

RELATIONSHIP OF CHEST WALL EXPANSION AND FUNCTIONAL CAPACITY ON WORK RELATED MUSCULOSKELETAL DISORDERS IN TAILORS – OBSERVATIONAL STUDY

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Abstract:

Background: Most musculoskeletal issues are a result of poor work posture. Tailoring consists of tasks such as cutting, sewing, embroidery, pressing, and finishing, all done while hunched over the sewing machine with a curved back and bent head and neck. According to the data collected during the task analysis, it seems that posture issues caused by an inadequate workstation setup and repetitive tasks. Pain in the neck, shoulder, upper back, and lower back area caused by work-related musculoskeletal issues. so there is Postural deviations, muscle imbalance, and other biomechanical changes such as forward head, rounded shoulders, increased thoracic kyphosis, and altered scapula-humeral rhythm are observed, The Nordic questionnaire was utilized in epidemiological research to evaluate musculoskeletal disorders in various body regions. The scapular index was determined by using a Vernier caliper to measure the rounded shoulders. Poor posture like leaning forward, slouching, or having rounded shoulders limits chest expansion. Incorrect body positions greatly impact the biomechanics of the upper body. Sitting for long periods reduces the use of muscles, leading to a decline in functional capacity.

Purpose: To study the relationship of chest wall expansion and functional capacity on work related musculoskeletal disorders in tailors.

Methodology: 80 subjects who fulfilled selection criteria were included. Study included subjects were 30-55 years of age and minimum 7 year experience, questionnaire were filled such as Nordic questionnaire also included reduced scapular index. subjects were given written informed consent and outcome measures that is chest expansion and functional capacity. These were then collected and analysed.

Results: The result of study showed a 96% tailors affected form chest expansion and all the subjects (100% tailors) affected form functional capacity.

Conclusion: The present study concludes that chest expansion and functional capacity having significant relationship with MSDs in tailors.

Keywords: Chest expansion, functional capacity, scapular index, Nordic questionnaire, vernier caliper

I. INTRODUCTION

Most musculoskeletal issues are a result of poor work posture. Work-related musculoskeletal issues are prevalent in current times. WMSDs are common due to workers maintaining a seated position with their arms flexed and raised, while also bending their head and body forward. They occur in workers who constantly use incorrect posture and make excessive movements.¹

Tailoring consists of tasks such as cutting, sewing, embroidery, pressing, and finishing, all done while hunched over the sewing machine with a curved back and bent head and neck.² <C:\Users\Atulkumar\Valand\Downloads\IJISRT19NOV280.pdf>

According to the data collected during the task analysis, it seems that posture issues caused by an inadequate workstation setup (such as wrong table and chair heights, non-adjustable equipment, and lack of back rests) and repetitive tasks like pedalling, extreme bending of the trunk and neck, and the highly repetitive nature of the work are the main factors contributing to the high rates of MSDs.³ In Sweden, the majority of sewing machine operators reported experiencing neck and shoulder pain, with 75% reporting issues in the past year and 51% in the past week.³ Prolonged neck strain from constantly looking down with a flexed neck and straining eyes because of poor task lighting is a common issue among tailors.¹

The research indicated that Shoulder MSDs can lead to decreased muscle contractions, resulting in circulatory issues and ultimately early fatigue in the shoulder muscles.⁵

The position they take while sewing a piece of clothing includes bending their neck forward, lifting their elbows above/below their shoulders, bending their wrist downward and inward, and leaning their back forward, which leads to discomfort in their posture.⁴ Postural deviations, muscle imbalance, and other biomechanical changes such as forward head, rounded shoulders, increased thoracic kyphosis, and altered scapula-humeral rhythm are observed in upper cross syndrome. An article has shown that 91% of the population has tightness in their pectoralis major and minor muscles, while 77% have tightness in their upper trapezius muscles. 86% of the population has weakness in the middle and lower trapezius muscles, while 80% of the population has weakness in the deep cervical neck flexors. 23% of the population exhibits mild disability according to the neck disability index, while moderate disability affects 43% and severe disability affects 17%. Out of the total number of people they studied, 35 tailors, they found that 77% of the population has Upper Cross Syndrome.⁴

Nordic Musculoskeletal Questionnaire is a tool available for public use that was created as part of a project by the Nordic Council of Ministers. This survey is useful for evaluating musculoskeletal disorders in various areas of the body in epidemiological research.¹⁰ <C:\Users\Atulkumar Valand\Downloads\validity and reliability of nordic scale.pdf> The items are answered with either Yes or No, and the evaluation timeframe is one week and one year.⁵

The scapular index is utilized to evaluate the scapula's shape by measuring the relationship between breadth and length (Abdelhameed & Abdel-Aziem, 2016). The scapula is essential for the posture of the upper extremity, and any change in its position can lead to musculoskeletal discomfort and pain. The scapular index decreases when individuals use smartphones excessively, resulting in worse forward head posture and rounded shoulders in comparison to those who use smartphones for shorter periods each day.⁶

Investigation and demonstration show that decreased chest expansion is caused by poor posture like forward neck posture, slouched posture, or rounded shoulder. Rounded shoulders, caused by forward head posture, result in decreased chest expansion.⁶

Several factors have been linked to rounded shoulders, including muscle shortening and weakness, which impact posture and body segment alignment. Decreased chest expansion is caused by the tightness of the pectoralis and scalene muscles. Reduced chest expansion results in a decrease in both vital capacity and total lung volumes.¹¹ Circumferential measurement of chest expansion was conducted with a cloth tape measure placed around the chest, below the armpit [at Axilla], at nipple height, and at xiphoid process level [at T8 level]. Chest measurements were recorded while taking three deep breaths at every level of expansion.⁶

The article described how individuals have reduced lung volume when breathing in, are less effective in contracting muscles when breathing out, and encounter increased airway blockage in all sizes when sitting for an extended period. Prolonged sitting in a flexed position can result in sustained lumbar flexion, leading to muscle stiffness and a decrease in muscle elasticity. Likewise, it was found that extended sitting led to an increase in stiffness of the lumbar spine and a decrease in pulmonary function.¹²

Incorrect body positions greatly impact the biomechanics of the upper body. Sitting for long periods reduces the use of muscles, leading to a decline in functional capacity.⁸

MATERIALS AND METHODOLOGY

- Nordic questionnaire scale
- Vernier caliper
- Cloth inch tape
- Stopwatch
- Pulse Oximeter
- Sphygmomanometer
- Two cones
- Chair
- Consent form

METHODOLOGY

- Study type : Observational study
- Study design : Cross sectional study
- Study duration : 6 month
- Type of sampling : Simple random sampling
- Sample size : 80
- Study setting : Tailor workstation in Sangli district

OUTCOME MEASURES

1) Cloth inch tape: (measuring chest expansion)

- Using a cloth tape measure, the circumference of the chest was assessed by wrapping it around the chest at the armpit (Axilla), nipple, and xiphoid (T8 level). Measurements of the chest were conducted as the individual took three deep breaths at various levels of expansion. Participants were told to "breathe out fully" and "unwind" before every

breath. A measurement of the chest size was done while in a state of rest. After measuring the inhalation, participants were told to "take a deep breath" and then their inhalation was measured again. The procedure was carried out three times for each participant on every level.

2)6Min walk test:

- The 6min walk test is an effective way to assess functional capacity. The six-minute walk test was carried out in accordance with the guidelines provided by the American Thoracic Society (ATS). Participants were instructed to walk 30 meters back and forth for 6 minutes, with the distance they covered being recorded. Healthy individuals typically walk between 400 and 700 meters in a 6-minute period, with gender, age, and height being the primary factors influencing this distance.

REFERENCE EQUATIONS FOR 6-MIN WALK DISTANCE IN HEALTHY ADULTS

Men:

$$6MWD = (7.57 \times \text{height}_{\text{cm}}) - (5.02 \times \text{age}) - (1.76 \times \text{weight}_{\text{kg}}) - 309 \text{ m.}$$

Alternate equation using BMI*:

$$6MWD = 1,140 \text{ m} - (5.61 \times \text{BMI}) - (6.94 \times \text{age})$$

When using either equation, subtract 153 m for the LLN

Women:

$$6MWD = (2.11 \times \text{height}_{\text{cm}}) - (2.29 \times \text{weight}_{\text{kg}}) - (5.78 \times \text{age}) + 667 \text{ m.}$$

Alternate equation using BMI:

$$6MWD = 1,017 \text{ m} - (6.24 \times \text{BMI}) - (5.83 \times \text{age})$$

When using either equation, subtract 139 m for the LLN

Definition of abbreviations: BMI = body mass index; 6MWD = 6-min walk distance; LLN = lower limit of normal.

* BMI in kg/m^2 .

GENDER	FREQUENCY	PERCENT	P-VALUE
MALE	32	40.0	0.074
FEMALE	48	60.0	
TOTAL	80	100.0	

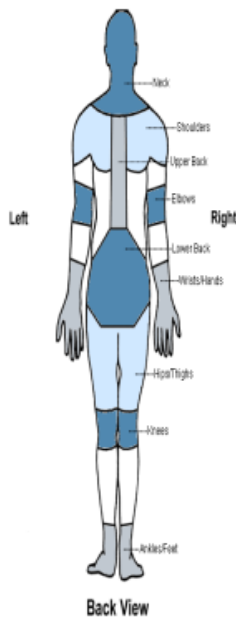
Musculoskeletal Discomfort Form (Based on the Nordic Questionnaire (Kourinka et al. 1987)) Employee ID: _____

Job/Position: _____ Gender: M F Age: _____ Height: _____ ft. _____ in. Weight: _____
 How long have you been doing this job? _____ years _____ months How many hours do you work each week? _____

How to answer the questionnaire:

Picture: In this picture you can see the approximate position of the parts of the body referred to in the table. Limits are not sharply defined, and certain parts overlap. You should decide for yourself in which part you have or have had your trouble (if any).

Table: Please answer by putting an "X" in the appropriate box - one "X" for each question. You may be in doubt as to how to answer, but please do your best anyway. Note that column 1 of the questionnaire is to be answered even if you have never had trouble in any part of your body; columns 2 and 3 are to be answered if you answered yes in column 1.



To be answered by everyone	To be answered by those who have had trouble	
Have you at any time during the last 12 months had trouble (ache, pain, discomfort, numbness) in:	Have you at any time during the last 12 months been prevented from doing your normal work (at home or away from home) because of the trouble?	Have you had trouble at any time during the last 7 days?
Neck <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
Shoulders <input type="checkbox"/> No <input type="checkbox"/> Yes, right shoulder <input type="checkbox"/> Yes, left shoulder <input type="checkbox"/> Yes, both shoulders	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
Elbows <input type="checkbox"/> No <input type="checkbox"/> Yes, right elbow <input type="checkbox"/> Yes, left elbow <input type="checkbox"/> Yes, both elbows	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
Wrists/Hands <input type="checkbox"/> No <input type="checkbox"/> Yes, right wrist/hand <input type="checkbox"/> Yes, left wrist/hand <input type="checkbox"/> Yes, both wrists/hands	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
Upper Back <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
Lower Back (small of back) <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
One or Both Hips/Thighs <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
One or Both Knees <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes
One or Both Ankles/Feet <input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes	<input type="checkbox"/> No <input type="checkbox"/> Yes

RESULTS

- The data was entered using Microsoft excel 2013 and it was analysed using SPSS version 23.
- The normality testing of data was done by KARL PEARSON CORRELATION

Table no.:1 - gender

Graph no. - 1

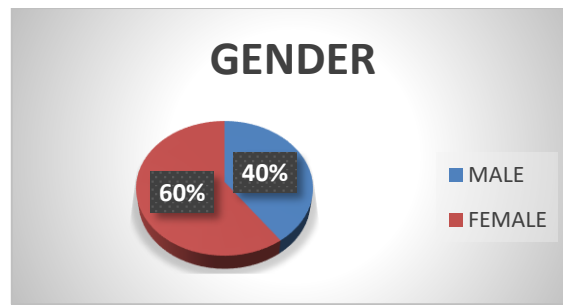
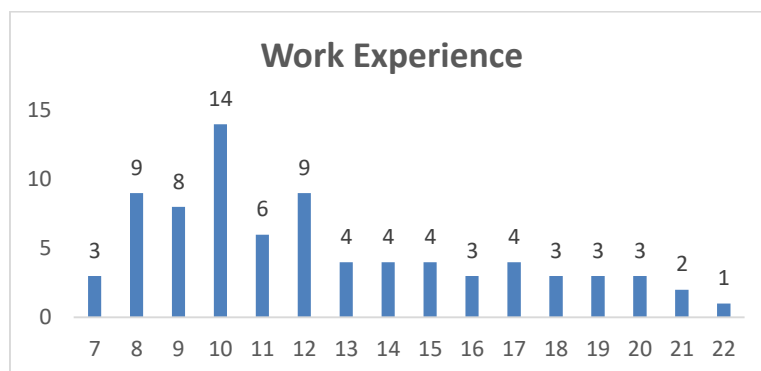


Table no.:2 – work experience

Work Experience	Frequency	Percent	P-value
7.00	3	3.8	0.003
8.00	9	11.3	
9.00	8	10.0	
10.00	14	17.5	
11.00	6	7.5	
12.00	9	11.3	
13.00	4	5.0	
14.00	4	5.0	
15.00	4	5.0	
16.00	3	3.8	
17.00	4	5.0	
18.00	3	3.8	
19.00	3	3.8	
20.00	3	3.8	
21.00	2	2.5	
22.00	1	1.3	
Total	80	100.0	

Graph no.-2



Descriptive Statistics Table no:3 - age

Variable	Mean	SD
Age	44.58	5.41

Graph no. -3

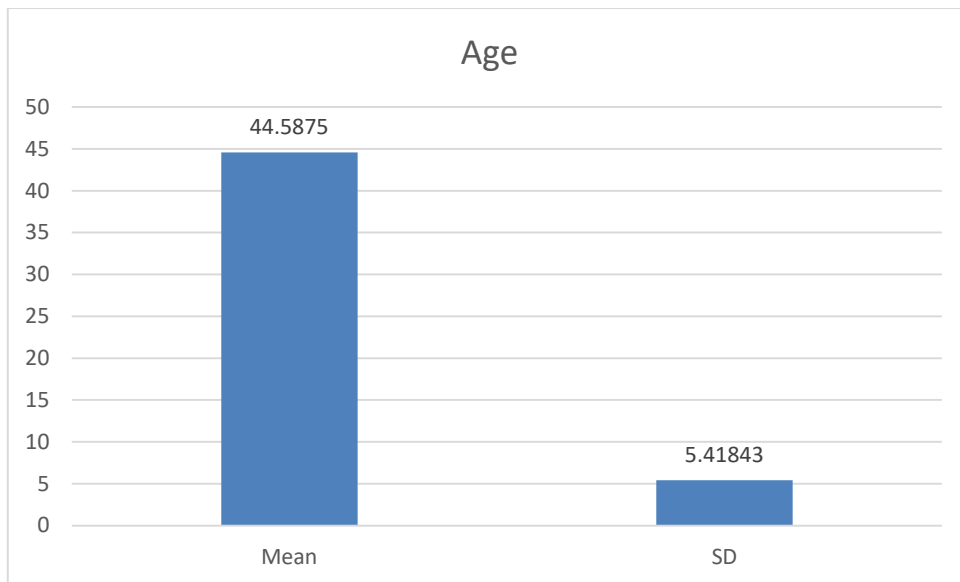


Table no:4 – work experience

Variable	Mean	SD
Work Experience	12.47	3.97

Graph no. -4

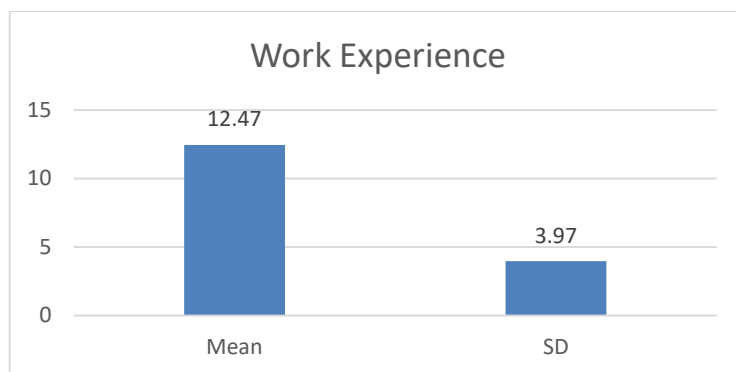


Table no:5

PREVALENCE RATE OF CHEST EXPANSION

Variable	Frequency	Prevalence Rate
Normal chest expansion	3	3.75
Affected chest expansion	77	96.25

Graph no. -5

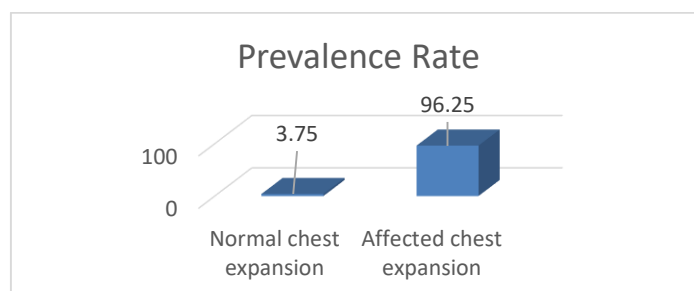


Table no:6

CHEST EXPANSION

Variable	Mean	SD
Normal	3.00	0.00
Upper	1.54	0.48
Middle	1.49	0.40
Lower	1.51	0.46

Graph no. -6

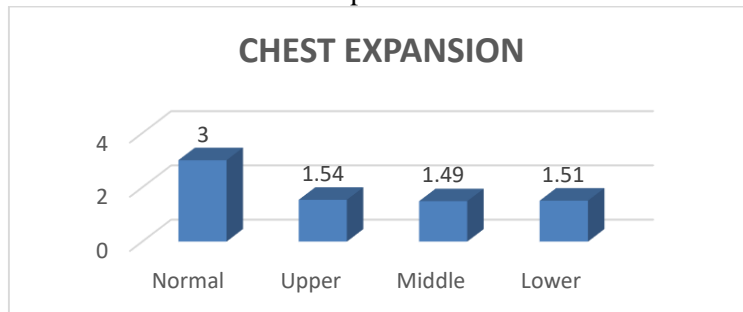
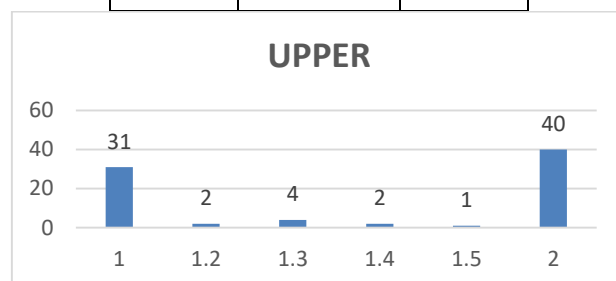


Table no:7

CHEST EXPANSION

UPPER	Frequency	Percent
1.00	31	38.8
1.20	2	2.5
1.30	4	5.0
1.40	2	2.5
1.50	1	1.3
2.00	40	50.0
Total	80	100.0



Graph no. -7

Table no:8

MIDDLE	Frequency	Percent
1.00	24	30.0
1.10	3	3.8
1.20	3	3.8
1.30	5	6.3
1.40	2	2.5
1.50	2	2.5
1.60	7	8.8
1.70	1	1.3
1.80	12	15.0
1.90	7	8.8
2.00	9	11.3
3.00	3	6.3

Total	80	100.0
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Graph no. -8

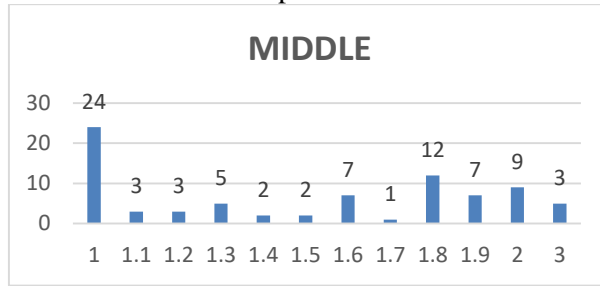


Table no.:9

LOWER	Frequency	Percent
1	31	38.8
1.2	2	2.5
1.3	4	5
1.4	2	2.5
1.5	1	1.3
1.6	5	6.3
1.8	2	2.5
2	33	41.3
Total	80	100

Graph no. -9

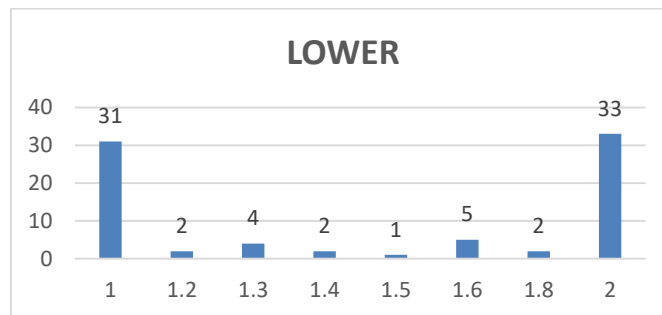
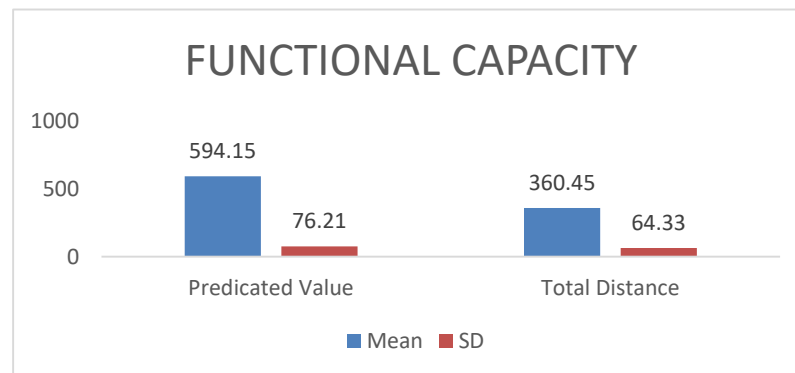


Table no.:10

FUNCTIONAL CAPACITY

Variable	Mean	SD
Predicated Value	594.15	76.21
Total Distance	360.45	64.33

Graph no. -10



DISCUSSION

The present study is an observational study which was conducted to see the relationship of chest wall expansion and functional capacity on work related musculoskeletal disorders in tailors. This study aimed to find out the relationship of chest wall expansion and functional capacity on work related musculoskeletal disorders in tailors. 80 tailors with MSDs according to Nordic questionnaire and fulfilled with inclusion and exclusion criteria, subjects includes both male and female.

Sidharth shiva sankant et.al (2023) recently discovered that the prevalence of WMSD was 99.09% in 110 tailors, with the most common sites of pain being neck (70.90%), lower back (64.54%), shoulder (61.81%), upper back (49.09%), arm (42.7%), and leg (37.27%).¹⁶

The Nordic questionnaire is employed to gain a deeper insight into each tailor's difficulties with a particular body part during a specific period. This study is an observational study and involves this questionnaire in which 80 individuals are asked to respond with yes or no. The questionnaire also gathers information on age, gender, working hours, and duration.

Research indicates that workers in specific occupations, such as tailors, have a higher risk of developing musculoskeletal issues due to inadequate ergonomics, such as improper table and chair heights, non-adjustable equipment, and lack of back support.³

According to Siddhi kale et al (2020), study that was done on 35 tailors ; concluded that more than 50% of them have upper cross syndrome; significantly showing forward head posture ,hunching of the thoracic spine, elevated and protracted shoulders, scapular winging, and decreased mobility of the thoracic spine.⁴

Overall 80 subjects participated in this study. From all the participants, individuals aged 30-55 with at least 7 years of work experience were chosen based on the Nordic questionnaire, showing higher MSD symptoms and a lower scapular index, as per the inclusion criteria.

The participants were examined for the prevalence of rate of chest expansion (table no. 5). The average chest expansion in normal individuals is 3. Normal chest expansion is seen in 3 subjects, with a frequency and prevalence rate of 3.75. Reduced chest expansion is seen in 77 subjects, with a prevalence rate of 96.25. 77.. Chest expansion was measured at three levels (upper, middle, and lower) with averages of 1.54, 1.49, and 1.51 respectively. The average chest expansion at each level is lower than the overall normal chest expansion mean.

In this study, mean upper chest expansion and lower chest expansion more affected than middle chest expansion. It is indicated that MSDs is inversely proportional to chest expansion.

Gan et al. stated that The middle chest experiences the greatest expansion among other areas because of the biomechanics of the rib cage while breathing. The upper thoracic area primarily experiences an anterior-posterior expansion or pump-handle motion, while the lower thoracic region mainly undergoes lateral expansion or bucket-handle motion. This could result in the upper chest and middle chest becoming bigger than the lower chest.¹⁷

Previous study Qurat Ul Ain Gohar et al (2021) shows that chest expansion to be decreased as a result of poor posture like forward neck, slouched, or rounded shoulder posture.⁶

The article stated that prolonged sitting individual has reduced lung volume when breathing in, are less effective in contracting muscles when breathing out, and encounter increased airway blockage in all sizes when sitting for an extended period. Prolonged sitting in a flexed position can result in sustained lumbar flexion, leading to muscle stiffness and a decrease in muscle elasticity. Likewise, it was found that extended sitting led to an increase in stiffness of the lumbar spine and a decrease in pulmonary function.¹²

In our study functional capacity mean (SD) 6MWD (table no.6), predicted distance are 594.15 m (SD-76.21) and total distance are 360.45 m (SD-64.33) observe in 80 participants compare to predicted distance and total distance, the result or graph shows that total distance is less than predicated distance. In our study indicates that MSD is inversely proportional to functional capacity.

A previous investigation Dipti B Geete et al (2023) stated that incorrect posture has a notable impact on the biomechanics of the upper body, and prolonged periods of sedentary behavior lead to reduced use of skeletal muscles, resulting in a decline in functional capacity.⁸

(Lanza Fde et al., 2013) stated that Several factors influence the amount of movement the chest wall can make, such as the flexibility of the soft tissues around the thorax, the shape of the chest, and the power of the respiratory muscles.¹⁸

CONCLUSION

The present study concludes that chest expansion and functional capacity having significant relationship with MSDs in tailors.

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