AJHS.
Asian Journal of Home Science
Volume **9** | Issue 1 | June, 2014 | 219-222

Research Paper

e ISSN-0976-8351 | Open Access - *www.researchjournal.co.in*

Ergonomic evaluation of kitchen sink

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Received: 26.02.2014; **Revised:** 07.05.2014; **Accepted:** 20.05.2014

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■ **ABSTRACT :** The study on ergonomic evaluation of kitchen sink while cleaning utensils in standing posture was conducted by interview method among 30 purposive randomly selected home makers. For experiment only 5 ft. to 5.5 ft. height range home makers having one wall kitchen were selected. The criteria chosen to measure for ergonomic evaluation were anthropometric measurement (height and weight), dimensions of the sink, heart rate, energy expenditure and postural deviation. The selected variables were correlated with independent variables.

■ **KEY WORDS:** Postural deviation, Physiological cost, Sink dimensions

■ **HOW TO CITE THIS PAPER :** Rodge, Jayshree and Sarambekar, Hemangini (2014). Ergonomic evaluation of kitchen sink. *Asian J. Home Sci.,* **9** (1) : 219-222.

Kitchen is the major part of the work area and also a social centre of family and focal point around which several activities revolve. A kitchen will continue to be a housewife's battle field as well as studio where she creates delightful nourishing meals for the family.

Kitchen being the prominent room of a home, with varied work centre the kitchen sink to cater to the needs of the homemaker while performing the activities. Practically all the tasks / activities start from sink and end up with the sink hence careful planning regarding the placement has to be done for convenient and comfortable working.

According to Julien (2005), the sink should be approximately at the level of one's navel, in such a way that plates can be held with column straight and elbow forming a 90^0 angle. The design and placement of the sink require careful consideration of a number of factors which can reduce fatigue from work. Comfortable design of kitchen in the home is important in order to reduce ergonomic cost of work and fatigue to minimum, maintenance of good posture and enhanced productivity. The present study was undertaken to analyze the posture of homemaker while working at sink and to estimate the physiological cost of homemaker while working at sink.

■ RESEARCH METHODS

The investigation was conducted in Parbhani city, Marathawada region of Maharashtra state. Sample of 30 home makers was selected through purposive random technique from different localities of Parbhani. Homemakers with 5 ft. to 5.5 ft. having one wall kitchen in their houses were selected for the study.

Information on general profile of home makers and their opinion regarding the kitchen sink was collected by personal interview method. The anthropometric measurements of home makers were taken with the help of an anthropometric tape. Shallow fry pan, one small vessel, four plates, four glasses and four catories were selected for cleaning in standing posture and taking heart rate of home makers.

The postural analysis of home makers was done by using the Goniometer and angle of deviation collected through the following method:

Angle of deviation = Natural standing angle – working angle

The angle of deviation was calculated at lumbar, cervical and elbow joint. Physiological cost of homemaker was collected by using heart rate monitor. For measuring the heart rate, the Polar sport tester heart monitor was used. Physiological cost of work was calculated through the following method:

PCW = TCCW total work of activity

where,

TCCW = Total cardiac cost of work.
CCW = Cardiac cost of work.
CCR = Cardiac cost of recovery.
CCR = (Avg. Recovery HR–Avg. Resting HR) x Duration.
CCW = (Avg. Working HR – Avg. Resting HR)x Duration.

The collected data were statistically analyzed by applying correlation co-efficient test.

■ RESEARCH FINDINGS AND DISCUSSION

Postural deviation of selected home makers while cleaning utensils at sink in standing posture is shown in Table 1. Postural deviation of body at cervical, lumbar and elbow joint of respondents was measured while cleaning utensils at sink in standing posture. From the table it is clearly seen that higher deviation was recorded at lumbar joint, the maximum angle of postural deviation was 76^0 and minimum angle of deviation was 34^0 with average mean 57.45 and 10.47 standard deviation. The maximum angle of deviation recorded at cervical joint was 59^0 and minimum was recorded *i.e.* 22^0 with average mean 46.9 and 9.92 standard deviation. The maximum angle of deviation at elbow joint was 67^0 and minimum angle of deviation observed was 30^0. The mean and standard deviation of elbow joint was 55.63 and 10.28, respectively.

It can be concluded from the table that the maximum postural deviation was found at lumbar joint. The reason for maximum deviation at lumbar joint was observed that width of front projection was more. The finding is in line with the results of Kahtoon and Dayal (2009) that maximum deviation in body angle 52^0 was found to be in scrubbing the utensils activity followed by 43^0 in rinsing utensils.

Table 2 discloses correlation of angle of deviation of selected home makers and sink dimensions. It is clear from

Table 1: Postural deviation of selected homemakers while cleaning utensils in standing posture

Sr. No.	Body parts/ Joint	Angle of deviation		
		Minimum	Maximum	Mean ± S.D. (cm)
1.	Cervical joint	22	59	$46.9^0 \pm 9.92$
2.	Lumbar joint	34	76	$57.45^0 \pm 10.47$
3.	Elbow joint	30	67	$55.63^0 \pm 10.28$

Table 2: Correlation of postural deviation with sink dimension

Sr. No.	Sink dimension (cm)	Angle of deviation		
		Cervical joint	Lumbar joint	Elbow joint
1.	**Sink height to floor**			
	76 – 80 (40)	- 0.285 NS	- 0.304 NS	- 0.199 NS
	81 – above (60)	- 0.395 NS	0.193 NS	0.246 NS
2.	**Depth of the bowl**			
	14 – 18 (53.33)	0.629 **	0.448 NS	0.494*
	19– above (46.66)	- 0.600**	- 0.425 NS	-0.269 NS
3.	**Tap height**			
	20 – 40 (30)	0.324 NS	0.720**	0.838**
	41- above (70)	0.103 NS	0.234 NS	0.203 NS
4.	**Front projection**			
	6 – 14 (76.66)	0.046 NS	0.132 NS	0.017 NS
	15– above (23.33)	0.701 NS	0.923**	0.943**
5.	**Length**			
	30 – 33 (43.33)	- 0.100 NS	- 0.060 NS	0.020 NS
	34– above (56.66)	- 0.018 NS	0.255 NS	0.059 NS
6.	**Breadth**			
	30 – 37 (43.33)	- 0.091 NS	-0.166 NS	-0.136 NS
	38– above (56.66)	- 0.039 NS	-0.042 NS	-0.037 NS
7.	**Height**			
	14 – 24 (76.66)	0.360 NS	0.120 NS	0.082 NS
	25– above (23.33)	- 0.576 NS	- 0.451 NS	-0.450 NS

Figures in parenthesis indicates percentages, NS=Non-significant

the table that there was no significant correlation of angle of deviation at cervical, lumbar and elbow joint, with sink dimensions *i.e*. sink height from floor, length of sink, breadth of sink and height of sink.

Correlation of depth of the bowl with cervical joint revealed highly significant correlation for bowl depth of 14 – 18 cm (0.629**) and 19 and above cm depth showed negatively significant correlation (- 0.600*). Whereas correlation of depth of the bowl with elbow joint showed significant correlation for bowl depth of 14 – 18 cm. (0.494*) implying that if the depth of bowl increases the angle of deviation at cervical and elbow joint also increases.

Highly significant correlation was noted for tap height and postural deviation at lumbar joint (0.720**) and elbow joint (0.838**) for the group 20 – 40 cm. tap height infesting that as the tap height increases the deviation at lumbar joint and elbow joint increases.

A highly significant correlation was noted for front projection of sink and postural deviation at lumbar and elbow joint for the group 15 and above cm projection (0.923* and 0.943*) Varma (2010) showed similar findings for length, breadth and height of sink with the postural deviation at cervical and elbow joint.

Table 3 indicates the average of physiological cost, working heart rate, resting heart rate and energy expenditure of selected home makers. The average physiological cost of selected women while cleaning utensils in standing posture was 37.21 cm, an average working heart rate was 109.3 beats per minute while the average resting heart rate was 84.24 beats per minutes and average energy expenditure was 8.51 kj / minute for cleaning utensils in standing posture.

Correlation of age, height and weight with cleaning utensils of selected home makers are presented in Table 4. Statistical analysis revealed that the age group of home makers with physiological cost for the age group 41 and above years showed significant correlation where other two groups 20-30 years revealed negative non-significant correlation and 31-40 years age group noted non-significant correlation.

A negative correlation between height of home makers and their physiological cost was noted. A non-significant correlation between body weight of home makers and their physiological cost was noted for the groups 45-50 kg weight and 56 and above kg weight. But for the group 51-55 kg weight, the physiological cost of work showed negative non-significant correlation.

This finding is in line with the result of Varma (2010) that negative correlation between height of home makers and their physiological cost. Also the results are in conformity with non-significant correlation between body weight and physiological cost of work of selected homemakers.

Table 3: Physiological parameter of selected homemaker while dishwashing in standing posture

Sr. No.	Physiological parameter	Average
1.	Physiological cost	37.21
2.	Working heart rate (beats / min.)	109.3
3.	Resting heart rate (beats / min.)	84.24
4.	Energy expenditure (kj / min.)	8.51

Table 4 : Correlation between age, height and weight with physiological cost of cleaning utensils of selected homemakers

Sr. No.	Variables	No. of respondents	Physiological cost of homemakers (average)	'r' value
	Age group (Year)			
1.	20 - 30	7	36.11	0.309 ^{NS}
2.	31 – 40	11	36.83	-0.186 ^{NS}
3.	41 - above	12	38.19	0.564*
	Height(cm)			
1.	152 - 159	19	37.29	-0.129 ^{NS}
2.	160 - 167	11	37.06	0.251 ^{NS}
	Weight (kg)			
1.	45 – 50	5	36.24	0.729 ^{NS}
2.	51 – 55	6	37.13	-0.686 ^{NS}
3.	56 - above	19	37.54	0.129 ^{NS}

* indicate significance of values at P=0.05, NS = Non-significant

Conclusion:

Study revealed that the maximum postural deviation was found at lumbar point of home makers. The correlation of depth of the bowl with cervical joint showed highly significant correlation for bowl depth of 14-18 cm (0.629**) whereas elbow joint showed significant correlation for bowl depth of 14-18 cm (0.494*). Highly significant correlation was noted for tap height and postural deviation at lumbar joint (0.720**) and elbow joint (0.838**).

The average physiological cost of selected home makers while cleaning utensils in standing posture was 37.21. Statistical analysis revealed that age (41 and above years) had significant correlation (0.564*) with the physiological cost of the selected home makers. The age group of home makers with physiological cost for the age group 41 and above years showed significant correlation.

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