. Anantnag is situated 55 km south-east of Srinagar (the summer capital of the state of Jammu and Kashmir, India); it has an area of 3984 km^2 and a population of 1 172 434. Pulwama is situated 32 km north of Srinagar; it has an area of 1370 km^2 and a population of 652 607.

Altogether, 182, 192, 192 and 200 workers in spring, summer, autumn and winter, respectively, participated in the investigation. They were randomly sampled. The questionnaire was structured as per the guidelines of OSHA with slight modifications [13]. Workers aged 18–36 years were the target group. Light intensity, temperature and humidity, and dust concentration in the air were measured with a digital lux meter (MS 6610; Instruments and Machinery Corporation, India), a thermo-hygrometer (288 CTH; Instruments and Machinery Corporation, India) and a handy air sampler (HS-7A; Polltech Instruments, India), respectively.

The results of the experiments were analysed with one-way analysis of variance (ANOVA) with Duncan's multiple range test to compare the mean values for different seasons; $p < .05$ was considered statistically significant.

Table 1 represents the weavers' physical characteristics. There was no significant difference between males and females in all four seasons.

3. INADEQUATE LIGHTING

Carpet weaving is considered precise work as the knots are very fine and close together, and colour recognition is vitally important. Such operations require adequate lighting both quantitatively and quantitatively [14]. Table 2 gives the light intensity in the carpet units; it was clearly substandard. That low intensity of light will cause eye irritation, eye strain and sometimes workers adopt

TABLE 1. Demographics of Study Population

Parameters	Gender	Spring	Summer	Autumn	Winter
Age	male	29.7 ± 3.5	28.4 ± 6.5	31.5 ± 7.4	34.0 ± 11.0
	female	24.5 ± 4.5	24.5 ± 4.5	23.4 ± 5.4	27.3 ± 6.3
Height	male	5.5 ± 0.3	5.5 ± 0.3	5.4 ± 0.5	5.5 ± 0.8
	female	4.9 ± 0.3	4.9 ± 0.3	4.3 ± 1.0	4.3 ± 0.7
Weight	male	58.0 ± 1.2	62.4 ± 10.3	61.3 ± 9.8	62.4 ± 6.5
	female	52.0 ± 1.0	54.3 ± 1.2	53.4 ± 3.2	51.4 ± 1.1

Notes. Data are expressed as $M \pm 1$ *SEM*; values do not differ from each other at $p \leq .05$ (based on Duncan's multiple range test).

harmful postures to see things clearly. The mean level of illumination in all seasons in the carpet units was low compared to the standard level of 500 lx recommended by Choobineh, Shahnawaz and Lahmi [15]. There was a significant difference in the mean intensity of light (lux) in the carpet units in spring and winter. However, there was no significant difference in the other seasons.

4. THERMAL COMFORT

Maintaining body temperature is an essential requirement for a body to function properly. This is possible when there is a constant exchange of heat between the body and the environment. Any deviation in these two systems will reduce workers' capacity in their working environment. Improper climate will have an adverse effects on the weavers' well-being and, consequently, on their performance. The mean temperature at the workplace ranged from 6.81 ± 0.66 °C in winter to 23.21 ± 0.24 °C in summer. There were significant differences in the mean temperature at the workplace in all seasons except spring and autumn. There were significant differences in the maximum temperature at the workplace between spring and summer, summer and winter, and autumn and winter. There were significant differences in the minimum temperature at the workplace between spring and summer, spring and winter, summer and winter, and autumn and winter (Table 3). The humidity in the carpet units ranged between 62.46 ± 7.57% in summer and 78.73 ± 4.33% in winter. In terms of climatic conditions, acceptable ambient temperature of comfort would be slightly higher in summer (22.80–26.10 °C) than in winter (20.00–23.90 °C) The observed maximum and minimum mean humidity was above the standard of 30–60% set by ASHRAE for performing different kinds of activities at the workplace [16].

5. CONTAMINATED AIR

The carpet industry involves different suboccupations, which are performed in distinct processing units necessary in manufacturing carpets. It is evident that weaving generates dust, which is a potential health risk. The concentration of airborne dust at weaving units was monitored. It was observed that similar units had a wide range of dust concentrations in different seasons (Table 4). The mean concentration of suspended

TABLE 2. Intensity of Light in Carpet Units in Different Seasons

	Intensity (lx)		
Season	**Max**	**Min**	***M***
Spring	316.66 ± 26.97	251.66 ± 25.77	281.80 ± 29.80[a]
Summer	332.66 ± 23.00	182.33 ± 16.98	239.50 ± 8.34
Autumn	361.66 ± 18.03	175.00 ± 22.00	255.37 ± 43.80
Winter	172.00 ± 12.67	107.00 ± 2.18	133.50 ± 8.80[a]

Notes. Data are expressed as *M* ± 1 *SEM*; a = values differ from each other at $p \leq .05$ (based on Duncan's multiple range test).

TABLE 3. Temperature and Humidity in Carpet Units in Different Seasons

	Temperature (°C)			Humidity (%)
Season	**Max**	**Min**	***M***	***M***
Spring	21.02 ± 2.33[a]	12.84 ± 1.61[a]	15.14 ± 2.12[a]	62.46 ± 7.57
Summer	31.20 ± 1.57[b]	19.75 ± 1[b]	23.21 ± 0.24[b]	68.46 ± 7.37
Autumn	23.68 ± 3.32[a]	7.26 ± 3.06[ab]	16.75 ± 3.06[a]	66 ± 2.66
Winter	13.14 ± 2.14[c]	3.79 ± 0.69[c]	6.81 ± 0.66[c]	78.73 ± 4.33

Notes. Data are expressed as *M* ± 1 *SEM*; values with different superscripts differ from each other at $p \leq .05$, values with the same superscripts do not differ from each other at $p \leq .05$ (based on Duncan's multiple range test).

particulate matter in different seasons at the workplace was found to range from 0.32 ± 0.03 to 0.37 ± 0.06 mg/m^3. However, those differences were not significant. These units did not have any dust control measures. Exposure to cotton and wool fibres caused various respiratory problems.

TABLE 4. Suspended Particulate Matter in Carpet Units in Different Seasons

	Suspended Particulate Matter (mg/m^3)		
Season	Max	Min	*M**
Spring	0.499	0.218	0.35 ± 0.03
Summer	0.499	0.218	0.32 ± 0.03
Autumn	0.499	0.218	0.34 ± 0.03
Winter	0.656	0.250	0.37 ± 0.06

Notes. * = data are expressed as *M* ± 1 *SEM*; other values are given as means; values with the same superscripts do not differ from each other at $p \leq .05$ (based on Duncan's multiple range test).

6. OCCUPATIONAL HEALTH PROBLEMS

Ergonomic issues are observed in most units engaged in weaving carpets in Kashmir. Most of these units have a working environment that is unsafe and unhealthy for the workers. The workers face a number of problems such as unsuitable furniture, improper ventilation and lighting, and no efficient safety measures in case of emergencies. The workers in such units are at risk for developing various occupational diseases. Musculoskeletal disorders like carpal tunnel syndrome, lower back pain, neck pain, shoulder pain and osteoarthritis of the knees are some of the occupational diseases that have been observed among the workers on account of poor ergonomic conditions. Table 5 shows that the prevalence of all the

TABLE 5. Symptoms and Conditions in Different Seasons

Symptoms and Conditions	Spring *N* = 182	Summer *N* = 192	Autumn *N* = 192	Winter *N* = 200
Finger pain	65 (35.71)	62 (32.29)	87 (45.31)	93 (46.50)
Numbness	113 (62.08)	111 (57.81)	126 (65.62)	125 (62.50)
Allergic reactions	18 (9.89)	12 (6.25)	24 (12.50)	20 (10.00)
Trouble smelling odour	1 (0.54)	2 (1.04)	6 (3.10)	0 (0)
Asthma	30 (16.48)	21 (10.93)	33 (17.10)	39 (19.50)
Chronic bronchitis	12 (6.59)	13 (6.77)	24 (12.50)	28 (14.00)
Shortness of breath	59 (32.41)	47 (24.47)	72 (37.50)	78 (39.00)
Shortness of breath when walking fast or slow	88 (48.35)	75 (39.06)	90 (46.80)	97 (48.50)
Coughing that produces phlegm	27 (14.83)	25 (13.02)	39 (20.30)	49 (24.50)
Chest pain when breathing deeply	24 (13.18)	17 (8.85)	33 (17.10)	43 (21.50)
Injuries	156 (85.61)	119 (61.97)	176 (91.66)	182 (91.20)
Swollen torsils	113 (62.08)	87 (45.31)	117 (60.93)	107 (53.50)
Swelling in legs and feet	123 (67.58)	107 (55.72)	114 (59.37)	141 (70.50)
Need to wear glasses	15 (8.24)	14 (7.29)	15 (7.80)	19 (9.50)
Eye irritation	150 (82.41)	112 (58.33)	162 (84.37)	152 (76.00)
Wrist pain	32 (17.58)	12 (6.25)	57 (29.68)	59 (29.50)
Skin allergies and rashes	14 (7.69)	11 (5.72)	30 (15.60)	40 (20.00)
Anxiety	11 (6.04)	12 (6.25)	66 (34.37)	6 (3.00)
General weakness and fatigue	134 (73.62)	123 (64.06)	147 (76.50)	167 (83.50)
Weakness in any arm	123 (67.58)	119 (61.97)	153 (79.68)	143 (71.50)
Back pain	144 (79.12)	160 (83.33)	156 (81.25)	166 (83.00)
Difficulty in fully moving arms and legs	124 (68.13)	116 (60.41)	132 (68.75)	135 (67.50)
Difficulty in moving head up and down	53 (29.12)	62 (32.29)	81 (42.18)	87 (43.50)
Headache	147 (80.76)	150 (78.12)	150 (78.10)	154 (77.00)
Joint pain	102 (56.04)	94 (48.95)	114 (59.37)	118 (59.00)

Notes. Values in parenthesis represent percentage of the subjects.

diseases is highest in winter, followed by spring, autumn and summer.

7. DISCUSSION

Working in extreme cold and hot weather involves several adverse effects that are observed in carpet weavers. Many of these effects may be aggravated when working conditions are not adequate. In Kashmir, climatic conditions (temperature, wind, humidity and precipitation) vary, which complicates appropriate protection.

Eyesight disorders occur due to constant close attention to the point of weaving or knotting under inadequate lightning, and vitamin A deficiency. Eyesight disorders are very frequent in winter when it is cloudy and lighting is poor. The intensity of lighting decreases to 133.50 ± 8.80 lx in winter as a result of which weavers have to adopt deviated postures that make them prone to musculoskeletal disorders as well. It is quite evident from the results that musculoskeletal problems significantly increase in winter. However, the long hours at the workplace without frequent rest cannot be ruled out as a cause. Symptoms of acute respiratory symptoms, shortness of breath and chronic bronchitis may be linked to workers' exposure for 8 h each day to dust and high humidity at the workplace. The increase in respiratory infection in winter may be due to dry weather conditions when there is less dispersion of particulate matter. Inhaling a large volume of cold air may provoke symptoms of respiratory distress.

The percentage of injuries is high, in winter the climatic conditions are very severe and it becomes difficult for a weaver to handle the tools used for weaving properly. As a result, weavers are prone to injuries; moreover, the design of the tools is not ergonomic. Young, old, male and female use the same type of tools for the same process. In some cases, the comb is heavy and difficult for certain weavers to handle, which results in soft hand injuries. It should be noted that a decrease in 1 °C in body temperature may markedly impair performance and increase the risk of occupational injuries and accidents [17]. It is quite evident that in winter, when the temperature conditions in the valley are harsh, the acci-

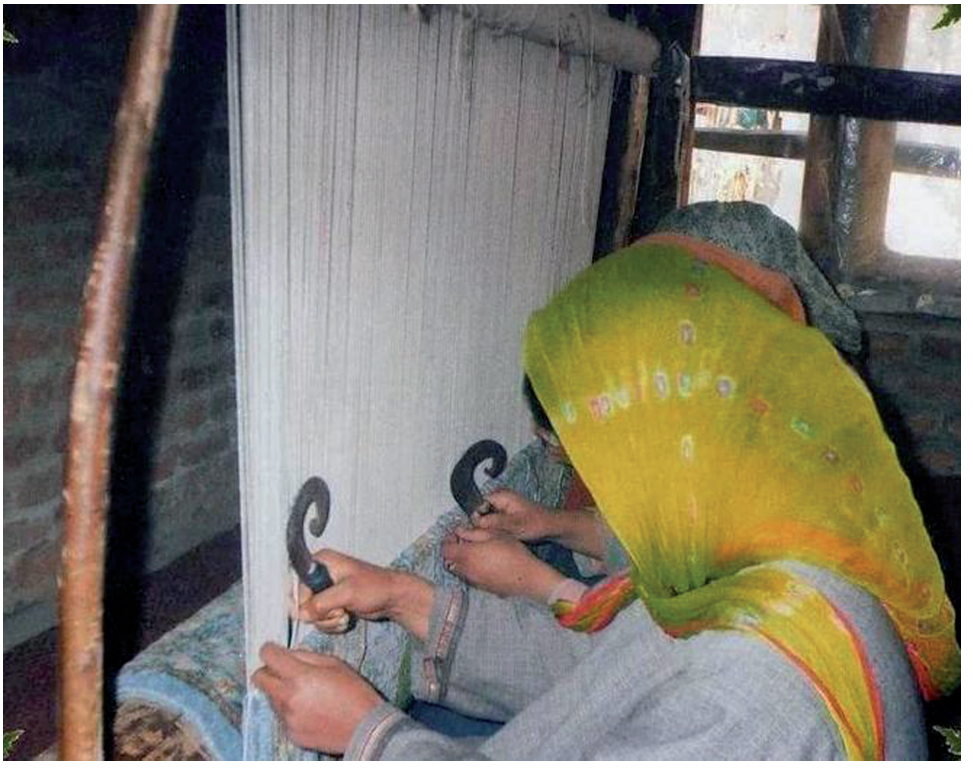

Figure 1. Women at a horizontal loom; deviated postures.

dent rate increases to 91.20% and in summer, when climatic conditions are suitable, the accident rate among weavers decreases to 61.97%. Weakness and fatigue may be attributed to long work hours and no balanced diet, which exposes these weavers to various types of diseases.

Therefore, we concluded from the study that health risk was highest in winter and lowest in summer. The decrease in the frequency of health risk factors in spring and the increase in autumn and winter may be due to the fact that in autumn and winter the minimum temperature drops to 7.26 ± 3.06 °C and 3.79 ± 0.69 °C, respectively (Table 3), which is unsuitable for this type of work. Mitigation of the adverse effects and adaptation to winter conditions require interdisciplinary analyses and integrated preventive planning.

There is an ample scope for improvement in work design, machine layout and working conditions of the carpet units from the ergonomic point of view with the objective of providing maximum comfort to weavers to promote their health and well-being and, consequently, enhance productivity. To decrease fatigue, it is advisable to provide frequent breaks. Seats with an adjustable back rest supporting the lumbar spine with proper matting are recommended to reduce the workers' back pain. There must be established policies binding the owners of carpet units to keep conditions favourable for weaving. Most diseases and health problems found in carpet units can be avoided with proper precautions and care. Some protective equipment must be provided, e.g., face masks and first-aid facilities, to protect workers from the adverse environment. The owners, with the co-operation of the government, must also provide health insurance.

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