

Ergonomic assessment of washing clothes on washing centers with different heights

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ABSTRACT

To assess the physiological cost of washing clothes a survey of 30 households and 30 homemakers from Parbhani city was carried out. The selected static and dynamic measurements of 30 homemakers were recorded. Existing washing method of respondents was observed and improvements in terms of dimensions of workplace and equipment centers were suggested to rectify the postural alignment of respondents. The improved and existing washing centers were compared in terms of the physiological cost of washing clothes. Findings of the study indicated the range of 20-30 cm in anthropometric measurements of women. Majority of women were spending 45 minutes on washing and adopting bending and squatting posture while washing clothes. The work centre below 3 inches than waist height proved better for quality and physiological cost of washing clothes.

Key Words : Physiological cost, Work center, Washing clothes

INTRODUCTION

The Indian homemaker spent 40 per cent of the day on household activities. These activities include cooking, washing utensils, washing clothes and cleaning house. Among these household tasks the most drudgery prone are washing clothes and mopping floor. Due to repetitiveness of the task and postural bending the task of washing was proved as a tiring job for most of the women. (Educational planning group, 1993). If the method of work as well as the work centers are improved it is possible to reduce the drudgery of the tasks and increase the production. The desired effect can be achieved by making changes some times in work method, sometimes in equipment or sometimes in work centers and work environment (Limaye and Munshi, 1994). In present study the attempt has been made to study the task of washing clothes with specific objectives

- To study the existing washing method followed by homemakers.
- To study the details of washing centres existing in selected houses.
- To assess the physiological cost of washing clothes on washing centers with different heights

METHODOLOGY

Survey of 30 households and 30 homemakers from Parbhani city was carried out to assess

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physiological cost of washing clothes. The selected static and dynamic measurements of 30 homemakers were recorded. Existing washing method of respondents was observed and improvements in terms of dimensions of workplace and equipment centres were suggested to rectify the postural alignment of respondents. The existing and improved method was compared in terms of facilities, postural alignment and ergonomical assessment. Physiological cost of washing clothes was assessed by using formula given by Varghese *et al.* (1994)

RESULTS AND DISCUSSION

The selected anthropometric measurements of homemakers in standing and squatting position were recorded and presented in Table 1. It is clear from the table that mean normal standing height, elbow height, mid shoulder height, waist height and span of selected homemakers were recorded as 155.7 cm, 98.4 cm, 127.9 cm, 95.2 cm and 155.7 cm respectively. Arm reach height of homemakers in standing position at upper, mid and lower position was found to be 164.8 cm, 122.3cm and 63.6 cm respectively. Arm reach length measurements in standing position at upper, mid and lower positions were recorded as 63.3, 60.7 and 59.9 cm respectively. Maximum forward arm reach in squatting position was recorded as 87.7cm whereas side arm reaches for left and right hand in squatting position was same (67.2 cm).

General information on existing method of washing clothes is presented in Table 2. It is clear from the table that majority of the homemakers spent 45 minutes in washing clothes (60%) followed by 30 minutes (33.33%). Very few homemakers were spending 1hour in washing clothes (6.67 %). With reference to the homemaker's posture while washing, it was reported that majority of the homemakers used the combination of bending and squatting posture (63.33%) while washing clothes. On the other hand few homemakers reported combination of bending and standing posture (16.67%) for washing clothes. Squatting posture was used by 20 per cent homemakers while washing clothes.

Information on type of washing zone and facilities provided in washing centre is presented in Table 3. It is evidenced from the table that in majority of the houses there was no facility for storing cleansing material and cleaned clothes (80%). Provision of wooden plank for the storing the washed clothes and cleansing material was noticed in 13.33 per cent houses. Open shelf was provided for the

| Table 1 : Anthropometric measurements of homemakers in standing and squatting posture | | |
|--|--------------------------------|------------|
| Anthropometric variables | Measurements (cms) Mean±S.D | Range |
| Stature | 155.7 ± 9.70 | 146 - 166 |
| Elbow height | 98.4 ± 6.77 | 80 - 110 |
| Mid shoulder height | 127.9 ± 6.55 | 117 - 137 |
| Waist height | 95.2 ± 6.77 | 78 - 105 |
| Span | 155.7 ± 6.66 | 146 -163.5 |
| Upper position arm reach height | 164.8 ± 9.65 | 150 -177 |
| Mid position arm reach height | 122.3±15.28 | 62 -140 |
| Lower position arm reach height | 63.6 ± 14.24 | 50 -100 |
| Upper position arm reach length | 63.3 ±21.5 | 39 -110 |
| Mid position arm reach length | 60.75± 9.8 | 51- 81 |
| Lower position arm reach length | 59.9± 19.3 | 52 -82.5 |
| Maximum forward arm reach squatting | 87.7 ±5.64 | 81 96 |
| Squatting side arm reach of left hand | 67.2±9.26 | 67 74 |
| Squatting side arm reach of right hand | 67.2 ± 9.26 | 67 74 |

storage of cleansing material and clothes in very few houses (6.67%). Washing centre was situated in open space in majority of houses (76.67%), where as sheltered /shaded work place was provided for washing clothes in 23.33 per cent of houses. Fixed stone was observed in 33.33 per cent houses whereas in 53.33 per cent houses the mobile stone placed at particular space was used for washing clothes. Very few houses were not having any stone for washing clothes (13.33%). All the houses had tap facility as source of water for washing clothes.

The washing zone *i.e.* stone was modified in terms of postural alignment of homemaker and cleaning quality of clothes and presented in Table 4. It is clear from the table that mean values for working angle of homemakers at Lumbar and Cervical region was observed to be lowest when washing clothes was carried out on stone of waist height (185 and 187). It was found that the lowest height of washing stone *i.e.* 5” below waist line increased the working angle of homemakers at lumbar and cervical region. Cleaning quality of the clothes washed on lowest stone 5” below waist line was best followed by the stone 3” lower than the waist height. Washing quality of clothes was lowest when washed on the stone of waist height.

Results of physiological workload of washing clothes on different washing centers is presented in Table 5. It is apparent from the table that the average peak heart rate (132), average working heartrate (112) and physiological cost of work (36), total cardiac cost of work (546.66), energy expenditure(9.08)

| Table 2 : Information of existing method of washing clothes | |
|--|--|
| Attributes | Frequency and percentage of homemakers |
| Time spent for washing clothes (minutes) | |
| 30 | 10 (33.33) |
| 45 | 18 (60) |
| 60 | 2 (6.67) |
| Posture adopted while washing clothes | |
| Bending and standing | 5 (16.67) |
| Squatting | 6 (20) |
| Combination of bending and squatting | 19 (63.33) |

Figures in parentheses indicate percentages

| Table 3 : Information regarding existing washing centres | |
|---|------------------------------------|
| Attributes of washing clothes | Frequency and percentage of houses |
| Facility for storing material | |
| No facility | 24 (80) |
| Open shelf | 02 (6.67) |
| Wooden plank | 04 (13.33) |
| Situation of washing zone | |
| Open | 23 (76.67) |
| Shade | 07 (23.33) |
| Type of washing zone | |
| Fixed stone | 10 (33.33) |
| Mobile stone | 16 (53.33) |
| No stone | 04 (13.33) |
| Type of water source | |
| Tap | 30 (100) |

Figures in parentheses indicate percentages

| Work centre height | Working angle of body region | | Quality perception |
|----------------------------------|------------------------------|-------------|--------------------|
| | Lumbar | Cervical | |
| Equal to waist height | 185 ± 12.04 | 187 ± 13.10 | 2.11 ± 0.5 |
| 3 inches lower than waist height | 192 ± 20.82 | 190 ± 11.0 | 2.98 ± 0.7 |
| 5 inches lower than waist height | 201 ± 17.52 | 198 ± 9.0 | 3.00 ± 0.25 |

| Physiological parameter | Washing centers at | | | 'F' value |
|---------------------------------|--------------------|----------------------------|----------------------------|-----------|
| | Waist height | 3" lower than waist height | 5" lower than waist height | |
| Resting heart rate (bpm) | 77±3 | 77±3 | 77±3 | -- |
| Working heart rate (bpm) | 103±6 | 104±5 | 112±6 | 12.2** |
| Recovery heart rate (bpm) | 82±4 | 84±5 | 81±4 | 1.8NS |
| Peak heart rate (bpm) | 125±6 | 123±5 | 132±6 | 13.1** |
| Physiological cost of work | 26±5 | 32±4 | 36±4 | 12** |
| Total cardiac cost of work | 520±15 | 535±18 | 546.66±16 | 18.03** |
| Energy expenditure (kj) | 7.65±2.3 | 7.81±3.5 | 9.08±2.2 | 2.8NS |
| Average peak energy expenditure | 11.15±3 | 11.83±2 | 12.26±3 | 2.9NS |

NS=Non-significant ** Significant at 1 per cent level

and average peak energy expenditure (12.26) were highest when the washing was carried out on the stone 5" lower than waist height of worker. Though the values for majority of physiological parameters were higher when clothes were washed on washing zone 3" lower than waist height when compared to waist height washing zone but these values were lower as compared to washing zone of low height, i.e. 5" lower than waist height and quality of washed clothes was better with wash centre below 3" waist height of women. Statistical analysis revealed significant variations in working heart rate (F=12.2**), peak heart rate (F=13.1**), physiological cost (F= 12**) and total cardiac cost (F=18.03**) when the task of washing was carried out on washing stones at different heights.

Conclusion :

On the basis of findings of the study and discussions with subjects involved in activity of washing clothes it can be concluded that the height of washing stone should be 3" below waist height of worker to improve the postural alignment of homemakers and maintain cleaning quality of clothes. Dimensions of washing centre should be in relation to comfortable reach measurements of worker to reduce muscular strain. Adoption of sitting posture in between for selected washing activities will reduce drudgery and physiological cost of washing clothes.

Adequate and accessible facility for storage of cleansing material will help to minimise the strain of body and vision.

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