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Original Article

Physiotherapy Section

Evaluation of Ergonomic Risk Factors and Pinch Strength in Goldsmith Workers: A Cross-sectional Study

MINAL DHAIRYA BHAVSAR[1], BHAVANA RAJESH GADHAVI[2], YAGNA UNMESH SHUKLA[3]

ABSTRACT

Introduction: Gold ornament making industries are small scale widespread industries. India is the largest exporter of gems and jewellery. Goldsmith work is highly repetitive and strenuous job which may lead to Musculoskeletal Disorders (MSD) among workers. In the work, the worker uses tools such as cables, screwdrivers, scissors, cutters, pliers etc., for various gripping tasks. Such repetitive movements while working impair the pinch strength of the goldsmith, which is one of the MSDs.

Aim: To evaluate the risk of MSDs and pinch strength in goldsmith workers.

Materials and Methods: This observational cross-sectional study was conducted from jewellery workers from different areas of Ahmedabad, Gujarat, India, on March 2024 to July 2024, which comprised of 300 male participants. Study was affiliated with government physiotherapy college and government spine institute, civil hospital Ahmedabad, Gujarat, India. Rapid Upper Limb Assessment (RULA) was used to assess the stress of workers for all predominant postures by scoring them according to their severity of stress. The average working posture of the goldsmiths at their working condition were analysed by the RULA method. This was carried out with the digital photography. Baseline hydraulic pinch gauze was used to measure pinch strength. Pinch strength was tested using a standardised position given by American Society of Hand Therapists. Measurements were taken alternately between two hands. Descriptive statistics, including mean and standard deviation, were calculated for pinch strength data based on age group and hand dominance. To compare pinch strength between goldsmith workers and the normal values in the Gujarati population for both hands, the Mann-Whitney U test was performed.

Results: The RULA analysis indicates that a significant majority of goldsmith workers are at risk for MSDs due to their adoption of awkward postures during daily work processes, with 44.3% (133 subjects) classified as low-risk suggesting that changes may be needed, 53.7% (161 subjects) categorised as medium-risk indicating a need for further investigation and prompt interventions and 2% (6 subjects) found to be at high-risk, which requires immediate changes, while none of the workers were at negligible risk level. Result of this study showed that tip to tip pinch strength, key pinch strength and three jaw chuck strength values were reduced in goldsmith workers as compared to normal values of population. Furthermore, there was a significant difference between all three types of pinch strength of goldsmith workers and normal values (p-value <0.05).

Conclusion: From the observation and analysis of the result it was concluded that health of the goldsmiths were highly affected by the improper body posture and workload. Therefore, it is necessary to undertake ergonomic interventions in designing goldsmith workers workstation. Based on the results, the high-risk factors lead to significant decrease in pinch strength of goldsmith workers.

Keywords: Body posture, Musculoskeletal diseases, Occupational health, Pinch grasp, Risk assessment

INTRODUCTION

The gold ornament making industry is a prevalent small-scale industry in India, operating within the unorganised sector. Many goldsmiths work in this industry for extended periods, sitting in a cross-legged position at a semiconfined workstation. This prolonged posture may contribute to the development of various MSDs among them [1]. Ijadunola KT et al., found that a poorly designed workstation can lead to increased physical exertion, resulting in decreased efficiency and productivity. Additionally, maintaining a static posture, like sitting, puts more strain on the muscles, ligaments and other soft tissues of the musculoskeletal system [2]. MSD can result from strenuous physical activity, prolonged static postures, frequent bending and twisting, lifting, pushing and pulling, repetitive tasks, exposure to vibrations and psychological and psychosocial stress [3]. A task with high repetition and poor postures may result in a significant number of complaints or injuries such as carpal tunnel syndrome, neck pain, shoulder pain and MSDs.

There are three types of pinch grasps: tip to tip, pad to side prehension (key grip or lateral pinch) and pad to pad or palmar prehension [4]. The process of manufacturing jewellery includes precision designs like setting metals and stones, polishing, cutting, hand work, decorative and filing [5]. Goldsmiths create jewellery by hand, using tools like cuticle, clippers, beads, precious stones and metal pieces. This intricate task demands precision, skill, kindness and patience, as well as putting strain on the hands and wrists due to the biomechanical stress involved [6].

The goldsmiths, belonging to the sedentary class of workers, primarily used their upper limbs for their tasks rather than their lower limbs. To assess their posture, the RULA tool was used to specifically evaluate the positioning of their upper limbs. Developed by McAtamney L and Nigel Corlett E in 1993, RULA is a score-based tool that considers factors such as upper and lower arm position, wrist twist and position and neck and trunk position. This tool helps determine the risk of Upper Limb Disorders (ULD) by assessing individuals' exposure to postures, forces and muscle activities that can contribute to these disorders [7].

Due to the lack of evaluation of ergonomic risk factors and ergonomically designed workplaces in the informal sector, there is a need to conduct a study on prolonged work in uncomfortable positions. The aim of this study was to determine the adverse effects on different parts of the body during prolonged repetitive tasks.

Hand strength assessment is considered a reliable and objective parameter tomeasure the functional integrity of the hand [8]. Hand strength testing is simple and inexpensive and is often performed to evaluate outcomes after upper limb injuries [9]. Therefore, pinch strength can be considered a more objective parameter to measure and quantify pre- and postorthopaedic and physiotherapy outcomes.

Many studies have focused on grip strength, but none have specifically looked at the effects on pinch strength. Nejad NH et al., found that MSDs significantly reduce grip and pinch strength in female carpet weavers in Southeastern Iran [10]. Bori G, noted that repetitive work and high workload in the handloom industry cause grip fatigue and a notable decrease in grip strength due to long service and low efficiency [11]. Hand strength can vary significantly based on occupation, so this study aims to evaluate the level of hand use needed for hand rehabilitation. The study will focus on analysing pinch strength in goldsmith workers.

The aim of the study was to evaluate the risk of MSDs and pinch strength in goldsmith workers. The primary objectives of the study was to find out ergonomic risk factors using RULA in Goldsmith workers and to find out pinch strength using pinch gauze in Goldsmith workers. The secondary objectives of the study were to compare pinch strength in goldsmith workers as compared to age/gender match individuals.

MATERIALS AND METHODS

The observational cross-sectional study was conducted from jewellery workers from different areas of Ahmedabad, Gujarat, India, from March 2024 to July 2024, which comprised of 300 male participants. The ethical approval was obtained from the Institutional Ethics Committee (IEC) of Shree Swaminarayan Physiotherapy College, Ranip Ahmedabad Gujarat with ethical Approval no. SSPC/IEC/101/2023 before implementation of the study. Written informed consent was taken from subjects who were willing to participate in the study. As per the inclusion criteria, subjects will be selected for the study.

Inclusion criteria: Workers with age 20-45 years, all male subjects, workers who have been making ornaments for at least last one year, workers who are working minimum for more than five hours/day for six days/week or 30 hours a week, workers willingness to participate in study were include in the study.

Exclusion criteria: History of any upper limb injury less than one year, history of any congenital/acquired musculoskeletal deformity, neurological conditions, cardio-pulmonary conditions, history of other pathological condition like osteomyelitis, neoplasm etc., range of motion deficit in elbow and hand, subjects who does not understand the command were excluded from the study.

Sample size calculation: Sample size was calculated from the result of the pilot study

It was determined by the formula [12].

$$\text{Sample size } n=\frac{(z_{1-\alpha/2})^2\times(\sigma)^2}{(d)^2}$$

n=Desired number of samples

$z_{1-\alpha/2}$=Standardised value for the corresponding level of confidence. (At 95% CI, it is 1.96)

d=Margin of error or rate of precision (0.2)

σ=SD which is based on pilot study conducted in 50 males (1.8)

So, required sample size, n=300

The demographic data including age, gender, height, weight, dominancy, working hours per day, years of experience, duration of rest per day were collected through data collection sheet. Consent forms from the participants were taken. A video of different sections was taken. From videos snapshots of 300 workers working in different sections were obtained. Both frontal and sagittal plane analysis was done. The snapshots were analysed to fill the scores in RULA.

Study Procedure

Ansalysis of working posture:

- RULA is a score-based information tool containing items of upper and lower arm position, wrist twist and position and neck and trunk position.
- A single page worksheet was used to evaluate required body posture, force and repetition. Based on the evaluations, scores were entered for each body region in section A for the arm and wrist and section B for the neck and trunk. After the data for each region was collected and scored, tables on the form were then used to compile the risk factor variables, generating a single score that represents the level of MSD risk [13].

Key components of Rapid Upper Limb Assessment (RULA) [Table/Fig-1] [13]

1. Posture Assessment:
   - Evaluates neck, trunk and limb positions, scoring based on:
     - Neck (flexed, extended, turned)
     - Upper Arm (raised, lowered, extended)
     - Forearm (parallel, twisted)
     - Wrist/Hand (neutral, extended, flexed)
     - Trunk (flexed, twisted)
2. Muscle activity:
   - Considers the effort needed to maintain postures and evaluates movement frequency and muscle exertion.
3. Force and load:
   - Assesses the force exerted during tasks like heavy lifting, which increases injury risk.
4. Rapid assessments:
   - The assessment typically takes only a few minutes to observe and score postures.

Score	Level of risk assessment
1-2	Negligible risk, no action required
3-4	Low-risk, change may be needed
5-6	Medium-risk, further investigation, change soon
7+	Very high-risk, implement change now

[Table/Fig-1]: RULA scoring system [13].

Pinch strength measurement

Pinch grip strength was measured using Standard Hydraulic pinch gauze (BASELINE*; 12-0235), White plains New York, USA [14,15]. The measurement was performed in the standard position recommended by the American Society of Hand Therapists (Fess and Moran, 1981) and Mathiowetz V et al., (1984, 1985) [16,17] of hand therapists. Participants was seated on a chair without armrests with their feet flat on the floor, shoulder adducted and neutrally rotated, elbow flexed to 90°, forearm in neutral position, the wrist slightly extended (0-15) and between 4 and 15 ulnar deviation.

In tip pinch, the pinch meter will be grasped with the tips of the thumb and index finger [Table/Fig-2]. For key pinch grip, the pinch gauge will be positioned between the pad of the thumb and the radial side of the middle phalanx of the index finger [Table/Fig-3]. For palmar pinch grip, the pinch gauge will be grasped between the pads of the thumb, index and long fingers [Table/Fig-4] [4]. For each measurement, three consecutive measurements were taken, alternating between the dominant and non dominant hands. The average of the three trials was calculated.

[Table/Fig-2]: Tip to tip pinch strength.

[Table/Fig-3]: Key pinch strength.

[Table/Fig-4]: Three-jaw chuck pinch strength.

STATISTICAL ANALYSIS

The data collected was assessed and analysed using Statistical Package for the Social Sciences (SPSS) version 27.0. Descriptive statistics i.e., mean and standard deviation was calculated for the data according to the age group and hand dominance for all types of pinch strength. RULA was used for evaluation of ergonomic risk factors. To check whether the data follows normal distribution or not, Shapiro-wilk test was applied at 95% confidence interval. The Shapiro-Wilk test shows p-value <0.05 suggest that data are not normally distributed. To assess the pinch strength difference between goldsmith workers and normal value in Gujarati population (Dominant and non dominant hand) the Mann-Whitney U test was performed.

RESULTS

A total of 300 goldsmith workers in the age group of 20-45 years participated in the study. [Table/Fig-5] represents the general physical information of the workers. The mean age of the workers is 37.19 years and they have average 165.7 cm height and 67.34 kg weight. The average years of experience are 20.17 years. It is observed that the goldsmiths work six days in a week. The average duration of work per day was 9.8 hour that varies on the demand of work and they work for six days in a week.

Variables	Minimum	Maximum	Mean±SD
Age years	20	45	37.19±8.7
Weight (Kg)	35	120	67.34±12.6
Height (cm)	142	190	165.7±7.83
BMI (kg/m^2)	15.9	39.8	24.53±4.27
Years of experience	1.0	40.0	20.17±9.89
Duration of work per day (in hours)	5	18	9.88±2.25

[Table/Fig-5]: Demographics of the workers.

Age: Age is a very important variable in an occupational study as it affects the working capacity of an individual. Out of the 300 workers selected for the present study, maximum number of the respondents i.e., 165 (55%) belonged to the age group of 40-45 years while 42 (14%) belonged to the age group of 20-24 years [Table/Fig-6].

Work and break duration: A total of 197 (65.7%) workers worked up to 10 hours and 103 (34.3%) of them worked more than 11 hours. A total of 155 (51.7%) workers took a break after one hour, 82 (27.3%) took a break after two hours, 60 (20%) took a break after more than two hours [Table/Fig-6].

Personal details	Group	n (%)
Age (years)	20-24	42 (14)
	25-29	27 (90
	30-34	30 (10)
	35-39	36 (12)
	40-45	165 (55)
Working time (in hrs)	5-10	197 (65.7)
	11 and above	103 (34.3)
Break time (in hrs)	Within ½	3 (1.0)
	1h	155 (51.7)
	2 h	82 (27.3)
	More than 2	60 (20)
No. of years of experience	1-5	32 (10.7)
	6-10	36 (12)
	11-15	36 (12)
	16-20	43 (14.3)
	Above 20	153 (51)
Working posture	Standing	4 (1.3)
	Sitting on the ground	228 (76)
	Sitting on a chair/stool	68 (22.7)

[Table/Fig-6]: Socio-personal profile of the worker.

Work experience: A total of 153 (51%) of them reported that they had been performing this activity more than 20 years, 43 (14.3%) had experience of 16-20 years [Table/Fig-6].

Working posture: About 228 (76%) workers were worked in the sitting on the ground position, 68 (22.7%) were worked in the sitting

on a chair/stool position and 4 (1.3%) were worked in the standing position [Table/Fig-6].

Analysis of working posture is shown in [Table/Fig-7]. About 44.3% of the workers are at low-risk level and change may be needed whereas 53.7% workers were found at medium-risk level which needs to be investigated further and changed soon. A total of 2% of the workers are at high-risk level and require immediate change. These results reveal that low, medium and high categories of the risk levels exist in the job postures of jewellery making workers. Further investigation with an immediate change was recommended to most of these workers. [Table/Fig-8] also shows that none of the worker was at negligible risk level.

[Table/Fig-7]: Working postures adopted by the goldsmith workers at work.

RULA score	Action	n (%)
1-2	Acceptable posture	0 (0)
3-4	Further investigation, change may be needed	133 (44.3)
5-6	Further investigation, change soon	161 (53.7)
7+	Investigate and implement change	6 (2)

[Table/Fig-8]: Assignment of RULA scores according to position of body part.

Analysis of pinch strength measurement

The descriptions of dominant and non dominant hand tip to tip pinch strength, key pinch strength and three jaw chuck strength mean values for each age groups of goldsmith workers are shown in [Table/Fig-9].

Age (years)	Male				
	N	Hand*	Tip to tip pinch strength (Kg) Mean±SD	Key pinch strength (Kg) Mean±SD	Three jaw chuck strength (Kg) Mean±SD
20-24	42	D	5.1±1.4	7.7±1.7	6.7±1.8
		ND	4.4±1.4	6.8±1.6	6.1±1.7
25-29	27	D	5.5±1.5	7.5±1.1	7.9±1.7
		ND	4.6±1.1	6.7±1.1	7.1±1.6
30-34	30	D	6.4±1.8	8.1±1.1	7.6±1.9
		ND	5.6±1.7	7.0±1.1	6.7±1.7
35-39	36	D	5.9±1.2	7.6±1.05	7.3±1.4
		ND	4.9±1.2	6.8±1.02	6.6±1.4
40-45	165	D	5.4±1.4	7.6±1.4	6.7±1.3
		ND	4.7±1.3	6.7±1.4	6.0±1.3
Total	300	D	5.5±1.5	7.7±1.4	7.0±1.5
		ND	4.7±1.4	6.8±1.3	6.2±1.5

[Table/Fig-9]: Pinch strength data for goldsmith workers (Male) with mean and SD values.
D: Dominant hand; ND: Non-dominant hand; SD: Standard deviation; N: Number

Difference between pinch strength of goldsmith workers and normative value of Gujarati population are described in [Table/Fig-10].

Pinch strength	Hand	Goldsmith workers Mean±SD	Normal values Mean±SD	Z-value	p-value
Tip to tip pinch strength	D	5.5±1.5	6.5±1.6	-9.66	<0.001
	ND	4.7±1.4	6.1±1.5	-13.81	<0.001
Key pinch strength	D	7.7±1.4	8.2±1.7	-3.87	<0.001
	ND	6.8±1.3	7.9±1.6	-9.83	<0.001
Three jaw chuck strength	D	7.0±1.5	7.9±1.6	-9.09	<0.001
	ND	6.2±1.5	7.6±1.6	-12.84	<0.001

[Table/Fig-10]: Difference between pinch strength of goldsmith workers and normative value of Gujarati population (in Kilogram force).
*These normative values were determined by the author group as a part of another project, data on file
Statistical tests applied: Mann-Whitney U test for D and ND comparisons of goldsmith workers as well as normal values; p-values indicate statistical significance (<0.05)
D: Dominant hand; ND: Non-dominant hand; SD: Standard deviation

Mann-Whitney U test for comparing Tip to tip pinch strength of Goldsmith workers to normative data across age groups. p-values indicate statistically significant difference was found in all age groups with p value <0.05 except in age group of 30-34 years and 35-39 years dominant hand tip to tip pinch strength which shows p-value 0.32 and 0.18 respectively [Table/Fig-11].

Age category (years)	Hand	Goldsmith workers Mean±SD	Normal values Mean±SD	Z value	p-value
20-24	D	5.1 (1.4)	6.6 (1.8)	-4.94	<0.001
	ND	4.4 (1.4)	6.1 (1.6)	-5.38	<0.001
25-29	D	5.5 (1.5)	6.4 (1.5)	-3.15	0.001
	ND	4.6 (1.1)	6.0 (1.4)	-5.18	<0.001
30-34	D	6.4 (1.8)	6.7 (1.5)	-0.976	0.32
	ND	5.6 (1.7)	6.4 (1.5)	-2.63	0.001
35-39	D	5.9 (1.2)	6.3 (1.5)	-1.32	0.18
	ND	4.9 (1.2)	6.0 (1.4)	-4.13	<0.001
40-45	D	5.4 (1.4)	6.5 (1.7)	-7.46	<0.001
	ND	4.7 (1.3)	6.1 (1.6)	-9.99	<0.001

[Table/Fig-11]: Difference between Tip-to-tip pinch strength of goldsmith workers and normative value of Gujarati population (in Kilogram force).
*These normative values were determined by the author group as a part of another project, data on file

Mann-Whitney U test for comparing Key pinch strength of Goldsmith workers to normative data across age groups. p-values indicate statistically significant difference was found in all age groups of non-dominant hand with p value <0.05. Dominant hand key pinch strength values in the age group of 20-45 years were 0.18, 0.14, 0.45, 0.67 and 0.001 respectively [Table/Fig-12].

Age category (years)	Hand	Goldsmith workers Mean±SD	Normal values Mean±SD	Z value	p-value
20-24	D	7.7±1.7	8.2±1.7	-1.35	0.18
	ND	6.8±1.6	7.9±1.8	-3.39	<0.001
25-29	D	7.5±1.1	8.1±1.6	-1.46	0.14
	ND	6.7±1.1	7.7±1.6	-3.22	0.001
30-34	D	8.1±1.1	8.5±1.8	-.74	0.45
	ND	7.0±1.1	8.2±1.6	-3.61	<0.001
35-39	D	7.6±1.05	8.0±1.6	-.42	0.67
	ND	6.8±1.02	7.7±1.5	-2.87	0.001
40-45	D	7.6±1.4	8.1±1.7	-3.19	0.001
	ND	6.7±1.4	7.8±1.7	-6.83	<0.001

[Table/Fig-12]: Difference between Key pinch strength of goldsmith workers and normative value of Gujarati population (in Kilogram force).
*These normative values were determined by the author group as a part of another project, data on file

Statistical tests applied: Mann-Whitney U test for comparing three jaw chuck strength of Goldsmith workers to normative data across age groups. p-values indicate statistically significant difference was

found in all age groups with p-value <0.05 except in the age group of 25-29 years where the p-value for dominant and non-dominant hand was 0.65 and 0.08 respectively [Table/Fig-13].

Age category (years)	Hand	Goldsmith workers Mean±SD	Normal values Mean±SD	Z value	p-value
20-24	D	6.7±1.8	7.8±1.9	-3.46	<0.001
	ND	6.1±1.7	7.5±1.8	-4.46	<0.001
25-29	D	7.9±1.7	8.0±1.6	-.46	0.65
	ND	7.1±1.6	7.7±1.6	-1.74	0.08
30-34	D	7.6±1.9	8.3±1.6	-2.37	0.02
	ND	6.7±1.7	8.0±1.6	-3.58	<0.001
35-39	D	7.3±1.4	8.0±1.5	-2.76	0.001
	ND	6.6±1.4	7.8±1.5	-4.52	<0.001
40-45	D	6.7±1.3	7.7±1.5	-6.62	<0.001
	ND	6.0±1.3	6.1±1.6	-9.05	<0.001

[Table/Fig-13]: Difference between Three jaw chuck strength of goldsmith workers and normative value of Gujarati population (in Kilogram force).
*These normative values were determined by the author group as a part of another project, data on file

DISCUSSION

The results of this study revealed that the goldsmiths are engaged in prolonged forward bending posture in there working position. It was observed that in the small-scale industries ergonomics is hardly given preferences as they have to assume specific positions repeatedly for prolonged period for their work. Goldsmith workers were working six days per week for eight to 10 hours while maintaining static posture for about two hours continuously. Majority took a break only for one hour. This study was undertaken to evaluate ergonomic risk factor and pinch strength in goldsmith workers. A total 300 goldsmith workers in the age group of 20-45 years were recruited for the study. The result of present study showed that 44.3% of the workers were at low-risk level and change may be needed whereas 53.7% workers were found at medium-risk level which needs to be investigated further and changed soon. A 2% of the workers are at high-risk level and needs an investigate and change immediately.

Jukariya T and Singh S, conducted study on MSDs risk assessment among Goldsmiths by using RULA method. Concluded that the immediate implementation of ergonomics interventions with proper knowledge among workers and health education on common postural change, implementation and monitoring of laws among industries are recommended to take down morbidity due to MSDs [18]. The process of jewellery manufacturing is to be performed manually and with daily practice in order to make the work faster; thus, causing Repetitive Strain Injury (RSI) of workers [6]. Goldsmiths require high-level of precision, repetitive hand motions, forceful pinching and sustained wrist postures. Depending on the workload, workers may need to work eight hours at a time or split into several steps. The assembly process requires sitting for hours making quick repetitive movements and maintaining static hand positions, resulting in overuseand fatigue of the hands and fingers. Also, developing tools (pliers, cables, screw drivers, scissor) putstress on the hands and wrists, causing various MSDs suchas carpal tunnel syndrome, supinator syndrome, etc., [6].

Pinch strength measurements are frequently required to provide an outcome for hand injuries and operations [19]. The present study showed that tip to tip pinch strength, key pinch strength and three jaw chuck strength values were reduced in goldsmith workers as compared to normal values of population. Furthermore, there was a significant difference between tip-to-tip pinch strength, key pinch strength and three jaw chuck strength of goldsmith workers and normal values (p-value <0.05) Based on these results, it can be concluded that the nature of the goldsmith workers, which involves repetitive tasks and requires prolonged and high force exertion is the cause of this decrease.

The goldsmith work activity is always performed by the same hand, i.e., due to the precision required for the activity, automakers cannot switch hands during the performance of activities, use only the hand that has more skill. For making a medium necklace, are necessary 200 (two hundred) bent pins with a crystal stone, therefore, are conducted 200 (two hundred) cycles with 800 (eight hundred) of supination movements and 400 (four) movements of pronation of the forearm. They are made 3.75 (three-point seventy-five) cycles per minute, 225 (two hundred and twenty-five) cycles per hour and 1800 (one thousand eight hundred) cycles per eight (eight) hours. Since, the large number of movements made by the wrist joint in a workday [6].

The results of the present study were compatible with those of the study by Babar MA et al., reported that tip pinch strength was found weaker in comparison to the other grips in both dominant as well as non dominant hands of goldsmith workers. The possible hypothesis for this could be the use of tools such as pliers that demands for power grip, cuticle clippers and tweezers that requires palmar grip. Key pinch is required for holding the bases or the metal object required for soldering or holding the hammers [20]. Another study conducted by Singh AK et al., on measuring static muscular strength among female operatives a cross-sectional comparison in different handicraft occupations and concluded that the decrement in pinch grip strength was evident due to long-cycle repetitive pinching movements of the distal phalanx during hand knotting and pearl drilling [21]. Last but not least, the reduced pinch strength might be attributed to muscle fibers fatigue mechanism due to repetitiveness of the task [22]. Fatigue in slow twitching muscle fibres can be attributed to the accumulated lactic acid and poor microcirculation [23].

The implications of present study findings highlight the urgent need for ergonomic assessments and interventions in the goldsmith industry. Implementing training programs, promoting regular breaks and introducing ergonomic tools could reduce strain and improve worker comfort and productivity.

Future study could be done to monitor the long-term effects of ergonomic interventions on goldsmith workers. Investigate the effectiveness of specific ergonomic tools and techniques in reducing MSDs for valuable insights. Expand research to include other artisan occupations to develop comprehensive strategies for improving occupational health across similar industries.

Limitation(s)

This study was limited to goldsmith workers; hence, its outcome cannot be generalised for other occupations, age groups and genders. prevalence of work-related MSDs was not calculated. Further research is needed to check if a correlation exists between pinch strength and different anthropometric factors.

CONCLUSION(S)

The study concluded that the significant percentage of workers work in uncomfortable and painful postures. This was due to the lack of knowledge and awareness of ergonomics in small and medium-sized enterprises. The study recommends the immediate implementation of ergonomic measures with proper knowledge and health education of workers on general posture changes. It can be concluded that the monotonous work and high-precision work load of goldsmiths causes fatigue in workers. The percentage decrease in pinch strength was high due to long period of service and low efficiency of work.

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PARTICULARS OF CONTRIBUTORS:
1. PhD Scholar, Parul University, Vadodara, Gujarat, India; Lecturer, Department of Physiotherapy, Government Physiotherapy College and Government Spine Institute, Civil Hospital, Ahmedabad, Gujarat, India.
2. Dean and Principal, Faculty of Physiotherapy, Parul University, Parul Institute of Physiotherapy, Vadodara, Gujarat, India.
3. Principal, Government Physiotherapy College, Civil Hospital, Ahmedabad, Gujarat, India; Chairman, National Commission for Allied and Healthcare Profession (NCAHP), Delhi, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Minal Dhairya Bhavsar,
PhD Scholar, Parul University, Vadodara, Gujarat, India; Lecturer, Department of Physiotherapy, Government Physiotherapy College and Government Spine Institute, Civil Hospital, Ahmedabad, Gujarat, India.
E-mail: minal.vsn1982@gmail.com

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