

## Ergonomic Assessment of the Existing Design of Selected Kitchen Tools

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### Abstract

The present study was undertaken to work out the ergonomic cost of work performed with the help of selected standardized and local brand kitchen tools. A multistage random sampling procedure was adopted for selecting the households to find out the possession of kitchen tools. Total 210 households were studied from three selected zones of Kanpur city. On the basis of survey most commonly used standardized and local brand kitchen tools were selected for the experimental study and their ergonomic features were also analyzed. Thirty physically fit respondents were selected to find out the significance relationship between performance of the peeling, cutting and squeezing activities on 84 cm standing height. Heart rate of the respondents was recorded during entire of the activities. Working heart rate, Energy expenditure and Grip strength were calculated. Muscular stress were measured by 5 point rating scale. Results of the study showed that ergonomic cost in terms of Heart rate for peeling 82.9 beats/min., cutting 81.7 beats/min., and squeezing 86.7 beats/min. while using standardized brand tools and 81.1 beats/min. for cutting, 86.3 beats/min. for peeling and 90.9 beats/min. for squeezing while using local brand. The energy expenditure were recorded 4.5 KJ/min. for peeling, 4.3 KJ/min. for cutting and 5.1 KJ/min. for squeezing while using standardized brand and 5.0 KJ/min. for peeling, 4.8 KJ/min. for cutting and 5.7 KJ/min. for squeezing while using local brand tools. Maximum grip strength decreased i.e. 21 percent while squeezing Lemon with Local brand and minimum 6.8 percent while cutting with standardized brand. Muscular stress were found more while using Local brand as compared to standardized brand kitchen tools due to faculty design, dimension, Low quality material of tools. The 't' value was found significant between standardized and Local brand kitchen tools.

**Key words:** Ergonomic, evaluation, physiological stress, muscular stress, grip strength.

### Introduction

In designing anything for a human being, it must be kept in mind, the dimensions, capabilities and limitations that should form the basis for designing of the tools. The designs of the equipment require the minimum utilization of physiological cost to the body and ensure the safety in use. The main goal of research related to kitchen tools is to identify and reduce the existing incompatibilities between human capacities and task requirements and to make workplace safe, healthy, productive as well as comfortable and satisfying one i.e. ergonomics means fitting of the task to the person. Lack of ergonomic data bank and research in this directions are the serious set back in this process. Therefore, it is

important to create on awareness among the manufacturer and consumers on the importance of user friendly equipment. The study in this direction is therefore expected to brief useful data for the improvement of equipment design to match with the requirement of users.

### Materials and Methods

Descriptive cum experimental research design was used in present study. The tool employed for data collection was interview schedule and observation technique. A sample of 210 home makers were selected randomly for the present study through multistage random sampling procedure for recording ergonomic features various

parameter were used i.e. diameter of handle, length of handle and blade (measuring tape), for experimental data various parameter were use for recording weight (weighing balance), height of the respondents (Anthropometric scale), heart rate (Polar heart rate monitor), Hand anthropometric measurement (measuring scale), grip strength (Grip dynamometer), Time spent stop watch. A five point rating was used to record the musculo-skeletal problem<sup>[4]</sup>.

### Results and Discussion

The Table 1 clearly indicates that for the possession of Vegetable knife maximum (37.62%) respondents possessed *Glare* brand followed by *Anjali* (26.19%) and *Crystal* (21.90%). The minimum (8.10%) respondents possessed *Tefal* brand for Potato Peeler, *Anjali* brand possessed by the majority (43.33%) of the respondents followed by *Glare* (24.76%) and *Crystal* (13.81%) respectively. For the Lemon squeezer *Glare* brand was possessed by the maximum (30.95%) respondents followed by *Anjali* and *Crystal* i.e. 17.62 percent and 17.14 percent respectively. It is also pertinent to mention here that *Anjali* was found to be main standardized brand for the possession of Vegetable grater, Hand juicer, Egg slicer, Churner, Saag cutting machine and for Multipurpose beater. *Crystal* was found to be the main standardized brand for onion chopper.

Majority (46.19 %) of the respondents possessed *Pilot* brand for Vegetable knife followed by 34.29 per cent of *Royal* brand and 18.57 per cent of *Aiso* brand respectively. For the Potato peeler majority of the respondents i.e. 24.76 per cent possessed *Royal* brand followed by *Ritu* (15.71 %) and *Pilot* (17.14 %) respectively. *Ankur* brand was possessed by the majority of the respondents for Lemon Squeezer. Data related to possession of kitchen tools were scrutinized that cent per cent respondents possessed more than one brand especially for Vegetable knife, Potato peeler and Lemon squeezer. The reason for their maximum possession may be their low cost, ease of operation, easy availability and frequent use<sup>[2]</sup>.

The results given in Table 2 showed the existing ergonomic features of selected standardized and local brand kitchen tools. For 'Length of blade' it was found that in case of standardized and local brand knife, maximum 49.5 per cent and 66.19 per cent respondents were having knives of 'Blade length' below the recommended size, whereas 24.76 per cent and 18.10 per cent respondents used knives of recommended size(6"-7"). Minimum 4.76 per cent and 10.48 per cent respondents were having knives of blade more than 7 inches respectively. Data pertaining to 'Material of blade' indicated that cent percent of the standardized brand of Vegetable knife, Potato peeler and Lemon squeezer were made of high carbon stainless steel as per recommended by **(Desai, 1973)** whereas in case local brand almost all the Vegetable knives, Potato peeler and Lemon squeezer were found made of stainless steel, wood and iron respectively. Approximately 60 per cent of the respondents were having equal value of recommended size for 'Length of handle' of standardized brand tools and remaining 40 per cent of the respondents were having 'Handle length' of kitchen tools below or above the recommended value ( $\leq 5$  cm). It was observed from the Table that all the standardized brand Lemon squeezer were found having adequate 'Number of holes' as recommended earlier<sup>[1]</sup>, whereas maximum (55.24%) respondents in case of local brand Lemon squeezer were having less than 10 number of holes. Nearly 18.10 per cent respondents were found having 10-15 holes in their Lemon squeezer. Data pertaining to 'Diameter of handle' indicated that majority i.e. 46.67 per cent and 50 per cent respondents were having more than 6 cm diameter in case of both standardized brand and local brand knives. The value of  $\chi^2$  was also observed significant for at 5 per cent level of significance hence brand of Knife, Peeler and Lemon squeezer significantly associated with ergonomic features such as, 'length of blade and handle', 'Diameter of handle', etc.

**Table 1 Possession of standardized and local brand of kitchen tools**

**N=210**

S. No.	Brand name	Kitchen Tools										
		Vegetable knife	Vegetable peeler	Lemon squeezer	Vegetable grater	Chopping board	Multipurpose beater	Hand juicer	Egg slicer	Churner	Saag cutting machine	Onion chopper
A.	Standardized brand											
i)	Anjali	55 (26.19)	91 (43.33)	37 (17.62)	35 (16.67)	21 (10.00)	22 (10.48)	16 (7.62)	31 (14.76)	44 (20.95)	26 (12.38)	11 (5.24)
ii)	Crystal	46 (21.90)	29 (13.81)	36 (17.14)	14 (6.67)	23 (10.96)	35 (16.67)	3 (1.43)	25 (11.90)	27 (12.86)	13 (6.19)	28 (13.33)
iii)	Glare	79 (37.62)	52 (24.76)	65 (30.95)	27 (12.86)	28 (13.33)	26 (11.90)	5 (2.38)	16 (7.62)	34 (16.19)	8 (3.81)	19 (9.05)
iv)	Fixwell	22 (10.48)	20 (9.52)	10 (4.76)	7 (3.33)	3 (1.43)	15 (7.14)	11 (5.24)	-	12 (5.71)	2 (0.95)	-
v)	Fixer	26 (12.38)	8 (3.81)	11 (5.24)	13 (6.19)	12 (5.71)	4 (1.90)	2 (0.95)	7 (3.33)	3 (1.43)	-	4 (1.90)
vi)	Tefal	17 (8.10)	6 (2.86)	-	8 (3.81)	5 (2.38)	-	4 (1.90)	2 (0.95)	4 (1.90)	1 (0.48)	2 (0.95)
vii)	Other (Suraj, united, kitchen care)	20 (9.52)	13 (6.19)	6 (2.86)	10 (4.76)	12 (5.71)	5 (2.38)	8 (3.81)	3 (1.43)	5 (2.38)	2 (0.95)	7 (3.33)
B.	<b>Local brand</b>											
	Sartaj / Royal	72 (34.29)	52 (24.76)	9 (4.26)	18 (8.57)	7 (3.33)	12 (5.71)	3 (1.43)	1 (0.48)	2 (0.95)	2 (0.95)	18 (8.57)
	Pilot	97 (46.19)	36 (17.14)	7 (3.33)	25 (11.90)	10 (4.76)	8 (3.81)	6 (2.86)	4 (1.90)	8 (3.81)	1 (0.48)	14 (6.67)
	Aiso	39 (18.57)	9 (4.29)	-	15 (7.14)	2 (0.95)	5 (2.38)	2 (0.95)	1 (0.42)	4 (1.90)	-	3 (1.43)
	Ritu	21 (10.00)	33 (15.71)	10 (4.76)	3 (1.43)	5 (2.38)	18 (8.57)	2 (0.95)	3 (1.43)	12 (5.71)	4 (1.90)	9 (4.20)
	Ankur	4 (1.90)	17 (8.10)	20 (9.52)	2 (0.95)	-	1 (0.48)	-	2 (0.95)	18 (8.57)	1 (0.48)	4 (1.90)
	Amit	10 (4.76)	18 (8.57)	5 (2.38)	7 (3.33)	2 (0.95)	9 (4.26)	8 (3.81)	4 (1.90)	7 (3.33)	8 (3.81)	8 (3.81)
	Others (Rasana choice, Nupur, Thakker, Iron & wood)	202 (96.91)	61 (29.05)	103 (49.05)	41 (19.52)	7 (3.33)	3 (1.43)	23 (10.95)	6 (2.86)	176 (83.81)	2 (0.95)	5 (2.38)

(Figures in parentheses indicate percentage)

Table 2 Ergonomic assessment of the existing design of kitchen tools

N = 210

S. No.	Ergonomic features	Kitchen Tools					
		Vegetable Knife		Potato peeler		Lemon squeezer	
		Standardized brand	Local brand	Standardized brand	Local brand	Standardized brand	Local brand
<b>1</b>	<b>Length of blade for knife</b>						
	Less than 6"	103 (49.5)	139 (66.19)	NA	NA	NA	NA
	6" – 7" (Recommended)	52 (24.76)	38 (18.10)	NA	NA	NA	NA
	More than 7"	10 (4.76)	22 (10.48)	NA	NA	NA	NA
	$\chi^2$	75.978**	121.955***				
	<b>Length of blade for peeler</b>						
	Less than 3'	NA	NA	68 (32.38)	108 (51.43)	NA	NA
	3" – 4" (Recommended)	NA	NA	72 (34.29)	86 (40.95)	NA	NA
	More than 4"	NA	NA	12 (5.71)	4 (1.90)	NA	NA
	$\chi^2$			44.137**	91030**		
<b>2</b>	<b>Material of blade</b>						
	High carbon stainless steel (Recommended)	165 (78.57)	4 (1.90)	151 (71.90)	-	107 (50.95)	-
	Others (Iron & Stainless Steel)	-	195 (92.86)	1 (0.48)	198 (94.26)	-	99 (74.14)
	$\chi^2$		183.322***	148.026***			
<b>3</b>	<b>Length of handle</b>						
	Less than 10 cm	28 (13.33)	106 (50.48)	29 (13.81)	126 (60.00)	34 (16.19)	115 (54.76)
	10 – 12 cm	126 (60.00)	73 (34.76)	102 (48.57)	64 (30.48)	65 (30.95)	26 (12.38)
	More than 12 cm	11 (5.24)	17 (8.10)	21 (10.00)	8 (3.81)	8 (3.81)	13 (6.19)
	$\chi^2$	140.109***	62.292**	78.137**	105.576***	45.250**	120.882***
<b>4</b>	<b>Material of Handle (heat resistant)</b>	165 (78.57)	196 (93.33)		-	27 (12.86)	89 (42.38)
<b>5</b>	<b>Diameter of handle</b>						
	Less than 4 cm	-	-	16 (7.62)	31 (14.76)	-	-
	4 – 6 cm	67 (31.90)	91 (43.33)	102 (48.57)	70 (33.33)	-	-
	More than 6 cm	98 (46.67)	105 (50.00)	36 (17.14)	97 (46.19)	107 (50.48)	154 (73.33)
	$\chi^2$	5.824*	1.000	79.431**	33.364**		
<b>6</b>	<b>Number of holes in Lemon squeezer</b>						
	Less than 10	NA	NA	NA	NA	-	116 (55.24)
	10 – 15	NA	NA	NA	NA	107 (50.95)	38 (18.10)
	More than 15	NA	NA	NA	NA		-
	$\chi^2$						39.506**
<b>7</b>	<b>Half hallow circle shape of squeezing part of Lemon squeezer</b>	NA	NA	NA	NA	107 (50.95)	154 (73.33)

NA = Not Applicable

(Figures in parentheses indicate percentage)

The table 3 shows that the three different activities i.e. Peeling, Cutting and Squeezing were performed on height 84 cm within 5 minutes by using standardized and

local brand kitchen tools for assessment of physiological cost of work stress of the respondents while performing these selected kitchen activities.

**Table 3 Ergonomic cost of work in terms of heart rate and energy expenditure N=33**

%	Activities	Average Heart Rate (beats/min.)		Percent Change	Energy Expenditure (KJ/Min.)		Percent Change	Work load
		Resting	Working		Resting	Working		
<b>I</b>	<b>Peeling potato</b>							
	Standardized brand	71.0	82.9	14.4	2.5	4.5	42.2	Very light
	Local brand	71.0	86.3	17.7	2.6	5.0	48.8	Very light
<b>II</b>	<b>Cutting potato</b>							
	Standardized brand	71.0	81.7	113.1	2.6	4.3	39.5	Very light
	Local brand	71.0	85.1	16.6	2.6	4.8	45.8	Very light
<b>III</b>	<b>Lemon Squeezing</b>							
	Standardized brand	71.0	86.7	18.1	2.6	5.0	49.8	Light
	Local brand	71.0	90.9	22.0	2.6	5.7	55.1	Light

The mean heart rate and energy expenditure while performing activities with the help of selected tools are given in Table 4. It can be observed that the average resting heart rate was found to be 71.0 beats/ min. The percentage increased in heart rate i.e. 14.4 per cent and energy expenditure 42.2 per cent found over the rest while performing with

standardized brand peeler whereas percentage increased in heart rate and energy expenditure i.e. 17.7 per cent and 48.0 per cent over the rest in case of local brand Peeler which was found more as compared to standardized brand. Similar trend was followed for Potato cutting and Lemon Squeezing.

**Table 4 Mean value of Grip strength mean distribution of the Grip strength according to use of standardized and local brand tools N=33**

Activities	Right Hand				Left Hand				Both Hand			
	St. Brand Mean + S.D.	Local Brand Mean + S.D.	Decrease %	't'	St. Brand Mean + S.D.	Local Brand Mean + S.D.	Decrease %	't'	St. Brand Mean + S.D.	Local Brand Mean + S.D.	Decrease %	't'
Potato peeling	26.0 ± 5.1	24.0 ± 4.9	7.7	19.982**	22.5 ± 4.4	20.9 ± 4.5	7.4	20.404**	31.9 ± 4.4	28.9 ± 4.4	9.4	21.891*
Potato cutting	26.3 ± 5.0	24.5 ± 4.9	6.8	16.699**	23.0 ± 4.3	21. ± 4.4	6.5	17.130**	32.3 ± 4.4	29.5 ± 4.2	8.7	21.608*
Lemon Squeezing	24.7 ± 4.8	22.7 ± 4.7	8.1	16.928**	21.5 ± 4.4	19.6 ± 4.2	11.6	17.832**	30.1 ± 4.4	27.4 ± 4.1	9.0	21.896*

\*\*Significant at 1% level

Analysis of table 4 depicts that percentage decrease in grip strength in right, left and both hands was found more in local brand as compared to standardized brand. It may be due to mismatch ergonomic design according to the users. It was also observed that in case of Potato peeling and cutting,

percentage decreases in right hand more as compared to left hand while using standardized and local brand kitchen tools. But in case of Lemon Squeezing percentage decrease in left hand more as compare to right hand further. It was also found that percentage decrease in grip strength in both hands more

than right and left hand in case of Potato peeling and cutting, but in case of Lemon squeezing percentage decreases more (11.6 %) in left hand as compared to right hand i.e. (8.1 %) and both hand (9.0 %) while using standardized and local brand Lemon squeezer. From overall discussion it was also observed that percentage decreased more in Lemon squeezing activity as compared to Potato cutting and Potato peeling.

#### **Musculo-skeletal problem**

Cutting potato with local brand knife majority (48.5%) of the respondents complained "Very mild" pain followed by 45.4 percent perceived "Mild" pain and minimum (6.1%) perceived "Moderate" pain in Finger. Pain in Wrist was observed 'Severe' in maximum (72.26%) of the respondents while using standardized brand lemon squeezer whereas 'Very severe' complained (54.5%) while using local brand Lemon squeezer. "Severe" pain were identified by majority of the respondents in Wrist and

Finger. The highest mean score was found in Wrist 3.7 (Rank I) followed by Shoulder 3.3 (Rank II) and Elbow 3.1 (Rank III).

#### **Conclusion**

From over all discussion it can be concluded that Kitchen tools were found more frequently used and almost all the respondents possessed more than one brand. The gap between desired and existing number of ergonomic features of kitchen tools of standardized and local brand was found significant for vegetables knife, Potato peeler and Lemon squeezer. The physiological cost of work and maximum musculo-skeletal problems in respondents were observed more in local brand as compared to standardized brand, it may be due to lack of ergonomic features in local brand kitchen tools.

It is expected that the findings of the study may be useful for homemakers for selecting best equipments of different brands available in the market according to ergonomic feature.

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