

Muscular Stress of Grinding Dry Spices in Different Postures

Pushpinder Sandhu, Harshpinder Kaur and Harpinder Kaur

Department of Family Resource Management, PAU Ludhiana, Punjab, India

KEYWORDS Muscular Stresses. Hand Grip Strength. Manual Grinder. Unnatural Posture. Physical Exertion

ABSTRACT A study on muscular stresses (hand grip and arms) during manual grinding of dry spices in different postures was conducted on 10 female subjects. Electromyogram machine and grip dynamometer was used to measure the muscular stresses of arms and hand grip. Results of the study showed that there were maximum muscular stresses of arm (1.68mv) and hand grip (8.47% and 6.58%) when subjects did this activity in the squatting posture and minimum of muscular stresses were observed when subjects performed the activity of grinding of spices while sitting on *Pihri* (1.29 mv and 8.47% and 6.58% for right and left hands). The muscular stresses of arm areas and hand grip for other two selected postures viz. standing at counter level and sitting on *Patra* were found to be more as compared to left hand because of the reason that right hand was used more intensively during the selected activities. On the whole sitting posture on *Pihri* was assessed as the best posture for grinding spices because of minimum muscular stresses in this posture.

INTRODUCTION

Kitchen being heart of the household, home makers spend major chunk of their time there. Strenuous tasks like grinding spices are done in conventional method using manual grinders daily in most Indian homes. Thus the undue physical exertion causes muscular fatigue, particularly when poor and unnatural postures are used. Static muscular efforts and incorrect body postures during grinding can damage the intervertebral discs (Grandjean, 1973). Hence a need was felt to measure muscular stresses during grinding of spices in different body postures in view to suggest most suitable posture which can help in right use of muscles for grinding spices. The objectives of the study were:

1. To measure the muscular stress of arm and hand grip while grinding spices in different body postures.
2. To evaluate sitting and standing postures while grinding dry spices which causes minimum muscular stress.

METHODOLOGY

The selection of the subjects, procedure for grinding spices to be grounded were all based on the preliminary survey made in one of the village of Ludhiana District.

Selection of the Subjects, Work and Working Postures: Activity was performed by taking 10 female subjects of mean age 22.4 ± 0.5 years,

weight 50.3 ± 1.3 kg height $5'2.6'' \pm 0.6''$ and body surface area 1.50 ± 0.02 sqm. and had normal health.

Four commonly used postures viz: Squatting on ground; Sitting on *Patra* (6.5 cm high wooden stool); Sitting on *Pihri* (13 cms high wooden stool) and Standing at counter level (31.5 cms high) were selected for the present study. Activity involved grinding 250 gms turmeric for 20 minutes in *Imam Dasta* (manual grinder - an iron bowl with iron sotta) in to a fine powder.

Collection of Data: Subjects were familiarized with equipments and explained the procedure. Each experiment lasted for 20 minutes and 30 minutes rest was given before starting the next experiment. It was conducted twice on each subject for each posture.

Measurement of Arm's Muscular Stresses: Muscular activity of the Bicep muscle (muscle of the upper arm) was measured by using electromyographic technique in polyrite 11 Electronic myograph model, by applying jelly over skin surface, fitting plastic clutch bands on upper arm and right foot. Recordings were made at rest and working position. Muscular stress were measured by quantitative method of analysis. The absolute values obtained in millivolts (mv) were tabulated and given scores on the basis of highest level of muscular activity in descending order. The score range was I to H; H for the highest muscular activity and I for the minimum activity.

Measurement of Muscular Stress of Hand Grip: The grip strength of both the hands was measured with the help of grip dynamometer. The subject was asked to pull the grip handle with

right and left hands and readings were noted at rest and during activity. The grip stresses were calculated in terms of percentage reduction in grip strength (grip stresses) during work (SW) from grip strength during rest (Sr)

$$\text{Percentage reduction of grip strength} = \frac{\text{Sr} - \text{SW}}{\text{Sr}} \times 100$$

Statistical Analysis of Experimental Data:

Analysis of variance (ANOVA) test was used to test the significance of differences. Calculated value of variance ratio 'F' was compared with corresponding table value. The critical difference was also calculated with the following formula:

$$\text{C.D.} = 2 \times \text{Error mean sum of square} \times t \text{ value at } 0.05/0.01 \text{ level} / \sqrt{\text{No. of replications}}$$

RESULTS AND DISCUSSIONS

Muscular Stresses of Arms: The minimum arm's muscular stresses was observed while grinding spices (wet) by sitting on *Pihri* (1.29 mv) and maximum arm's muscular stresses was found while grinding spices in squatting posture

Table 1: Mean values of arm's muscular stresses (mv) and percentage decrease in grip muscular strength in different selected postures during wet grinding of spices.

Muscular stresses	Squatting on ground	Sitting on Patra	Sitting on Pihri	Standing at counter level
Arm's muscular stresses (mv)	1.68	1.39	1.29	1.51
Mean percentage decrease in grip muscular strength				
Rest = 100,				
Right hand	24.69	13.86	8.47	16.20
Left hand	22.14	11.96	6.58	13.40

(1.68 mv) as shown in Table 1.

ANOVA test (Table 2) values indicated that there was highly significant differences between all the selected postures. This reveals that the muscle had to work more while grinding spices in squatting posture and the less while sitting on *Pihri*. These findings are in agreement with the findings of Sandhu et al (1991) who also reported that muscles are least active while grinding dry spices by sitting on *Pihri* and most active while squatting on ground. This might be due to more sustained contraction of deltoid muscles of the upper arm during squatting posture, which further restricts the blood flow of these muscles leading to increase in CO₂ accumulation and muscular fatigue. Atzler (1927) also reported that the sustained muscular contraction had the tendency to restrict the venous blood flow and might contribute to fatigue. The procedure of grinding dry spices which included brisk up and down movement of arms while grinding the spices with sotta (both at squatting posture and standing at counter level resulting in over stress and loss rhythmic contraction and relaxation of muscles whereas in upright posture like grinding while sitting on *Pihri* and *Patra*, the fatigue was less. Oberoi et al. (1987) also reported the same findings during their study. Basmajian (1962) observed that fatigue of standing was not due to muscular stresses because muscular activity in standing was slight or moderate; but due to effect on circulation and pain arising from pressure on ligaments, joint capsules and tendons.

Stresses on Grip Muscles: The values of mean percent decrease of the muscular strength of both the hands indicated that the minimum muscular stresses occurred while grinding dry spices in sitting posture on *Pihri* (8.47, 6.58). Analysis of

Table 2: Analysis of variance of arm's muscular stresses of arms and hand grip during wet grinding of spices.

Muscular stresses	Source of variation	D.F.	S.S.	M.S.S.	F ratio
Muscular stresses of arms	Between posture	4	18.14	4.533	94.47**
	Within posture	45	2.17	0.048	
	Total	49	20.31	-	-
Right hand grip stresses	Between posture	4	3366.560	841.64	105.86**
	Within posture	45	357.843		
	Total	49	3724.403	-	-
Left hand grip stresses	Between posture	4	2711.4971	677.87	103.96**
	Within posture	45	293.7585	6.52	
	Total	49	3005.2556	-	-

** Significant at 0.01;

C.D. = 0.12 at P < 0.05 and 0.16 < 0.01

Table 3: Comparative evaluation of all the selected postures grinding of spices with respect of muscular stresses

Muscular stresses	Body postures				Critical difference	
	Sitting on Pihri	Sitting on Patra	Standing at counter	Squatting on ground	At 5% level	At 1% level
Arm's muscular stresses (mv)	1.29	1.39	1.51	1.68	0.13	0.18
Grip Muscular Stresses						
Right hand (kg.)	8.47	13.86	16.20	24.69	1.80	2.39
Left hand	0.58	11.96	13.40	22.14	1.63	2.17

The line joining the values shows non significant differences.

variance technique has shown that the difference in percent decrease of muscular stresses for both hands was found to be statistically significant (Table 2).

Table 1 also showed that the percent decrease in grip strength of right handes was more because subjects were right handers. Maximum percent decrease in grip strength of both hands occurred when grinding at squatting posture (2.68, 22.14). It may be due to more stress and static contraction of grip muscles with bending back. Smith and Smith (1962) also reported that fatigue from static work is 3 to 6 times as great as from lifting.

The decrease in grip strength of both the hands was more while grinding spices by standing at counter level as compared to sitting on *Pihri*. This decrease might be due to the standing posture where the grinding is done by up and down movements of hands which might have put more stress and physical exertion to the grip muscles. The same has been reported by Oberoi (1982) and Dhillon (1983).

Comparative Evaluation of Best Posture: On the basis of arm and grip muscular stresses it was observed that the best posture causing minimum of muscular stress was sitting on *Pihri* (Table 3). It averaged significantly lower values for right and left hand grip muscles and muscular stresses when compared with the posture like sitting on *Patra*, standing at counter level and squatting on ground. Hence only sitting on *Pihri* was found to be best posture among all the other selected postures because it caused minimum muscular stress.

CONCLUSIONS

1. Maximum of arm muscular stresses was observed in squatting posture (1.68mv and minimum at posture of sitting on *Pihri* (1.29 mv).
2. Arms and grip muscular stresses were

significantly low while sitting on *Pihri* as compared to other postures.

3. Maximum of grip muscular stresses of both hands was observed at squatting posture (24.67 per cent, 22.14 percent) and minimum for the sitting posture on *Pihri* (8.49 per cent, 6.58 percent).
4. Squatting posture had significantly higher muscular stresses as compared to the postures of sitting on *Pihri*, sitting on *Patra* and standing at counter level while dry grinding.
5. Mean percent decrease of right hand was found to be more as compared to the left hand.
6. Comparative evaluation of all the selected postures revealed that sitting posture on *Pihri* is the best suitable posture for grinding dry spices because it is least taxing to the muscles as compared to other postures.
7. Squatting posture is rated most taxing to the muscles for dry grinding.

REFERENCES

- Atzler, E.: *Body and Work* (translation from *Korper und Arbeit*), George Thieme, Leipzig, Germany: 486. (1927).
- Basmajian, J.V.: *Muscle Alive: Their Functions Revealed by Electromyography*. Williams and Wilkins, Baltimore, pp.48-98 (1962).
- Dhillon, M.K.: *Comparative Study of Physiological Costs in Different Postures of Dish Washing*, Ph.D Dissertation, Punjab Agri. Univ. Ludhiana (1982).
- Grandjean, E.: *Ergonomics of the Home*, Toylor and Francis Ltd London :15-35 (1973).
- Oberoi et al: Ergonomic assessment of household activities. *J. Maharashtra Agri. Univ.*, **12**: 364-366 (1987).
- Sandhu et al. An Ergonomic study of muscular fatigue during manual grinding of spices in different postures. *J. Res.Punjab Agri. Univ.*, **20**: 298-304 (1991).
- Smith, K.U. and W.H. Smith: *Perception and Motion (An Analysis of Space Structured Behaviour)* W.B.Waunder & Co., Philadelphia, pp. 2-7 (1962).