

Reduction in Energy Costs of Doing Selected Household Work by Using Efficient Gadgets and Applying Ergonomics in Homes

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Household work now a days has become very strenuous and consumes 2700 k. cals to 2800 k. cals of energy in every day and it can be compared with any hard occupation outside the home in terms of energy costs and time utilization. However the use of efficient equipment in the home not only conserves the time and energy in performing housework but also improves the quality of product makes the tasks pleasant and its ownership enhances the prestige of household as reported by Richardson et al. (1985). As put forth by Grandjean (1973) energy costs of household work can rise up to 3.0-4.0 k. cals/sq.m/min if wrong posture is adopted for long time during work. On the other hand, a good working posture reduces the energy costs of work and fatigue to the minimum (Steidle and Bratton, 1968).

A need was felt to assess the human energy cost of doing household work and work out extent of energy saving pattern while performing household work in most comfortable posture which consumes minimum energy and by using selected time and labour saving devices in the kitchen. Hence the present study was conducted to assess the extent of human energy saved with the use of some selected time and energy saving kitchen devices, and to examine the human energy saving pattern while doing the household work in the posture which are least fatiguing.

METHODOLOGY

Twenty-four females having the same mean height, weight, age and body surface area, were selected for the study. They were asked to perform the given work first with the use of traditional devices than with the selected kitchen devices. Details of selected devices, activities performed and quantum of work done are given in table 1.

To evaluate the least fatiguing postures while doing housework, a group of 6 subjects each were given selected activity to perform in usual way and later on in modified way for 15 minutes as shown in table 2.

Subjects were given enough practice to breathe through mouthpiece of douglas bag. They came in comfortable dress, relaxed mood and got familiar with the procedure before starting the experiment, which lasted for 15 minutes and was repeated thrice with a pause of 30 minutes rest between each experiment. Mouthpiece was tied on the mouth with the help of elastic band to avoid any leakage of exhaled air. Subject respired through the mouthpiece for 5 minutes at rest, and than again for 5 minutes during activity just 5 minutes after the start of the activity. A representative sample of exhaled air during rest and activity was collected separately in 100-ml rubber bellows. This sample was analyzed within one hour after the collection of sample. Energy

Table 1: Selected devices, activities and the quantum of work done

<i>Time and energy saving devices</i>	<i>Traditional devices</i>	<i>Activities performed</i>	<i>Quantum of work done</i>
Saag cutting machine	<i>Datti</i>	Cutting <i>saag</i>	175 gms
Mixer grinder	<i>Kundi sota</i>	Grinding <i>masala</i>	100 gms
Onion chopper	Knife	Chopping onions	100 gms
Lemon squeezer	Hand squeezing	Lime squeezing	2 lemons
Vegetable peeler	Knife	Peeling vegetables	500 gms
Chopping Board	Knife	Chopping spinach	100 gms
Egg beater	Spoon	Beating eggs	2 eggs
Electric	Non-electric	Preparing	4 bread
Sandwich maker	sandwich maker	sandwich	slices
Electric juicer	Non-electric juicer	Extracting juice	4 oranges
Pressure cooker	<i>Patila</i>	Cooking <i>Dal</i>	150 gms

Table 2: Selected activities, quantum of work, posture and counter heights

Activities	Quantum of work	Adopted method	
		Usual way	Modified way
Washing Clothes	3 gents shirts, 3 ladies shirts, 2 towels 2 kitchen napkins, children clothes	Squatting on ground	Sitting on 6.5 cms high wooden stool (<i>Patra</i>)
Churning milk	5 litres curd hand churned	Squatting on ground	Sitting on 6.5 high wooden stool
Washing dishes	5 soiled Plates, glasses, <i>Katories</i> , spoons and rice plate	Squatting on ground	Sitting on 6.5 cms high wooden stool (<i>Patra</i>)
Grinding wet <i>masala</i>	150 gms Ginger, onion, garlic ground in manual grinder	Squatting on ground	Sitting on 13.5 cms high woven Stool (<i>Pihri</i>)
Grinding wet <i>masala</i>	Cumin seeds, coriander seeds, black pepper, Cardamon, cinnemon, Cloves in manual grinder	Squatting on ground	Sitting on 13.5 cms high woven stool (<i>Pihri</i>).
Mopping floors	100x150 sq. feet court yard mopped	Squatting on ground	Erect Standing
Brooming floors	100x150 sq. feet court yard broomed	Squatting cum bending	Erect Standing
<i>Chapati</i> Making	15 <i>Chapaties</i> , rolled & puffed	Squatting on ground	Standing at 82 cms high counter height
Ironing clothes	3 gents shirts and 3 single sheets ironed	Squatting on ground	Standing at 82 cms high table
Washing floors	100x150 sq. feet Court yard	Standing-cum bending	Erect Standing with 90 cms long broom
Ironing on Ironing board	3 gents shirts & 3 single bed Sheets ironed	68 cms high Ironing board	Erect Standing on 82 cms high Ironing board.
Washing Dishes	5 soiled plates, glasses katoris, spoons & rice Plate cleaned	61 cms high sink	Erect Standing on 82 cms high sink

cost in terms of k.cals used for the activities performed with the use of traditional and new kitchen device was calculated by converting the time used into energy by adopting the conversion factor given by Binning et al. (1983) detailed below:

Work	Time	Energy in MJ
Man	1 hour	1.96
Women	..	1.57
Child	..	0.98

(1 MJ= 238 kcals)

Percentage saving of energy was calculated for each pair of traditional and modern kitchen devices. Students 't' test was used to test the significant difference between the use of both kinds of devices. Expired air was analysed for CO₂

and O₂ percentage as per procedure given by Oberoi (1982).

$$\text{Energy utilization:} = \frac{\% \text{ O}_2 \text{ retained}}{(1/\text{sq.m/min}) \times 4.86}$$

(K Cal/sq.m/min)

The constant factor 4.86 was taken as it represents the calorific value of 1 litre of oxygen consumed during moderate activity.

FINDINGS OF THE STUDY

Household Work Performed with the Use of Time and Energy Saving Kitchen Devices

Table 3 showed the percentage human energy saving while performing work with the use of time and energy saving kitchen devices. The results supported the trade name given to these devices

Table 3: Saving of human energy with the use of right kitchen devices while performing household work

S. No.	Type of activity	Right kitchen devices	Percentage energy saving
1.	Grinding of masalas (Garam Masala and Podina chutney).	Electric Grinder	81.08
2.	Cooking with pressure (Dal)	Pressure cooker	60.70
3.	Squeezing lemons	Lemon squeezer	56.00
4.	Cutting of mustard leaves.	Saag cutting	54.68
5.	Extracting juice of Oranges.	Electric juicer	53.24
6.	Chopping of vegetables (beans and cabbage)	Chopping board	53.15
7.	Beating of Eggs	Eggs beater	52.96
8.	Peeling of vegetables (Potatoes and Carrots)	Vegetable peeler	25.38
9.	Making stuffed patties	Electric sandwich maker	11.89
10.	Onion Chopping	Onion chopper	5.21

as 'time and labour saving devices' since the use of all the selected devices resulted in considerable human energy saving. Maximum saving was observed in case of electric grinder (81.08 percent) as compared to use of manual grinder (*Kundi sota*). It was followed by use of pressure cooker (60.70 percent) instead of *Patila*. Use of lemon squeezer accounted for human energy saving up to 56.00 percent over lemon squeezing by hand. Saving of 54.68 percent was reported by women when the workers used *saag* cutting machine instead of cutting *saag* manually by *Datti*. Use of electric juicer as compared to extraction of juice by hand helped in saving of energy upto 53.15 percent. A subject saved upto 53.24 percent of their energy while using chopping board instead of cutting vegetables by knife. About fifty three percent energy was saved by using egg beater to beat eggs instead of using a spoon. Using vegetables peeler to peel and fruits accounted for saving of human energy up to 25.38 percent as compared to use of knife for peeling. Use of electric sandwich maker to make bread patties could save 11.89 percent of human energy

as compared to non electric sandwich maker. However using onion chopper could save only 5.2 percent of human energy as compared to chopping done by knife. Overall mean percentage saving of human energy by using selected time and labour saving devices instead of using traditional devices in the kitchen to do household work accounted to 45.37 percent. Kaur (1995) also stated that with the use of pressure cooker, pressure pan, peeler and chop-n-churn 45 percent of time and energy can be saved in cooking. These results seemed in line with the present study.

Household Work Performed in Right Postures and at Right Counter Heights

Table 4 indicated the percentage saving of human energy when subjects used right body postures and right counter heights (if work is to be performed at counter) to do household work. Standing at the appropriate counter level to do certain household work was found to be the least taxing to human body thus saving considerable amount of energy this was revealed by the results of present study which showed the maximum human energy saving up to 73.77 percent when subjects washed dishes at a sink height of 82-83 cms as compared to 61 cms high sink which was found more fatiguing to worker. Brooming is considered to be very uncomfortable task as it is done mostly in conventional semi-bending position, which puts strain on delicate ligaments of spinal cord thus causing backache. If home makers broomed floors by using long handled broom (90 cms long) in erect posture as compared to conventional short handled broom in bending position to broom, in addition to giving from stressed back bone could also save up to 54 percent of energy. For mopping of floors also, when it was done by long handled mop (135 cms long) in a standing (erect) posture, subjects were able to save human energy up to 50 instead of squatting on ground to mop with conventional mop (without handle). 48 percent human energy saving was reported when clothes were ironed on board 82 cms high instead of using 68 cms high ironing board to iron. Household work like churning milk manually in conventional churner of rural homes and washing dishes while sitting on wooden stool (*Patra*, 6.6 cms high) saved 40 percent of human energy as compared

Table 4: Saving of human energy by using right body posture and working at right counter heights to do household work

S. No.	Type of activities	Right body posture and right counter height	Percentage of energy saving
1.	Dish Washing in standing posture	Standing at 82-83 cms high sink	73.55
2.	Brooming floors	Erect posture (Standing) with 90 cms long handled broom	54.00
3.	Mopping floors	Erect posture (Standing) with 135 cms long handled mop.	50.00
4.	Ironing clothes	On 82 cms high ironing board	48.00
5.	Churning milk	Sitting on 6.5 cms high wooden stool <i>Patra</i> .	40.00
6.	Washing clothes	Sitting on 6.5 cm high wooden stool <i>Patra</i>	34.00
7.	Grinding wet and dry species	Sitting on 13.5 cms high woven stool <i>Pihri</i>	30.00
8.	Making <i>Chapaties</i>	Standing at 82 cms high counter level	26.00
9.	Washing floors	Standing erect with 90 cms long handled broom.	16.00

to squatting posture which women generally follow. Subjects saved 34 percent of human energy while washing clothes by hand, sitting on 6.5 cms high stool instead of squatting on ground which interfered with work by putting stress on leg muscles. Oberoi et al. also reported that these activities should be performed in the right postures since these put less stress on back bone and reduce the work costs.

Subjects were most comfortable and felt least fatigued when they sat down on woven stool (*Pihri* 13.5 cms high) to grind spices (both dry and wet) with manual grinder and saved upto 30 percent of human energy as compared to usual squatting posture followed by rural women. Making *Chapaties* thrice a day in sitting posture is also a monotonous and tiring job in Indian homes. Reporting of 26 percent saving in human energy when subjects made *Chapaties* while standing on 82 cms high counter as compared to squatting

position was done in the present study. Washing floors with long handled broom (90 cms long) could save 16 percent of human energy when erect posture was adopted with long handled broom instead of using standing cum bending position with conventional broom.

CONCLUSION

Use of labour saving kitchen devices accounted for overall human energy saving up to 45.37 percent over traditional devices such as electric grinder (81.08 percent) pressure cooker (60.70 percent) and lemon squeezer (56.00 percent). Energy saving by using *saag* cutting machine was 54.68 percent followed by electric juicer (53.24 percent) chopping board (53.15 percent) and egg beater (52.96 percent). Use of vegetable peeler, electric sandwich maker and onion chopper enabled subjects to save energy up to 25 percent. Using right body posture in doing household work also saved considerable amount of human energy. 73.55 percent of energy was saved while washing dishes standing at 82 cms high sink, followed by brooming with long handled broom (90 cms) in erect posture (54 percent) and mopping with long handled mopper in standing position (50 percent). Ironing clothes on 82 cms high ironing board accounted to 48 percent energy saving followed by churning milk & washing dishes (40 percent) and washing clothes (34percent) while sitting on 6.5 cms high wooden stool (*Patra*). Grinding wet and dry spices sitting on woven 13.5 cms high *Pihri* enabled subjects to save energy up to 30 percent followed by 26 and 16 percent energy saving for making *Chapati* while standing at 82 cms counter and washing floors with long handled broom in erect posture.

KEY WORDS Ergonomics. Traditional Devices. Body Posture. Clothes.

ABSTRACT An experimental study was conducted on 24 females to test the efficiency of selected kitchen gadgets and ergonomic principles for reducing energy costs of selected household work. The results of the study revealed that use of labour saving kitchen devices accounted for overall human energy saving up to 45.37 percent over traditional devices such as electric grinder (81.08 percent) pressure cooker (60.70 percent) and lemon squeezer (56.00 percent). Energy saving by using *saag* cutting machine was 54.68 percent followed by electric juicer (53.24 percent) chopping board (53.15 percent) and egg beater (52.96 percent). Use of vegetable peeler, electric sandwich maker and onion chopper

enabled subjects to save energy up to 25 percent. Using right body posture in doing household work also saved considerable amount of human energy. 73.55 percent of energy was saved while washing dishes standing at 82 cms high sink, followed by brooming with long handled broom (90 cms) in erect posture (54 percent) and mopping with long handled mopper in standing position (50 percent). Ironing clothes on 82 cms high ironing board accounted to 48 percent energy saving followed by churning milk & washing dishes (40 percent) and washing clothes (34 percent) while sitting on 6.5 cms high wooden stool (*Patra*). Grinding wet and dry spices sitting on woven 13.5 cms high *Pihri* enabled subjects to save energy up to 30 percent followed by 26 and 16 percent energy saving for making *Chapati* while standing at 82 cms counter and washing floors with long handled broom in erect posture.

REFERENCES

- Binning, A.S, Pathak, B.S. and Panesar, B.S.: The energy Audit of Crop Production System. *Research Report*, School of Energy Studies for Agricultural. Punjab Agri. University, Ludhiana (1983).
- Grandjean, E.: *Ergonomic of the Home*. Tayler and Francis Ltd. London, pp. 15-35 (1973).
- Kaur, K.: *A Study on the Kitchen Organization and Equipment in Rural and Urban Homes*. M.Sc. Thesis, Punjab Agri. University, Ludhiana (1995).
- Oberoi, K.: *A Compative Study of the Physiological Cost of Washing Clothes Manually and by Machine*. Ph.D. Dissertation, Punjab Agri. University, Ludhiana (1982).
- Oberoi, K., Dhillon, M.K. and Miglani, S.S.: A study of energy Expenditure during manual and machine washing of clothes in India. *Ergonomics*, **26 (4)**: 375-378 (1987).
- Richardson, S., Phillips, J.A., Anolon, J.M., lovingood, R.P., Pearson, J.M. and Sattmarch, M.: Total and active time required to prepare convenience and home prepared foods with an electric range and a microwave oven. *Home Econ, Res. J.*, **14**: 21-28 (1985).
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