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Ergonomic health evaluation of bead products making women using discomfort ratings

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Abstract

Bead production of different kinds of woods is done on large scale in Mangali village of Hisar district Haryana. The production process involves major role of men while the stringing and finishing of products involve women participation at household level. Apart from stringing which is already done on string makers, women are involved in adding *3-eyed Guru bead* with *Tassel* to 108 beaded strings which earns them a low cost at high discomfort because of sitting and performing activities on floor for longer hours. Existing work pattern on 10 women respondents was analyzed through body part discomfort score (BPDS) and overall discomfort rating method (ODR). It was found that the mean BPDS was found to be extremely uncomfortable (4.1) to moderately uncomfortable for 3-eyed bead adding, highly uncomfortable (3.9) to moderately uncomfortable on workstation table (2.4) in tassel making activity while it was extremely uncomfortable (4.1) to lightly uncomfortable (2.4) in other bead products making activity. According to ODR, the comparison with 3-eyed Guru bead is heavy discomfort (8.7) on floor to slightly more than moderate discomfort (6.8) on table, that tassel making activity was moderately uncomfortable (5.0) on table and more than moderately uncomfortable (6.2) on floor. Bead products other than former activities caused extreme discomfort (9.1) to light discomfort to body (3.6) on prototype. The study proposed the efficient output of the workstation table prototype while working with three different kinds of activities to avoid discomforts to various body parts and for saving body parts' energy of women for other household works even after these works. More efficiency can be brought about with slight modifications of prototype according to the recommendations of respondents.

Keywords: Prototype workstation table, discomfort scores, bead product activities, BPDS, ODR, etc

1. Introduction

Wood beads of various wood materials and different designs, colors, sizes and textures are produced/ manufactured at a village Mangali in Hisar district of Haryana. Majority of the habitants are working for over decades on their production and then sell it to other outside places by middlemen which then are used for various utilities like for sacred or decorative or accessories functions. These beads are mainly sold in form of strings of 108 beads each made by the village women. These women get only 1 INR per string along with another 1 INR for adding *3-eyed Guru bead* with *Tassel* to a string. These strings are made in form of bundles of 20 strings each. These bead products are formed by women while sitting on floor or small cushion called *pidi* and keep stringing or making products for hours and hours making long strings which are later cut by another women. A prior survey of residents involved in bead production and its products is done regarding gender participation in which it is found that majority of men and less no of women are involved in wood procurement and bead production while almost all string making works are done by women (Gandhi *et al*). Beads are either owned by these women or they make them at labor wages.

The workplace intervention is done for the women involved in string (mala) cutting, 3-eyed guru bead adding to strings and tassels making so that their drudgery and work hazards can be reduced. (Promila *et al*) in her study suggested the need to improve the workstation as well as the working environment as these work hazards were due to improper work station with low height and unorganized work place. For string making already a string maker has been developed by Family Resource Management Department of Home Science College of CCSHAU, Hisar. Now a workstation table is designed for the village women so that they can work over it to reduce the physical discomfort faced during doing the similar works while sitting on floor. The main purpose of the intervention is to decrease discomfort and increase efficiency of bead product makers.

Also other products of beads are prepared by training women are made by making them work on the table. The prototype table is tested among 10 string making women so that it can be designed for future training of bead products on large scale. The discomfort ratings are measured before and after the use of table so that their results can be compared.

To determine the discomfort levels two different methods were used which were overall discomfort rating method (ODR) and body part discomfort score (BPDS). Overall Discomfort Rating (ODR) was taken on a 10point psychophysical scale (0= no discomfort, 10= extreme discomfort) which is an adoption of Corlett & Bishop (1976) technique. It consisted of a 70 cm long graduated scale (fig 2) with its left side marked as 0 and it's and right ends with 10. A sliding pointer was provided on the scale to mark the level of discomfort. At the end of each trial, subjects were asked to mark their overall discomfort rating on the scale.

For identifying the body part discomfort score (BPDS) human body is divided into 12 main regions especially according to the women workers. Each subject was asked to explain to discomfort of these body parts (Sam and Kathirvel, 2008). The number of different groups of body parts which are identified from extreme discomfort (10) to no discomfort (0) represented the number of intensity levels of pain experienced. The total score for each trial was the sum of all individual scores of the body parts assigned by the operator scale. Meyer and Radwin (2007) [4] used body part discomfort score (BPDS) to find difference in body strain at stoop and prone postures for a simulated agricultural harvesting task. They found that body part discomfort score of working stoop posture is higher than working in prone posture.

Vyas (2012) [7] in his study had proposed the gender difference in prevalence of upper extremity musculoskeletal symptoms among farmers. By using overall discomfort scores (ODR) he tried to reveal Symptoms in the wrists and hands such as numbness, reduced muscle strength, aching fingers and wrists, and tendency to drop things were significantly more common among the women than the men.

Based on the above matter of fact the following objectives of the research were devised:

1. To conduct an analysis of different activities and drudgery caused to women by these activities in various postures and repetitive movements.
2. To evaluate the workstation table in real working conditions among rural women workers.
3. To estimate the effect and output of the workstation table by comparing discomfort scores of respondents before and after working on the table.

2. Material and Methods

10 women workers who were healthy and with no physical ailment were selected carrying the similar work experience for at least more than 5 years. For the current study Mangali Village (Mohabbat) of Hisar District, Haryana in India was taken. The BMI score of all these 10 women was taken to be nearly normal (table 1). Women workers were surveyed in 2

conditions, firstly when doing the work by traditional method and again when doing the similar work on workstation table. Daytime was selected for the activities to avoid any strain due to natural environment in their regular working place in homes which is supposed to be an open or wide area with sufficient lighting. 15 minutes break was taken y the workers to start for the new sitting and a total of 2 sittings were taken record of for both traditional and modified method. The BPDS was rated for 12 body parts (Body Map fig 1) and pre-test and post-test recordings were calculated on a 5 point continuum basis (table 2). The ODR scoring for body parts was made in 2 sittings for a task individually and based on the data perceived exertion rating was rated. Subjects were asked to mark the visual analogue discomfort (VAD) scale (fig. 2) after doing the work (table 3). The evaluation of the ergonomic workstation table was done y comparing the traditional and modified working conditions scores and results were formulated. The given workstation table was provided to the respondents to work upon for half day and to devise their conclusions regarding discomfort levels in comparison to floor level.

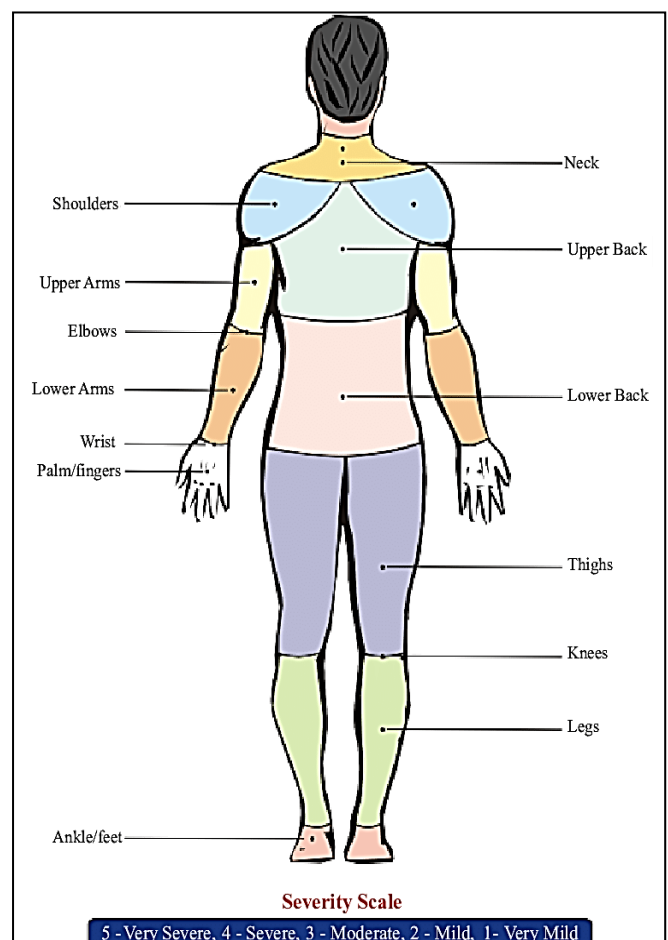


Fig 1: Body Map for Body Parts Discomfort Score

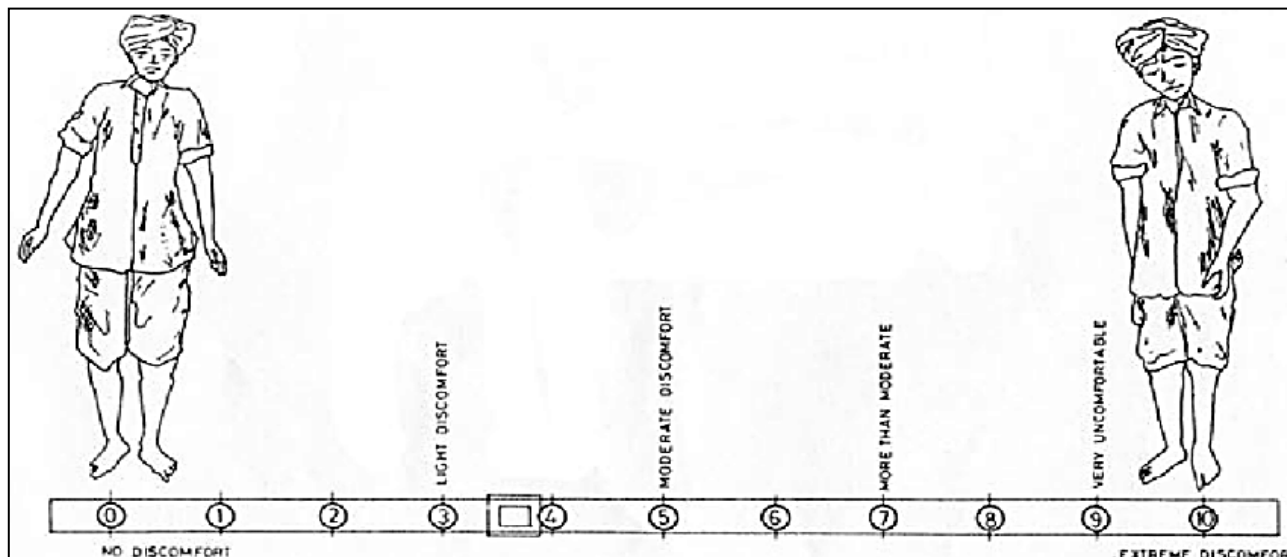


Fig 2: Visual Analogue Discomfort Scale for Overall Discomfort Rating

3. Results and Discussions

3.1 Physical Characteristics of Respondents

10 women respondents of work experience more than or equal to 5 years were taken to evaluate the ergonomic workstation table. Women of age group 21- 45 years were taken for the experiment. The mean age of 10 respondents was found to be 32.2 years and average height of women workers was found to be 153.5cm under the range of selected women heights. 47.6 kg was average weight of women respondents giving the mean BMI as 20.1 which is considered as normal and all the

women were having healthy Body Mass Index individually. Physical characteristics of respondents are given in table 1 below.

Table 1: Physical characteristics of village respondents: N=10

Physical characteristics	Range	Mean scores
Age	21-45	32.2 years
Height (cm)	141-180	47.6 kg
Weight (kg)	40-70	153.5 cm
BMI	18.9-26.3	20.1

Table 2: Mean Body Part Discomfort Scores of respondents for all body parts before and after workstation table: N=10

S. No	Body Parts	3-Eyed Bead Adding		Tassel Making		Other Bead Products	
		Before	After	Before	After	Before	After
1	Eyes	4.2	2.6	3.9	2.1	4.1	1.1
2	Neck	4.9	2.3	4.7	1.5	5	1.4
3	Shoulder	4.5	2.9	4.1	1.9	4.6	2.1
4	Upper arm	3.3	2.8	3.1	3.0	3.7	3.4
5	Elbow	4.3	3.6	4.1	3.1	3.5	3.6
6	Lower arm	3.9	3.7	3.5	3.1	2.9	3.1
7	Wrist	3.4	3.1	4.2	1.1	4.2	2.9
8	Fingers/palm	4.8	3.9	4.6	0.9	4.9	3.5
9	Upper back	5.0	2.3	4.4	1.5	4.8	1.1
10	Lower back	4.7	3.3	4.2	3.5	4.6	0.3
11	Thighs/knees	3.1	3.6	3.1	3.0	3.1	2.6
12	Ankle/feet	3.4	3.5	3.4	3.5	4.1	3.6
Mean score		4.1	3.2	3.9	2.4	4.1	2.4

Distribution of BPDS: 0-1=No Discomfort, <1-2=Light Discomfort, <2-3=Moderate Discomfort <3-4= High Discomfort <4-5=Extreme Discomfort.

3.2 Body Part Discomfort Scores (BPDS) of respondents for all body parts

Mean Body Parts Discomfort Scores of respondents are taken for 12 main regions of body most prone to musculo-skeletal discomfort while working by sitting on floor. The biggest difference discomfort is seen when women are making additional products of beads in which they found moderate discomfort while working on workstation table (2) in comparison of extreme discomfort faced while sitting on floor (4.1). The reasons for this may be the minute detailing works that takes extra strenuous effort in concentrating and bending while working on floor which gets easier when they work on

eye level on table. This pooled mean scoring is followed by high discomfort on floor (3.9) to moderate discomfort on workstation table (2) in tassel making activity while it reduces from extreme discomfort on floor (4.1) in Guru bead adding activity to moderate discomfort over workstation table (2). In a bigger picture, the workstation table is reducing discomfort scores hence can be a good substitute to traditional method of bead products construction by women with a few alterations. Neck, shoulder and upper back are benefitted the most in all the three activities as the table is preventing these body parts from bending down to floor for long hours along with eyes except the eyes need protection from needles and dangerous tools and equipments at this height. Elbow and lower arm are at rest but need a little less height of the table so they can rest comfortably over it so that fingers also can work efficiently also they need a friction causing

surface to stop beads from rolling down.

Thighs/knees are at more discomfort as the workers had to keep folding their feet for long hours which caused moderate discomfort (3.6).

3.3 Overall Discomfort Rating (ODR) of Respondents

It was reported in subjective form and was self-reported on the basis of estimations made to discomfort level perceived by the respondents. The respondent women were assessed to take knowledge of overall discomfort using 10 point VAD scale. Table 3.1 and 3.2 under section Table 3 depict the mean scores of Overall Discomfort Rating (ODR) of respondents under selected activities.

Table 3: Overall Discomfort Rating (ODR) of Respondents N=10

Table 3.1: Working traditionally

Activity	Mean scores	Discomfort rating
3-eyed Guru bead adding	8.7	Heavy Discomfort
Tassel making	6.2	More than Moderate Discomfort
Other bead products making	9.1	Extreme Discomfort

Table 3.2: Working on workstation table

Activity	Mean scores	Discomfort rating
3-eyed Guru bead adding	6.8	More than Moderate Discomfort
Tassel making	5.0	Moderate Discomfort
Other bead products making	3.6	Light Discomfort

Distribution of ODR: 0=No Discomfort, 1-3=Light Discomfort, <3-5=Moderate Discomfort, <5-7= More than Moderate Discomfort, <7-9=Heavy Discomfort, <9-10=Extreme Discomfort.

The ODR gives the fact that the mean discomfort scores of working on workstation table have been decreased gradually causing overall comfort to the body of the workers in comparison to working on floor. The activity with 3-eyed Guru bead has reduced heavy discomfort (8.7) to slightly more than moderate discomfort (6.8) where rolling down of beads because of lack of friction and barrier has been a reason. Tassel making activity has also been comfortable on workstation table (5.0) as moderately uncomfortable from previous more than moderately uncomfortable (6.2) on floor. This does not need barrier or rough surface hence is comfortable on table more than former activity. Bead products other than former activities are highly recommended on workstation table as according to the study, they reduced extreme discomfort (9.1) to light discomfort to body (3.6) because of minute detailing of work which are better done at eye level as well as straight back.

4. Conclusion

The study indicates towards the efficient output of the workstation table while working with three different kinds of activities. The variations of discomfort scores from BPDS scale and ODR scale suggests number of advantages as well as disadvantages of the workstation table. But the disadvantages are technical shortcomings which can be easily fixed like thigh clearance, knee clearance, correct height of table but the advantages are so vast which can be very beneficial for women workers so their work doesn't hinder their health.

These activities involve whole upper body and buttocks to sit

for hours. Neck and shoulders are affected badly while sitting and keep looking down to the floor. The cushion/ *pidi* only make distance between the floor and eyes more far. When women get up from their places after working for long hours they suffer severe pain in these body parts especially in upper and lower back because of continuous bending. Women are the backbone of the family these activities, though important for their empowerment should not anyway disturb their life making any compromises towards health. The other household works only make the pains more severe.

The prototype developed should be safe and time saving for women which are their basic requirements. The ergonomic wellness is another urgency which can't be ignored as it should be able to cure previous strains or at least prevent future discomforts. The product should also be self repairable and self-maintained by workers in near future. The workstation table is user friendly in nature to respondents as it is decreasing their discomforts to a greater extent. It is efficient to save time and save health for women. Both money and wealth are targeted at once through this prototype. The modifications in the product according to respondents' reviews and discomfort levels shall be done to the prototype so that future product trainings can be given to women on a larger scale. Also methods need to be sought so that it can be made available to each worker in the same field. More income needs much better workstation where this workstation table is creating an onset to ergonomic awareness towards workers. Now they know that the same work they are doing for years can be done in an efficient and easier manner.

5. Recommendations

Based on the above study the following recommendations can be proposed which are devised after the work experience in same conditions and after the discussion with respondents:

- The chemical and physiological discomforts can also be taken and accordingly the PPE such as face mask, eye mask or thimbles can be added to the prototype.
- The height of the table shall be made adjustable and flexible for all ranges of respondents taking into consideration the maximum and minimum percentile.
- Thigh and clearance should be given space.
- The surface of the table should be rough or with holders and barriers to prevent beads from rolling down.
- The reduction in weight can make the table easily portable for women.
- More precise and accurate data in working environment with other techniques can give exact recommendations to improve the prototype.
- Provision of chair with the workstation table shall be added or designed accordingly for much drudgery reduction.

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