



International Journal of Agriculture Extension and Social Development

ISSN Print: 2618-0723
ISSN Online: 2618-0731
NAAS Rating (2026): 5.04
IJAESD 2026; 9(10): 253-264
www.extensionjournal.com
Received: 27-07-2026
Accepted: 24-09-2026
Published: 08-10-2026

Poripurna Goswami
Department of Family and
Community Resource
Management, Faculty of
Family and Community
Science, The Maharaja
Sayajirao University of
Baroda, Vadodara, Gujarat,
India

Urvashi Mishra
Department of Family and
Community Resource
Management, Faculty of
Family and Community
Science, The Maharaja
Sayajirao University of
Baroda, Vadodara, Gujarat,
India

Ergonomic assessment of bamboo and cane weaving craftsmen: workspace sitting arrangements and musculoskeletal discomfort

Poripurna Goswami¹, Urvashi Mishra²

DOI: <https://www.doi.org/10.33545/26180723.2026.v9.i10d.4391>

ABSTRACT

Bamboo and cane weaving is an important traditional livelihood activity in Assam; however, the predominantly manual nature of the occupation, repetitive hand movements, prolonged sitting, and awkward working postures may expose craftsmen to musculoskeletal discomfort. The present study was undertaken to assess the personal and occupational characteristics, workspace sitting arrangements, and perceived musculoskeletal discomfort among bamboo and cane weaving craftsmen in Assam. A descriptive research design was adopted, and data were collected from 260 craftsmen from the Barpeta craft cluster, comprising 97 bamboo-only, 47 cane-only, and 116 bamboo-and-cane craftsmen. A multi-stage purposive-cum-stratified sampling technique was employed for selection of respondents. Data were collected using a pre-validated interview schedule and observation sheet. Perceived musculoskeletal discomfort was assessed using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ). The findings revealed that the respondents had a mean work experience of 15.42 years and worked for an average of 7.48 hours per day. Four major workspace sitting arrangements were identified, namely floor sitting, sitting on a wooden low stool (Pidha), sitting on a bench, and sitting on a bamboo stool (Murha). The right and left wrists, forearms, neck, lower back, knees, and hip/buttock regions exhibited comparatively higher levels of perceived musculoskeletal discomfort. Floor-based working was particularly associated with prolonged static and constrained postures. A significant association was observed between workspace sitting arrangement and perceived musculoskeletal discomfort ($\chi^2 = 13.24$, $df = 4$, $p = .010$), with post-hoc analysis indicating a significant positive deviation for floor sitting. The findings highlight the ergonomic challenges associated with traditional bamboo and cane weaving practices and emphasize the need for practical, low-cost ergonomic interventions. Ergonomic adjustable work surfaces, scheduled micro-breaks, task rotation, stretching and mobility exercises, and foot support were recommended to reduce postural strain and improve occupational comfort. The study concludes that incorporating ergonomically appropriate modifications into traditional weaving workspaces may contribute to reducing musculoskeletal strain and promoting healthier and more sustainable working conditions among bamboo and cane weaving craftsmen in Assam.

Keywords: Ergonomic assessment, Bamboo and cane weaving, Craftsmen, Sitting arrangements, Musculoskeletal discomfort

Introduction

Bamboo and cane handicrafts represent important traditional livelihood activities in India, particularly in Northeast India, where these resources are abundant and closely associated with local culture, traditional knowledge, and rural livelihoods. Assam has a well-established tradition of bamboo and cane craftsmanship, which contributes to employment generation and household income. Despite its socioeconomic and cultural significance, the sector remains largely informal and continues to face challenges related to limited technological development, inadequate market access, limited capital, and insufficient institutional support (Bhattacharyya, 2024; Phukan, 2018; Shende *et al.*, 2024) [1, 2, 3].

Bamboo and cane weaving is a predominantly manual occupation involving repetitive activities such as splitting, stripping, bending, weaving, trimming, and finishing. These activities are often performed in low-level workspaces and require prolonged sitting, sustained flexion of the neck and trunk, repetitive upper-limb movements, and static muscular loading. Prolonged exposure to such occupational demands may contribute to work-related musculoskeletal disorders (WMSDs), particularly when adequate postural variation and recovery periods are limited. Previous studies among handloom weavers and handicraft workers have reported considerable musculoskeletal discomfort involving the lower back, neck, shoulders, upper limbs, and lower limbs (Das *et al.*, 2020; Haftu *et al.*, 2023; Meher *et al.*, 2025; Nag *et al.*, 2010) [4, 5, 6, 7]. Studies specifically involving bamboo craftsmen have also reported substantial ergonomic concerns. Salsabila *et al.* (2024) identified significant associations between musculoskeletal disorders and factors such as age, working hours, occupational stress, and work experience. Similarly, Sriagustini *et al.* (2022) [8] reported pro

Corresponding Author: Poripurna Goswami

Department of Family and
Community Resource
Management, Faculty of
Family and Community
Science, The Maharaja
Sayajirao University of
Baroda, Vadodara, Gujarat,
India

longed sitting, head and back flexion, and musculoskeletal discomfort involving the waist, hands, legs, and back among bamboo craftsmen. Research conducted among other craft-based occupational groups has likewise identified awkward working postures, repetitive movements, prolonged working hours, and inadequate ergonomic conditions as important occupational risk factors for musculoskeletal discomfort.

Although studies have examined occupational health and ergonomic problems among handloom workers and other craft workers in Assam, comparatively limited research has focused specifically on bamboo and cane weaving craftsmen. In particular, limited evidence is available regarding the sitting arrangements adopted within their workspaces and their association with musculoskeletal discomfort. Moreover, craftsmen engaged exclusively in bamboo weaving, cane weaving, or both bamboo and cane weaving may experience differences in work processes and postural demands. Comparative assessment of these groups may therefore provide useful evidence regarding occupation-specific ergonomic concerns.

However, limited evidence is available regarding the specific workspace sitting arrangements adopted by bamboo and cane weaving craftsmen in Assam and their association with perceived musculoskeletal discomfort. Furthermore, comparative evidence across bamboo-only, cane-only, and bamboo-and-cane craftsmen remains limited. Therefore, the present study was undertaken to assess workspace sitting arrangements and musculoskeletal discomfort among bamboo and cane weaving craftsmen in Assam.

Objectives of the study

The objectives of the study were:

1. To collect the personal and occupational information of the selected craftsmen of Assam engaged in Bamboo and Cane weaving Process.
2. To assess the workspace sitting arrangement of the selected craftsmen engaged in Bamboo and Cane weaving Process.
3. To determine the prevalence of perceived work-related musculoskeletal discomfort among the selected craftsmen engaged in Bamboo and Cane weaving Process.

Delimitations of the study

The present study was limited to-

1. Bamboo and Cane weaving craftsmen registered under the North Eastern Handicrafts and Handlooms Development Corporation (NEHHDC) who were actively engaged in Micro, Small, and Medium Enterprises (MSME) clusters with the highest number of craftsmen (both male and female) and the greatest annual production.
2. The craftsmen aged above 18 years, who were willing to participate in the study.
3. The craftsmen who have been engaged in Bamboo and Cane weaving for a minimum of two years
4. The craftsmen who were physically and mentally normal (not physically and mentally challenged), especially females not in the pregnancy stage.

Hypothesis of the study

1. There is a significant association between workspace sitting arrangement and perceived musculoskeletal discomfort among the selected bamboo and cane weaving craftsmen.

Materials and Methods

A descriptive research design was adopted to assess the personal and occupational characteristics, workspace sitting arrangements, and musculoskeletal discomfort among bamboo and cane weaving craftsmen in Assam, India. Assam, located between 24° and 28° N latitude and 89° and 96° E longitude, was selected as the study area because of its established tradition and socioeconomic significance of bamboo- and cane-based handicrafts (Bhattacharyya, 2024; Phukan, 2018; Shende *et al.*, 2024) [1, 2, 3]. The study population comprised craftsmen engaged in bamboo weaving, cane weaving, or both in Barpeta craft clusters in Assam. For analytical purposes, the participants were categorized into three groups: craftsmen involved in bamboo-only, cane-only, and bamboo-and-cane craftsmanship.

The sample size was 260 craftsmen from the Barpeta cluster of Assam at a 95% confidence level and a 6% margin of error. The total of 260 craftsmen comprised 97 bamboo-only craftsmen, 47 cane-only craftsmen, and 116 bamboo-and-cane craftsmen. A multi-stage purposive-cum-stratified sampling technique was employed for participant selection. Initially, craft-intensive districts and clusters were identified in consultation with the North Eastern Handicrafts and Handlooms Development Corporation (NEHHDC) office, Guwahati, Assam. The identified clusters were subsequently stratified according to the predominant type of craft activity, following which eligible participants were selected based on the predetermined eligibility criteria, accessibility, and willingness to participate.

The data were collected using a pre-validated interview schedule and observation sheet. The questionnaire included items related to the personal and occupational profile and musculoskeletal discomfort, whereas the observational checklist was used to assess workspace sitting arrangements. Musculoskeletal discomfort was assessed using the Cornell Musculoskeletal Discomfort Questionnaire (CMDQ), applicable to both male and female respondents (Hedge *et al.*, 1999) [9]. Prior to the main data collection, the questionnaire and observational checklist were pre-tested among 30 craftsmen who were not included in the final sample to assess the clarity, comprehensibility, sequencing, and contextual appropriateness of the research instruments. Each participant was interviewed individually for approximately 30–45 minutes. The purpose and procedures of the study were explained to each participant, and written informed consent was obtained before data collection.

The collected data were then coded, tabulated, and analyzed using descriptive and inferential statistical procedures. Frequencies and percentages were calculated for categorical variables, whereas means and standard deviations were calculated for continuous variables and musculoskeletal discomfort scores. The Chi-square (χ^2) test was used to examine associations between categorical variables. The level of statistical significance was set at $p < .05$.

Findings and Discussion

The collected data were analysed based on age, gender, educational qualification, monthly family income, self-reported comorbidities, and hand dominance during work.

It was found that Cent percent of the Cane craftsmen belonged to the 36–51 years age group, followed by 76.29 per cent of the bamboo craftsmen in the 20–35 years group and 53.45 per cent of the craftsmen who are engaged in both; the majority of them were in the 52–68 years group. The mean age was 42.88 years. Bamboo weaving included a relatively higher proportion of younger respondents, whereas cane weaving showed greater representation of middle-aged respondents (Figure 1).

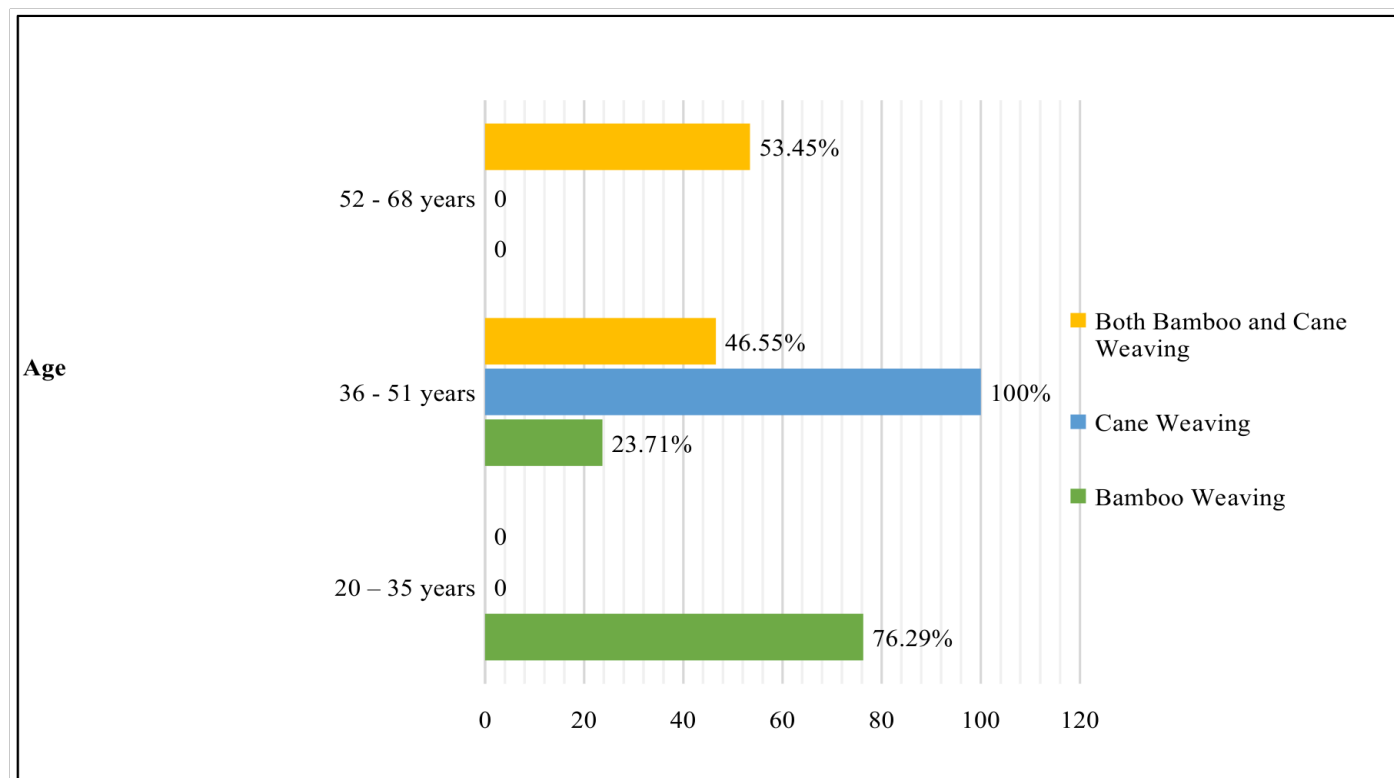


Figure 1. Percentage distribution of Respondents according to their Age

Figure 2 shows that among the respondents, males constituted 54.64 per cent of bamboo craftsmen and 63.83 per cent of cane craftsmen, whereas females constituted 59.48 per cent of respondents engaged in both bamboo and cane weaving. , the findings indicate substantial

participation of both men and women in bamboo and cane-based craft activities, with gender participation varying across weaving categories. Similar patterns have been reported by Deka and Nath (2021) and Das and Sharma (2019).

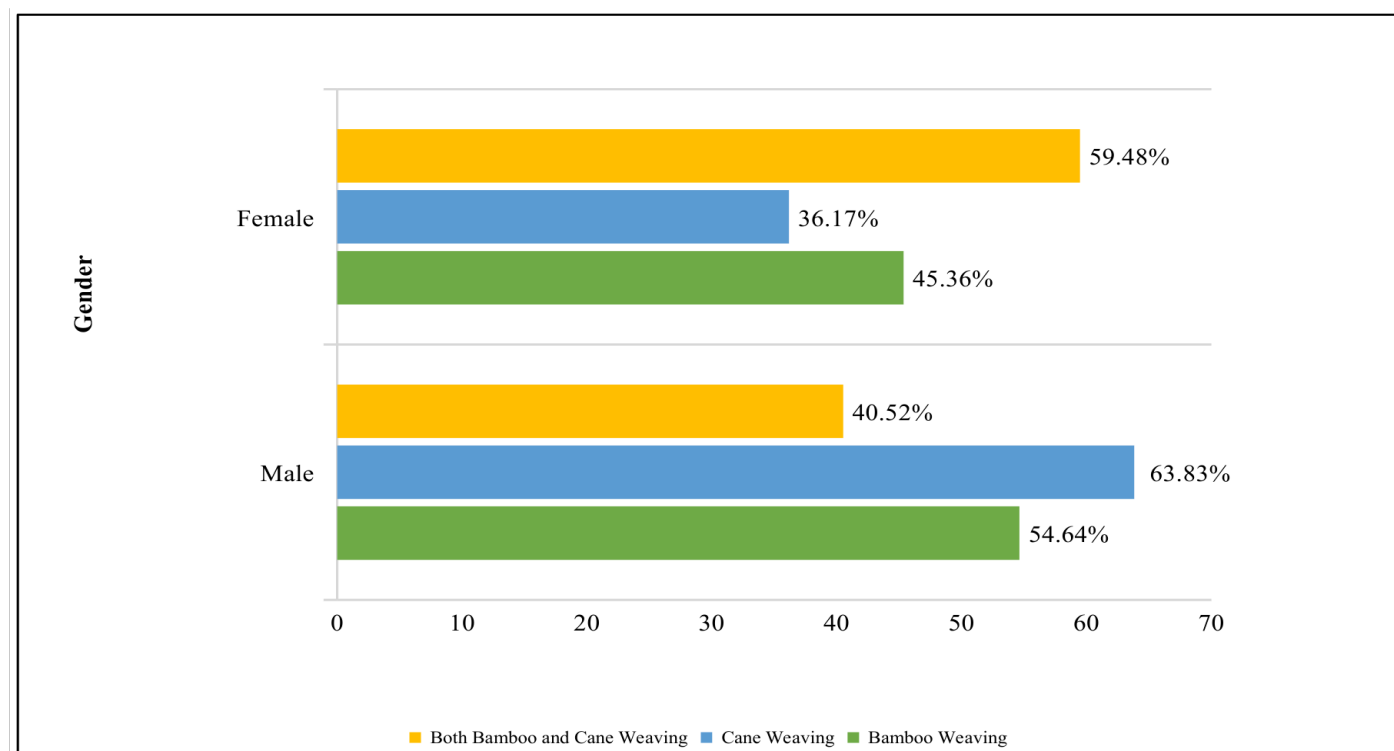


Figure 2. Percentage distribution of the respondents according to Gender

As shown in Figure 3, 84.23 per cent of respondents demonstrated mixed or ambiguous hand dominance, while 15.77 per cent were predominantly right-hand dominant. Mixed hand use was observed among 82.47 per cent of bamboo craftsmen, 78.72 per cent of cane

craftsmen, and 87.93 per cent of those engaged in both activities. The findings highlight the predominantly bilateral nature of bamboo and cane weaving activities.

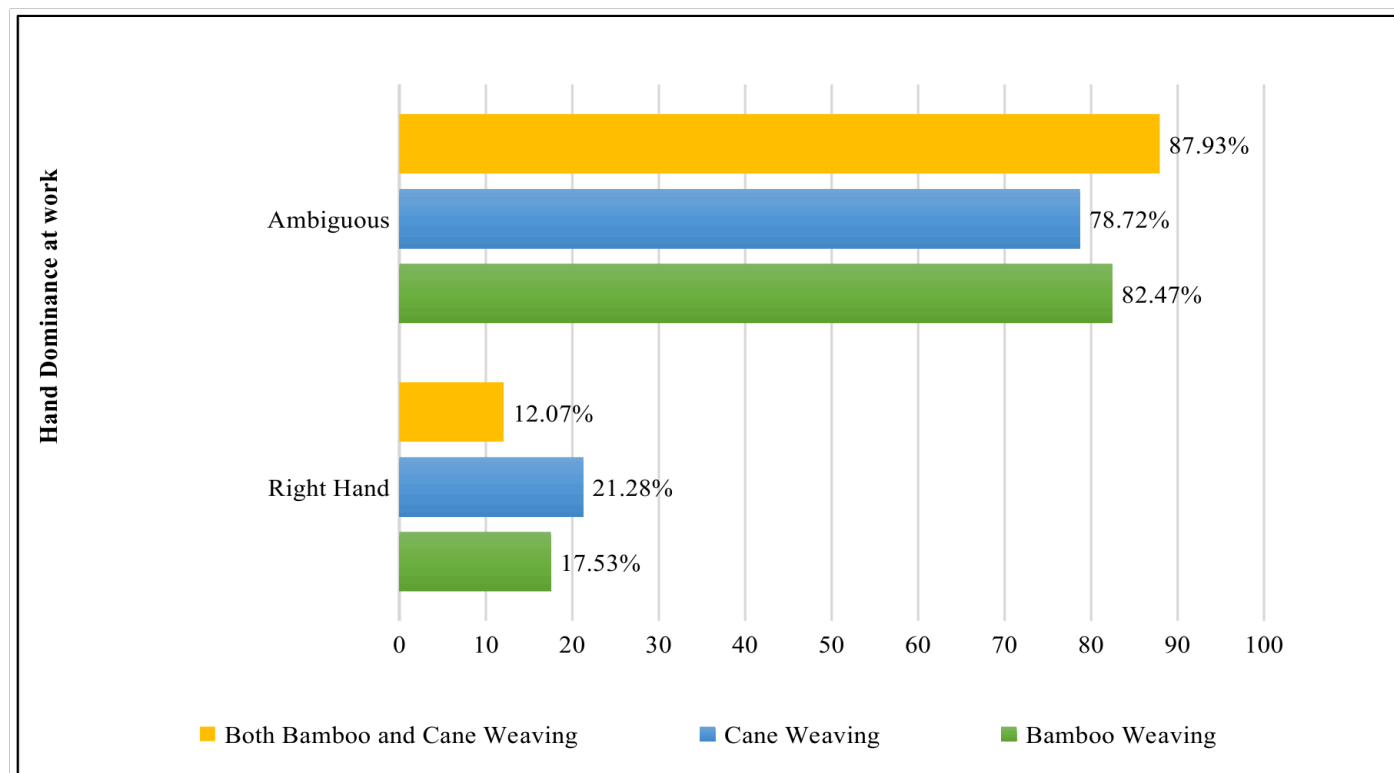


Figure 3. Percentage distribution of the respondents according to hand dominance during work

Figure 4 indicates that respondents had 2–41 years of work experience, with a mean experience of 15.42 years. Among bamboo craftsmen, 45.36 per cent had 2–14 years of experience, whereas 65.96 per cent of cane craftsmen and 64.66 per cent of those engaged in both activities fell within this category. Respondents with 28–41 years of

experience constituted 21.65 per cent of bamboo craftsmen, 6.38 per cent of cane craftsmen, and 11.21 per cent of combined craftsmen, indicating variation in occupational experience across the weaving categories.

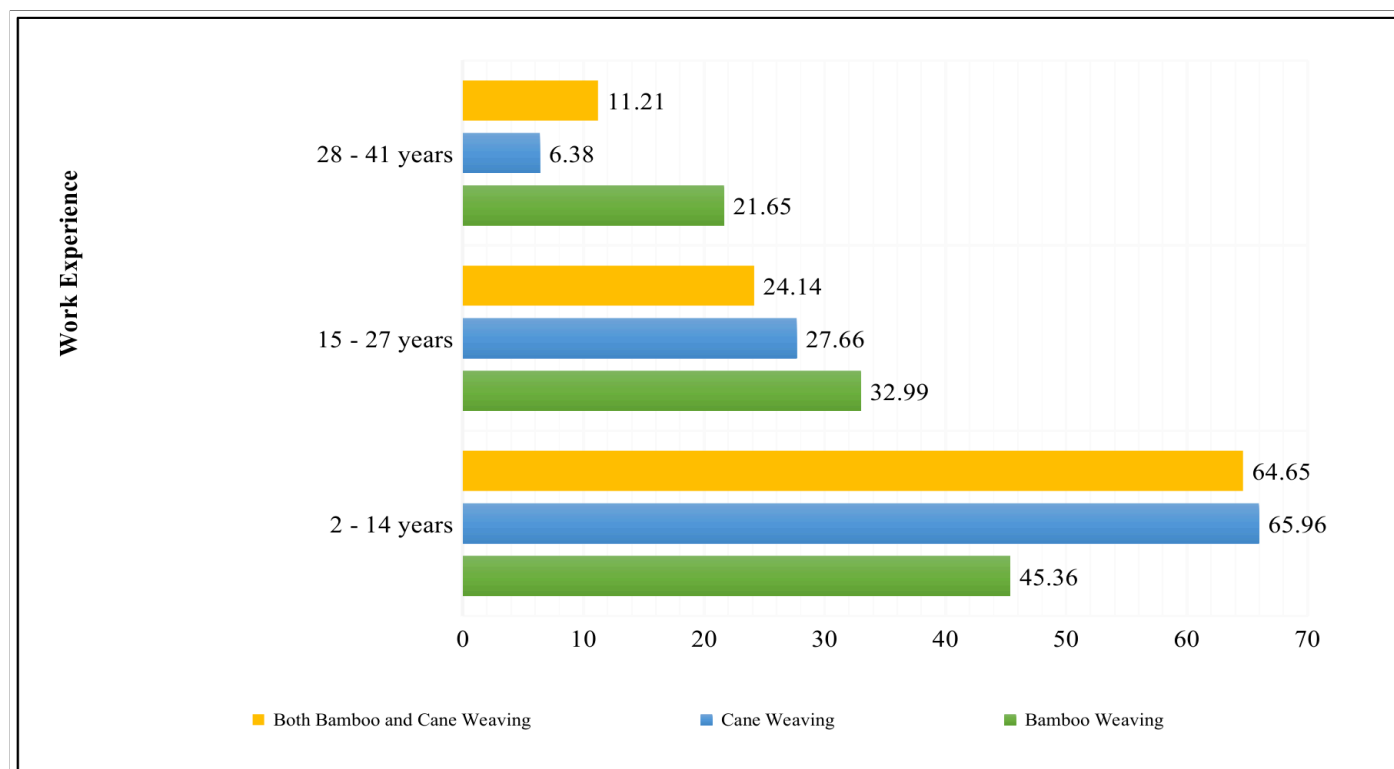


Figure 4. Percentage distribution of the respondents according to work experience

Figure 5 shows that respondents worked for a mean duration of 7.48 hours per day, generally between 7:30 a.m. and 4:30 p.m. Among the respondents, 43.46 per cent worked for 6–8 hours per day, 39.23 per cent for more than 8 hours, and the remaining respondents for less

than 6 hours. Thus, a substantial proportion of craftsmen reported working for more than eight hours per day, indicating considerable daily occupational exposure to weaving activities.

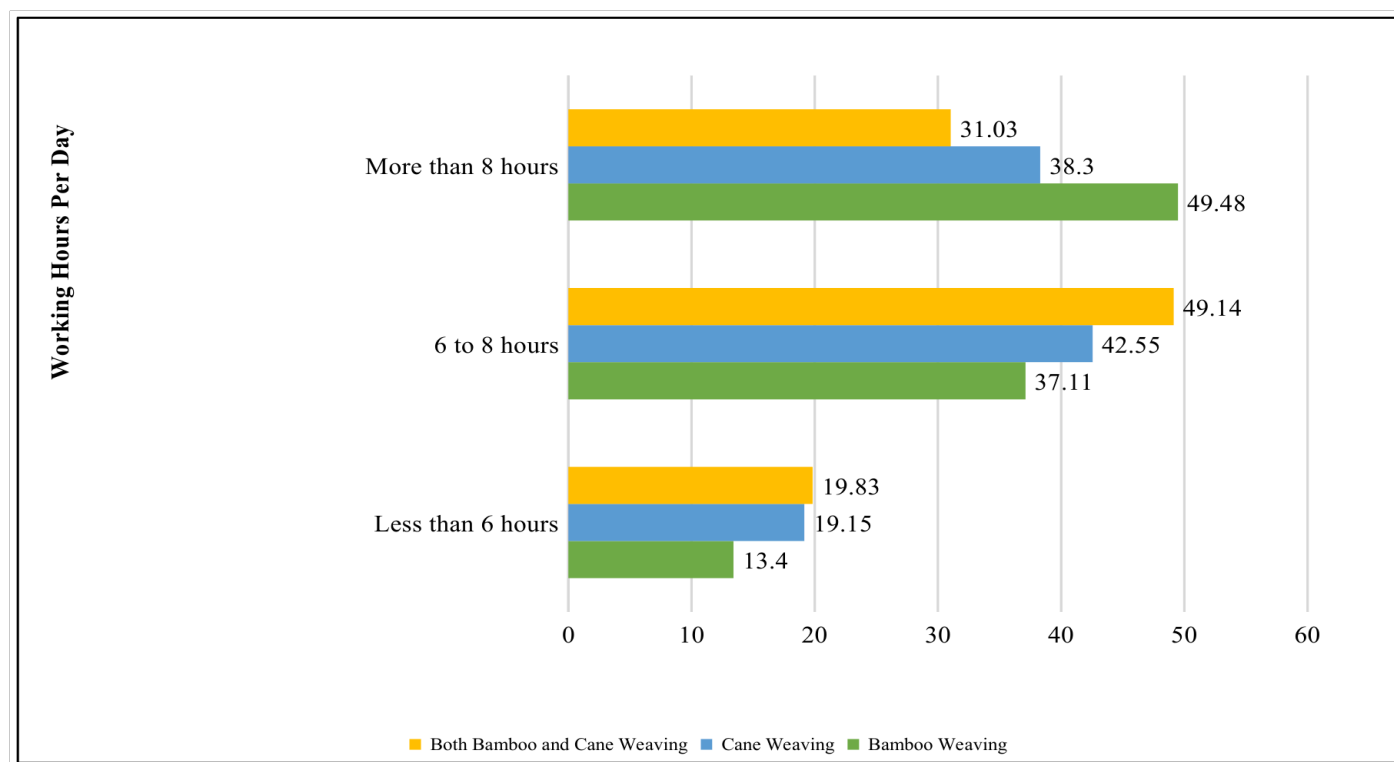


Figure 5. Percentage distribution of the respondents according to their Working Hours per Day

It was also found that 68.46 per cent of the respondents reported no any health co-morbidities. Among the reported conditions, eye strain was the most prevalent (11.54%), followed by hypertension (6.92%), frequent headaches (5.00%), diabetes (3.08%), skin irritation (3.08%), and respiratory problems (1.92%). Eye strain was reported most frequently among cane craftsmen (17.02%), while the prevalence of other conditions varied across the weaving categories.

Workspace sitting arrangement adopted by the respondents during bamboo and cane weaving process

The present study revealed that the respondents engaged in the bamboo and cane weaving process do not use any formal or standardized workspace. Craft weaving activities were mostly carried out in informal settings, either within the workers' own homes or in shared spaces belonging to two to three fellow craftsmen. In some cases, small workshop areas measuring approximately 10 to 15 square meters were used exclusively for craft production. These spaces are modest in size and provide only the minimum required area to accommodate materials, tools, and work activities. The study identified four distinct types of sitting arrangements (**Figure 6**) adopted by the craftsmen during various stages of the bamboo and cane weaving process. Each

arrangement differed in height, size, and ergonomic suitability, depending on the type of task performed and the duration of work.

Distribution of the respondents based on frequency of perceived musculoskeletal discomfort (CMDQ frequency score: 0–10)

Table 1 represents the frequency of perceived musculoskeletal discomfort among the respondents as follows-

Upper body parts

Among bamboo and cane craftsmen, the right and left wrists exhibited the highest CMDQ scores, indicating that these regions were most frequently affected. For bamboo craftsmen, the right wrist recorded the highest mean score (4.26 ± 2.89), closely followed by the left wrist (4.22 ± 2.90). Similarly, for both bamboo and cane craftsmen, the right and left wrists showed elevated scores of 4.25 ± 2.81 each, reflecting substantial repetitive strain in these joints. Additionally, the right and left forearms also exhibited relatively high CMDQ scores for all groups, with both weaving types scoring 3.90 ± 2.72 (right forearm) and 3.90 ± 2.73 (left forearm), suggesting frequent use and strain during the weaving process. The neck was another commonly affected region, with both weaving types reporting 3.89 ± 2.64 , indicating significant postural stress.



Figure 6. Workspace Sitting Arrangement during Bamboo and Cane Weaving



Plate 1. Workspace Sitting Arrangement of Craftsmen Engaged in the Bamboo and Cane Weaving Process of Assam

Lower body parts

In the lower extremities, the lower back consistently displayed the highest CMDQ scores across all weaving categories, with both weaving types showing a mean of 3.94 ± 2.79 , highlighting its susceptibility to prolonged static posture and bending during work. The left and right knees also reported relatively higher discomfort scores, particularly among both weaving types, with the left knee at 3.53 ± 2.82 and

the right knee at 3.41 ± 2.77 , suggesting the impact of sustained kneeling or squatting postures. Similarly, the left lower leg demonstrated elevated scores (3.53 ± 2.90) for respondents involved in both types of weaving. Among the hip and buttock region, both weaving types registered a mean CMDQ score of 3.81 ± 2.86 , indicating frequent musculoskeletal stress due to prolonged sitting and working postures (Figure 7).

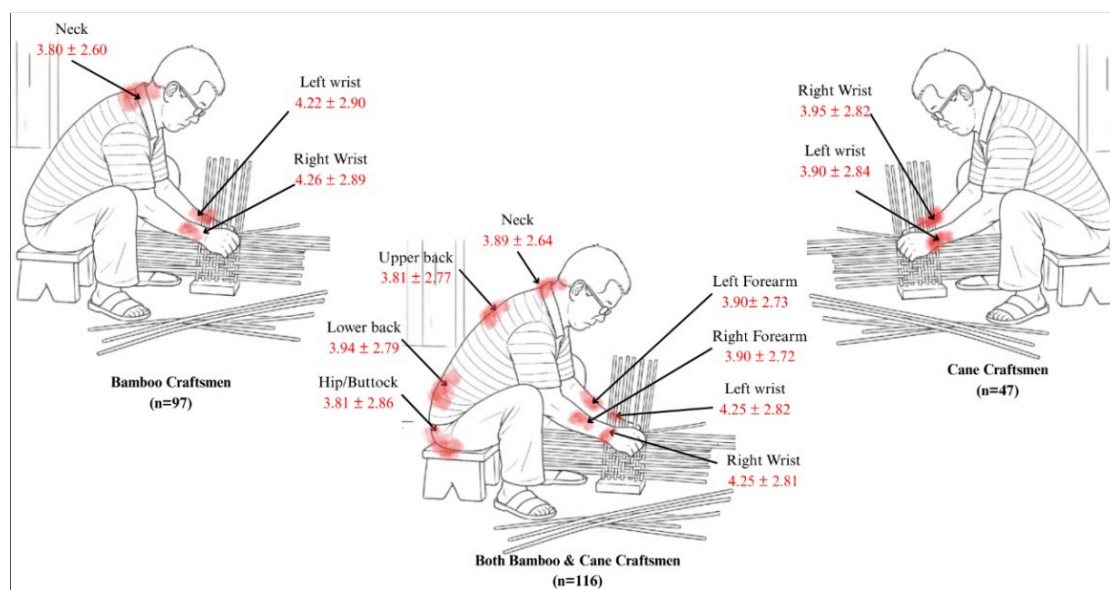
Table 1: Distribution of the Respondents based on Frequency of Perceived Musculoskeletal Discomfort (CMDQ Score 0–10)

Body Part	Bamboo Craftsmen (n = 97)	Cane Craftsmen (n = 47)	Both Bamboo & Cane Craftsmen (n = 116)
Upper Body Parts			
1. Neck	3.80 ± 2.60	3.67 ± 2.72	3.89 ± 2.64
2. Right Shoulder	3.16 ± 2.54	3.41 ± 2.54	3.64 ± 2.66
3. Left Shoulder	3.10 ± 2.58	3.60 ± 2.73	3.69 ± 2.74
4. Right Upper Arm	2.62 ± 2.26	3.19 ± 2.63	3.52 ± 2.70
5. Left Upper Arm	2.83 ± 2.62	3.19 ± 2.67	3.55 ± 2.72
6. Right Forearm	3.53 ± 2.49	3.66 ± 2.71	3.90 ± 2.72
7. Left Forearm	3.53 ± 2.61	3.51 ± 2.76	3.90 ± 2.73
8. Right Wrist	4.26 ± 2.89	3.95 ± 2.82	4.25 ± 2.81
9. Left Wrist	4.22 ± 2.90	3.90 ± 2.84	4.25 ± 2.82
10. Upper Back	3.52 ± 2.60	3.41 ± 2.78	3.81 ± 2.77
Lower Body Parts			
11. Lower Back	3.65 ± 2.54	3.64 ± 2.71	3.94 ± 2.79
12. Hip/Buttock	3.23 ± 2.49	3.45 ± 2.83	3.81 ± 2.86
13. Right Thigh	2.01 ± 2.13	2.36 ± 2.60	2.87 ± 2.77
14. Left Thigh	2.04 ± 2.13	2.43 ± 2.60	2.94 ± 2.84
15. Right Knee	2.94 ± 2.44	3.23 ± 2.66	3.41 ± 2.77
16. Left Knee	2.97 ± 2.43	3.23 ± 2.70	3.53 ± 2.82
17. +Right Lower Leg	2.92 ± 2.56	3.01 ± 2.73	3.35 ± 2.79

(continued on next page)

Table 1: Distribution of the Respondents based on Frequency of Perceived Musculoskeletal Discomfort (CMDQ Score 0–10)

18.	Left Lower Leg	2.99 ± 2.55	3.19 ± 2.71	3.53 ± 2.90
19.	Right Foot	2.63 ± 2.37	2.89 ± 2.77	1.98 ± 2.20
20.	Left Foot	2.72 ± 2.50	3.04 ± 2.74	2.09 ± 2.22

**Figure 7.** Distribution of the Respondents based on Frequency of Perceived Musculoskeletal Discomfort

Distribution of the respondents based on severity of perceived musculoskeletal discomfort (CMDQ severity score: 1–3)

Table 2 represents the severity of perceived musculoskeletal discomfort among the respondents as follows-

Upper body parts

Among cane craftsmen, the left and right shoulders displayed the highest severity scores, with the right shoulder registering 2.07 ± 0.73 and the left shoulder 1.90 ± 0.66 . The neck also exhibited elevated severity (2.00 ± 0.71), indicating considerable postural strain in these regions. For respondents engaged in both bamboo and cane weaving, the right shoulder showed the highest severity (2.04 ± 0.68), followed by the left shoulder (1.99 ± 0.65) and the neck (1.92 ± 0.66), suggesting that sustained repetitive motions and awkward postures contributed to moderate discomfort in these areas. Additionally, left and right upper arms also recorded relatively higher severity scores among both

weaving groups, with 1.96 ± 0.66 for the right upper arm and 1.92 ± 0.65 for the left upper arm in respondents performing both weaving types.

Lower body parts

In the lower body, the left lower leg exhibited the highest severity among cane craftsmen (2.64 ± 1.13), indicating pronounced musculoskeletal strain likely due to prolonged kneeling, squatting, or static postures during weaving. The right thigh also showed relatively higher severity (2.03 ± 0.70) among cane craftsmen, whereas hip/buttock regions reported elevated scores (2.00 ± 0.65) in cane craftsmen and 1.95 ± 0.68 in bamboo craftsmen. For respondents engaged in both weaving types, the lower back emerged as a body part with comparatively higher severity (1.90 ± 0.65), followed by the left foot (1.84 ± 0.67) and right foot (1.87 ± 0.65), reflecting the cumulative impact of prolonged sitting, bending, and static postures (Figure 8).

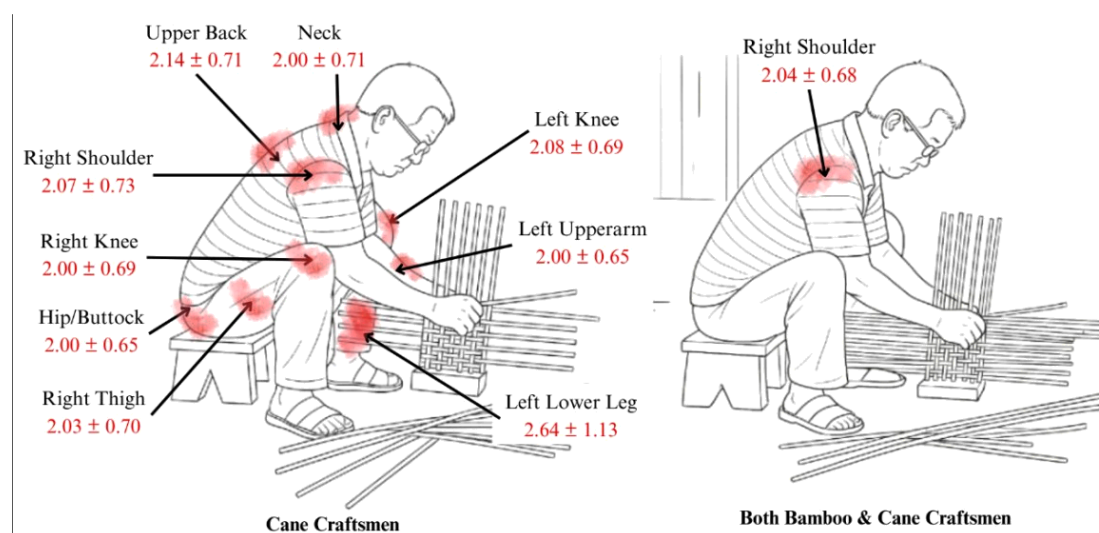
Table 2: Distribution of the Respondents based on Severity of Perceived Musculoskeletal Discomfort (CMDQ Score 1–3)

Body Part	Bamboo Craftsmen	Cane Craftsmen	Both Bamboo & Cane Craftsmen
Upper Body Parts			
1. Neck	1.91 ± 0.66	2.00 ± 0.71	1.92 ± 0.66
2. Right Shoulder	1.95 ± 0.70	2.07 ± 0.73	2.04 ± 0.68
3. Left Shoulder	1.95 ± 0.67	1.90 ± 0.66	1.99 ± 0.65
4. Right Upper Arm	1.84 ± 0.68	1.95 ± 0.68	1.96 ± 0.66
5. Left Upper Arm	1.84 ± 0.68	2.00 ± 0.65	1.92 ± 0.65
6. Right Forearm	1.84 ± 0.64	1.90 ± 0.70	1.89 ± 0.63
7. Left Forearm	1.76 ± 0.64	1.98 ± 0.72	1.94 ± 0.63
8. Right Wrist	1.97 ± 0.68	1.83 ± 0.65	1.89 ± 0.62
9. Left Wrist	1.90 ± 0.64	1.86 ± 0.63	1.83 ± 0.62
10. Upper Back	1.90 ± 0.68	2.14 ± 0.71	1.90 ± 0.64
Lower Body Parts			
11. Lower Back	1.86 ± 0.67	1.83 ± 0.65	1.90 ± 0.65
12. Hip/Buttock	1.95 ± 0.68	2.00 ± 0.65	1.89 ± 0.63

(continued on next page)

Table 2: Distribution of the Respondents based on Severity of Perceived Musculoskeletal Discomfort (CMDQ Score 1–3)

13.	Right Thigh	1.88 ± 0.72	2.03 ± 0.70	1.59 ± 0.65
14.	Left Thigh	1.88 ± 0.73	1.88 ± 0.66	1.55 ± 0.64
15.	Right Knee	1.81 ± 0.65	2.00 ± 0.69	1.66 ± 0.64
16.	Left Knee	1.73 ± 0.62	2.08 ± 0.69	1.62 ± 0.62
17.	Right Lower Leg	1.67 ± 0.66	1.97 ± 0.68	1.70 ± 0.65
18.	Left Lower Leg	1.70 ± 0.66	2.64 ± 1.13	1.66 ± 0.64
19.	Right Foot	1.71 ± 0.66	1.94 ± 0.67	1.84 ± 0.67
20.	Left Foot	1.62 ± 0.61	1.84 ± 0.62	1.87 ± 0.65

**Figure 8.** Distribution of the Respondents based on Severity of Perceived Musculoskeletal Discomfort

Distribution of the respondents based on extent of perceived work interference (CMDQ interference score: 1–3)

Table 3 represents the extent of perceived work interference due to musculoskeletal discomfort among the respondents as follows-

Upper body parts

Among bamboo craftsmen, the right wrist displayed the highest interference (2.06 ± 0.57), followed closely by the neck (2.03 ± 0.51) and the left wrist (2.02 ± 0.55). These results suggest that prolonged repetitive hand movements and awkward postures during weaving contribute significantly to interference in upper limb functions. Similarly, the upper back (2.00 ± 0.54), hip/buttock (2.00 ± 0.54), and left upper arm (1.91 ± 0.54) also exhibited notable interference among bamboo craftsmen. For cane craftsmen, the left lower leg, left foot, left knee, left upper arm, and right wrist all recorded elevated interference scores (1.95 – 1.94 ± 0.51 – 0.52), indicating that both lower and upper body parts are affected due to prolonged kneeling, bending,

and sustained hand activity during cane weaving. Additionally, the right thigh (1.94 ± 0.50) and right lower leg (1.94 ± 0.51) were also affected, highlighting ergonomic challenges in lower limb postures. Among respondents performing both bamboo and cane weaving, the right foot (2.03 ± 0.61) and left foot (2.00 ± 0.60) were the most prominently affected regions, reflecting cumulative stress on the lower limbs. Other upper body regions such as the right wrist, left wrist, and neck demonstrated moderate interference (1.94 – 1.98 ± 0.49 – 0.51), suggesting that prolonged repetitive hand and arm movements impacted work efficiency and functional performance.

Lower body parts

The data indicate that lower body interference is particularly notable among both cane and dual weaving craftsmen. In addition to the feet, the left lower leg (1.95 ± 0.51) and left knee (1.95 ± 0.51) for cane craftsmen also showed significant interference, suggesting that extended periods of kneeling or squatting during weaving tasks impose a higher functional burden (**Figure 9**).

Table 3: Distribution of the Respondents based on Extent of Perceived Work Interference (CMDQ Score 1–3)

Body Part	Bamboo Craftsmen	Cane Craftsmen	Both Bamboo & Cane Craftsmen
Upper Body Parts			
1. Neck	2.03 ± 0.51	1.95 ± 0.49	1.98 ± 0.51
2. Right Shoulder	1.99 ± 0.54	2.00 ± 0.56	1.97 ± 0.51
3. Left Shoulder	1.99 ± 0.52	1.93 ± 0.50	1.94 ± 0.49
4. Right Upper Arm	1.85 ± 0.56	1.93 ± 0.50	1.93 ± 0.53
5. Left Upper Arm	1.91 ± 0.54	1.95 ± 0.51	1.93 ± 0.52
6. Right Forearm	1.98 ± 0.52	1.95 ± 0.50	1.91 ± 0.48
7. Left Forearm	1.96 ± 0.53	1.98 ± 0.54	1.94 ± 0.51
8. Right Wrist	2.06 ± 0.57	1.95 ± 0.50	1.94 ± 0.50

(continued on next page)

Table 3: Distribution of the Respondents based on Extent of Perceived Work Interference (CMDQ Score 1–3)

9.	Left Wrist	2.02 ± 0.55	2.00 ± 0.52	1.94 ± 0.49
10.	Upper Back	2.00 ± 0.54	1.95 ± 0.51	1.92 ± 0.50
Lower Body Parts				
11.	Lower Back	1.99 ± 0.52	1.90 ± 0.47	1.96 ± 0.51
12.	Hip/Buttock	2.00 ± 0.54	1.95 ± 0.50	1.93 ± 0.49
13.	Right Thigh	1.81 ± 0.56	1.94 ± 0.50	1.84 ± 0.53
14.	Left Thigh	1.84 ± 0.55	1.95 ± 0.51	1.86 ± 0.53
15.	Right Knee	1.91 ± 0.52	1.93 ± 0.50	1.88 ± 0.50
16.	Left Knee	1.89 ± 0.52	1.95 ± 0.51	1.88 ± 0.49
17.	Right Lower Leg	1.87 ± 0.52	1.94 ± 0.51	1.91 ± 0.50
18.	Left Lower Leg	1.90 ± 0.53	1.95 ± 0.51	1.91 ± 0.50
19.	Right Foot	1.82 ± 0.56	1.94 ± 0.51	2.03 ± 0.61
20.	Left Foot	1.77 ± 0.51	1.95 ± 0.52	2.00 ± 0.60

Testing of hypotheses

H₀: There is no significant association between workspace sitting arrangement and perceived musculoskeletal discomfort among the selected bamboo and cane weaving craftsmen.

The Chi-square test was applied to determine whether a significant association existed between workspace sitting arrangement and perceived musculoskeletal discomfort among the selected craftsmen.

Based on the findings presented in **Table 4**, the Chi-square value was statistically significant ($\chi^2 = 13.24$, $df = 3$, $p = 0.010$), which was lower than the 0.05 level of significance. Therefore, the null hypothesis (H_0) was rejected and the alternative hypothesis (H_1) was accepted. The findings indicate a statistically significant association between workspace sitting arrangement and perceived musculoskeletal discomfort.

Table 4: Chi-square showing the association between workspace sitting arrangement and musculoskeletal discomfort

Variable 1	Variable 2	χ^2 Value	df	p-value	Level of Significance
Workspace sitting arrangement	Musculoskeletal discomfort	13.24	3	0.010	0.05*

Note: N.S. = Not Significant. *Level of Significance = 0.05 level

Table 5: Post-hoc analysis showing adjusted residuals for musculoskeletal discomfort and workspace sitting arrangement

Variable	Category	Observed Frequency (O)	Expected Frequency (E)	Z-score	Level of Significance
Musculoskeletal discomfort	On the Floor	40	30	2.10	0.05*
	Pidha	25	30	-0.91	N.S.
	Murha	15	20	-1.12	N.S.
	Bench	10	15	-1.29	N.S.

Note: Z-score $\geq \pm 1.96$ indicates significant deviation at the 0.05 level. N.S. = Not Significant.

Post-hoc analysis of adjusted residuals was subsequently conducted to identify the categories contributing to the observed association. The results indicated a significant positive deviation for the floor-sitting category ($Z = 2.10$), suggesting that the observed frequency of musculoskeletal discomfort among craftsmen working on the floor was higher than the expected frequency. The other sitting arrangements—Pidha, Murha, and Bench—showed non-significant deviations. Thus, the findings suggest that workspace sitting arrangement, particularly floor sitting, was significantly associated with perceived musculoskeletal discomfort among the selected craftsmen. However, the cross-sectional nature of the study permits interpretation in terms of association and does not establish a causal relationship.

Coping strategies for prevention of musculoskeletal discomfort experienced by the respondents at workplace

The occupational activities involved in bamboo and cane weaving require craftsmen to adopt static and often awkward postures for extended durations. Activities such as splitting, stripping, bending, weaving, and finishing demand repetitive body movements, prolonged squatting or cross-legged sitting, and frequent bending of the trunk. As per the suggestions from ergonomic expert, physiotherapists and architectural designer, the following coping strategies were suggested to the Bamboo and Cane Weaving Craftsmen to enhance musculoskeletal health:

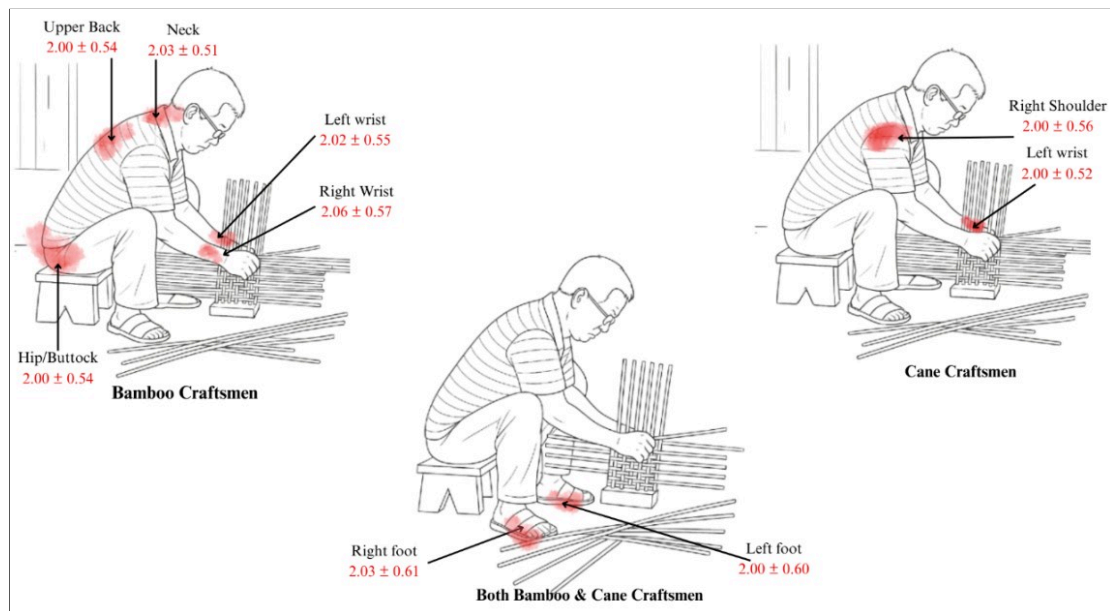


Figure 9. Distribution of the Respondents based on Extent of Perceived Work Interference

i. Adjustable Work Surfaces:

Work surface height and area are critical determinants of posture and biomechanical load during craft activities. Improperly positioned surfaces compel craftsmen to bend the trunk, overextend the arms, or adopt twisted postures, which contribute to cumulative musculoskeletal strain over time. To overcome these risks, ergonomic recommendations include a minimum floor-level platform height of 10 inches for cross-legged or squatting work, a work surface tilt of 10°–15° to support neutral wrist and arm positions, and a minimum work surface area of 3 feet in width and 2 feet in depth. These specifications ensure that materials and tools remain within safe and comfortable reach, thereby reducing unnecessary trunk flexion, repetitive reaching, and associated musculoskeletal stress.

ii. Scheduled Micro-Breaks:

Static postures for prolonged periods contribute significantly to muscular fatigue and reduced circulation. Therefore, micro-breaks of 2–5 minutes every 30–45 minutes was suggested which allow muscle relaxation, joint mobility, and partial recovery.

iii. Targeted Stretching and Mobility Exercise:

Specific exercises were recommended to the craftsmen to address occupational strain and reduce the risk of musculoskeletal discomfort associated with repetitive bamboo and cane weaving tasks. These included wrist flexion and extension with 10–15 repetitions per hand, shoulder rolls with 10 rotations forward and backward, knee and ankle rotations performed 10 times each, and seated back extensions with 5–10 repetitions. Implementation of these interventions helps to improve joint flexibility, restore circulation, and alleviate stiffness, thereby promoting musculoskeletal well-being and supporting sustained work performance among the artisans.

iv. Task Rotation:

Alternating high-intensity tasks (splitting, bending) with low-intensity tasks (weaving, finishing) every 45–60 minutes to distributes physical load across multiple muscle groups, preventing localized fatigue and cumulative trauma.

- v. **Elevate Foot during work:** While seating, elevate the foot using foot rest during work to reduce lower body part discomfort, improve blood circulation in the lower limbs, and relieve fatigue resulting from prolonged sitting during bamboo and cane weaving (**Plate No. 2**).



Plate 2. Stool for Foot Support

vi. Neutral Spine and Trunk Alignment:

Maintaining trunk flexion below 30°, hip and knee flexion between 90–110°, and regular weight shifting prevents excessive strain on the spine and lower limbs. Use of lumbar rolls or small cushions (10–12 cm thickness) enhances spinal support during prolonged sitting or cross-legged postures.

Conclusion

The present study was undertaken to assess the workspace sitting arrangements and perceived musculoskeletal discomfort among bamboo and cane weaving craftsmen in Assam. The study included 260 craftsmen comprising 97 bamboo-only craftsmen, 47 cane-only craftsmen, and 116 craftsmen engaged in both bamboo and cane weaving. The findings demonstrated that bamboo and cane weaving is a physically demanding, predominantly manual occupation involving repetitive upper-limb movements, prolonged sitting, bending, and static postures, thereby exposing craftsmen to considerable ergonomic stress.

The personal and occupational profile of the respondents indicated considerable variation in age, gender, and occupational experience across the three categories of craftsmen. The respondents had a mean work experience of 15.42 years and worked for an average of 7.48 hours per day, with a substantial proportion reporting more than eight hours of daily work. The predominance of mixed hand use during weaving further indicated the bilateral and repetitive nature of the craft activity. Although 68.46 per cent of the respondents reported no self-reported health comorbidities, conditions such as eye strain, hypertension, frequent headaches, diabetes, skin irritation, and respiratory problems were reported by some respondents.

The assessment of workspace conditions revealed that bamboo and cane weaving was predominantly carried out in informal and non-

standardized workspaces, generally within homes or small shared work areas. Four major sitting arrangements were identified: floor sitting, sitting on a wooden low stool (Pidha), sitting on a bench, and sitting on a bamboo stool (Murha). The choice of sitting arrangement varied according to the nature of the task and the workspace available. Floor-based working was particularly associated with prolonged static and constrained postures, which may increase biomechanical loading on the back and lower limbs.

The assessment of perceived musculoskeletal discomfort using the Cornell Musculoskeletal Discomfort Questionnaire revealed that the wrists, forearms, neck, and lower back were among the body regions showing comparatively higher frequency of discomfort. The right and left wrists showed particularly high frequency scores among bamboo and bamboo-and-cane craftsmen, reflecting the repetitive and forceful hand activities inherent to weaving. The lower back, knees, lower legs, and hip/buttock region also demonstrated notable discomfort, indicating the possible influence of prolonged sitting, squatting, kneeling, and trunk flexion during craft production. The severity and work-interference findings further indicated that discomfort was not restricted to a single body region but affected both upper and lower body segments.

The statistical analysis demonstrated a significant association between workspace sitting arrangement and perceived musculoskeletal discomfort ($\chi^2 = 13.24$, $df = 4$, $p = .010$). Post-hoc analysis indicated a significant positive deviation for floor sitting, indicating that the observed frequency of musculoskeletal discomfort among craftsmen using floor sitting differed significantly from the expected frequency. The findings therefore indicate that workspace sitting arrangement is an important ergonomic consideration in bamboo and cane weaving. However, the observed association should be interpreted as an association rather than evidence of a direct causal relationship.

Based on the ergonomic observations and recommendations obtained from ergonomic experts, physiotherapists, and architectural designers, several practical interventions were proposed. These included the use of ergonomically designed seating with appropriate support, *anti-fatigue* mats for floor-based activities, adjustable and appropriately elevated work surfaces, task rotation, scheduled micro-breaks, targeted stretching and mobility exercises, foot support, alternating hand use where feasible, and maintenance of a more neutral spine and trunk posture. These interventions are intended to reduce prolonged static loading, repetitive strain, awkward postures, and localized pressure while retaining the practical requirements of traditional weaving activities.

The study highlights the need to integrate ergonomic considerations into the existing work practices of bamboo and cane weaving craftsmen without compromising the traditional nature of the craft. Simple, low-cost, locally adaptable modifications to seating, work-surface height, foot support, task organization, and rest patterns may help improve workplace comfort and reduce occupational musculoskeletal strain. The findings provide a basis for developing ergonomically appropriate workspaces and intervention strategies for bamboo and cane craftsmen in Assam and may also contribute to improving occupational health, comfort, and sustainable productivity within traditional craft-based livelihoods.

Acknowledgement

The authors express sincere gratitude to The Maharaja Sayajirao University of Baroda, Gujarat, for providing the academic environment and institutional support necessary for conducting this research. The authors gratefully acknowledge the cooperation and support extended by the concerned authorities and members of the North

Eastern Handicrafts and Handlooms Development Corporation (NEHHDC), Guwahati, Assam, in facilitating access to the selected bamboo and cane craft clusters.

The authors are especially thankful to all the bamboo and cane weaving craftsmen of Assam who participated in the study and generously shared their time, experiences, and valuable information. Their cooperation was essential to the successful completion of this research.

The authors also acknowledge the guidance and assistance received from colleagues, experts, and other individuals who contributed directly or indirectly to the planning, data collection, analysis, and completion of the study. Finally, the authors extend their sincere appreciation to everyone who supported and encouraged the researchers throughout the course of this work.

References

1. Bhattacharyya P. Determinants of the income of cane and bamboo craft artisans: A study in Sivsagar district of Assam. *International Journal for Multidisciplinary Research*. 2024;6(6):1–7.
2. Phukan M. A study on cane and bamboo handicraft industry in North-East India. *Research Journal of Humanities and Social Sciences*. 2018;9(4):901–904.
3. Shende A, Rane M, Joshi P. Design interventions for the sustainable livelihood of the bamboo craft community. *DIID*. 2024;1(81).
4. Das D, Kumar A, Sharma M. A systematic review of work-related musculoskeletal disorders among handicraft workers. *International Journal of Occupational Safety and Ergonomics*. 2020;26(1):55–70.
5. Haftu D, Kerebih H, Terfe A. Prevalence of work-related musculoskeletal disorders and its associated factors among traditional cloth weavers in Chench district, Gamo zone, Ethiopia, an ergonomic study. *PLOS ONE*. 2023;18(11):e0293542.
6. Meher AK, Venkatachalapathy TK, Panda PK. Musculoskeletal disorders among the handloom weavers in Odisha, India: A cross-sectional study. *Clinical Epidemiology and Global Health*. 2025;33:101965.
7. Nag A, Vyas H, Nag PK. Gender differences, work stressors and musculoskeletal disorders in weaving industries. *Industrial Health*. 2010;48(3):339–348.
8. Sriagustini I, Supriyani T. Assessment of work posture on woven bamboo craftsmen. *The Indonesian Journal of Occupational Safety and Health*. 2022;11(2):295–306.
9. Hedge A, Morimoto S, McCrobie D. Effects of keyboard tray geometry on upper body posture and comfort. *Ergonomics*. 1999;42(10):1333–1349.

How to cite this article: Goswami P, Mishra U. Ergonomic assessment of bamboo and cane weaving craftsmen: workspace sitting arrangements and musculoskeletal discomfort. *International Journal of Agriculture Extension and Social Development*. 2026;9(10):253–264. doi: <https://www.doi.org/10.33545/26180723.2026.v9.i10d.4391>