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## ASSESSMENT OF POULTRY DRESSING TABLE LAYOUT WITH RESPECT TO WORKSPACE ENVELOPE

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**Abstract:** A survey study of thirty poultry butchers shops was carried out for assessment of positions of different components of poultry dressing tables from the central axis of the body in the live bird markets of state of Punjab, India. Ten representative samples were selected randomly. The workspace envelope was drawn by using the average height of northern Indian male workers which is 1685 mm. Segment lengths expressed as ratio of stature were used for the development of workspace envelope. The locations of different components of poultry tables surveyed were superimposed on the prepared two dimensional template of workspace envelope in both the planes and their locations were compared with respect to developed workspace envelope. Dicing boards were placed in the workspace envelope in all poultry dressing tables but did not fall in the optimum work area for tables G, H, I, and J. Weighing balances and washing buckets were out of workspace envelope in all the poultry dressing tables. Except for G, all the dustbins were out of workspace. All the meat holding bowls were out of workspace envelope with the exception of table G. Weighing balance was inside the horizontal workspace envelope in tables D, F, G, and I and outside the vertical workspace envelope in all the cases. The results clearly indicated the poultry butchers have to adopt uncomfortable postures and stretch their limits to reach at the different components while dressing the poultry birds.

**Keywords:** Poultry; Poultry dressing table; Workspace envelope; Poultry dressing, Ergonomics

### 1. INTRODUCTION

Traditional manual poultry dressing accounts for roughly 95% (Ministry of Food Processing Industries, Govt. of India, 2012) to 98% (Landes et al., 2004) of all the poultry meat consumed in India. Indian poultry processing sector operates almost completely as a live-bird market where live-birds are slaughtered at the time of sale. The poultry dressing in these live markets are characterized by poorly designed dressing tables, floor dressing, non-separation of clean and unclean area, improper carcass washing. Mostly poultry dressing is carried out in standing posture by the butchers and sometimes in sitting posture. A standing posture allows greater flexibility to exert force (Department of Occupational safety and Health, Malaysia, 2002). The highest risk industries, with respect to work related musculoskeletal disorders (WMSDs) were meat and poultry processing (Yassi et al., 1996). The physical work place factors associated with an increased risk of WMSDs are repetition, posture and force (Bernard, 1997). This industry implies a high risk of musculoskeletal disorders in the neck and upper limbs (Viikarijuntura, 1983; Frost et al., 1998, 2002; Van Rijn et al., 2009). McGorry et al. (2000) investigated a poultry processing operation and found a significant effect of elbow height and work surface height on the power requirement of the cutting operation. Interventions should in general aim at improving all these factors (Westgaard and Winkel, 1996). The improper design of a standing workstation would make the task more difficult, strenuous, fatiguing, boring, unacceptable and uncomfortable for the operators, which will have an effect on quality of work, productivity and safety and health of the employees (Department of Occupational Safety and Health, Malaysia, 2002).

The working posture and task should be designed to avoid strain and damage to any part of the body such as the tendons, muscles, ligaments, and especially the back. During work, employees subconsciously tend to accept and adapt to unsatisfactory standing working conditions. They may not realize that their body is under strain until they feel actual pain and even then they may not understand the causes (Department of





Occupational Safety and Health, Malaysia, 2002). Ideally all work activity should permit employees to adopt several different, equally healthy and safe postures without reducing the capability to do the work. The employees should be able to maintain an upright and forward facing posture. The work should be arranged so that it may be done either in the seated or standing position (Department of Occupational Safety and Health, Malaysia, 2002).

The present study was carried out to assess the locations of the different components or to compare the locations of the different components poultry dressing tables surveyed in live poultry markets with respect to developed workspace envelope for an average north Indian population. Anthropometric dimensions of average north Indian male farm workers were used to develop workspace envelope and different components were placed in horizontal and vertical plane of workspace envelope.

## 2. MATERIAL AND METHOD

A survey study was carried out for assessment of positions of different components of poultry dressing tables in the live bird markets of state of Punjab, India. Poultry butchers were using different components viz. dustbin for bleeding the birds and keeping by-products waste, washing bucket to wash the poultry carcasses after bleeding, dicing board to cut the poultry carcasses into different parts, weighing balance to weigh the meat and meat holding bowl to temporarily store the unsold meat. In this study dustbin, washing bucket, dicing board, weighing balance, and meat holding bowl are referred as different components of poultry dressing table. The survey was conducted to assess the locations of the different components of poultry dressing table from the central axis of the body. The standing position of butcher is considered by leaving 10 cm of clearance from the inner edge of the table. The measurements were taken for the comparative evaluation in relation to the developed workspace envelope in horizontal and vertical planes of an average height of male farm worker in northern region of India. The poultry shops of thirty butchers were visited. Ten representative samples were selected randomly out of 30 sampling units (Table 1 and 2).

Table 1. Dimensions of different poultry dressing tables (cm)

Poultry dressing table	A	B	C	D	E	F	G	H	I	J	Mean
Height (cm)	82	79	73	70	78	98	86	88	65	68	78.7 (±10.18)
Length (cm)	140	127	220	45	178	153	106	153	255	270	164.7 (±68.76)
Width (cm)	80	74	87	70	100	92	67	112	85	95	86.2 (±14.09)

Values in parenthesis are standard

Table 2. Distance and height of different components of poultry dressing table from central axis of the body

Poultry dressing table	Distance of dicing board (cm)	Height of dicing board (cm)	Distance of weighing balance (cm)	Height of weighing balance (cm)	Distance of washing bucket (cm)	Height of washing bucket (cm)	Distance of meat holding bowl (cm)	Height of meat holding bowl (cm)	Distance of dustbin (cm)	Height of dustbin (cm)
A	42	94	90	97	68	55	60	82	70	59
B	47	98	87	94	130	42	84	79	71	40
C	40	88	80	88	95	43	88	73	80	44
D	46	80	70	85	85	43	87	70	60	40
E	44	89	98	93	96	43	65	78	95	70
F	44	115	80	113	70	45	90	98	80	52
G	60	98	70	101	16	44	40	86	40	76
H	50	98	96	103	75	43	63	88	70	56
I	50	85	75	90	100	45	68	65	65	54
J	55	90	80	83	90	44	70	68	68	50
Mean	47.8 (±5.81)	93.5 (±9.16)	82.6 (±9.41)	94.7 (±8.66)	82.5 (±27.94)	44.7 (±3.55)	71.5 (±15.04)	78.7 (±9.66)	69.9 (±13.61)	54.1 (±11.31)

Values in parenthesis are standard deviation from mean.

### ☐ Workspace envelope template

A workspace envelope was drawn by using the average height of northern Indian male workers which is 1685 mm (Gupta et al., 1983). The anthropometric survey conducted by Gupta et al. (1983) on Indian farm workers established that there was a linear relationship between the standing height and other body dimensions and therefore other dimensions could be predicted from the standing height. Segment lengths expressed as ratio of stature by Roebuck et al. (1975) were used to arrive at the anthropometric dimensions of body parts (Figure 1). These body dimensions were used for the development of workspace envelopes. Workspace envelope should ideally be designed for the 5<sup>th</sup> percentile or 95<sup>th</sup> percentile population. In present case however this will result in too little common space for placement





of different utilities however use of 50<sup>th</sup> percentile is considered to be more appropriate to accommodate (Kumar et al., 2009) majority of meat workers population.

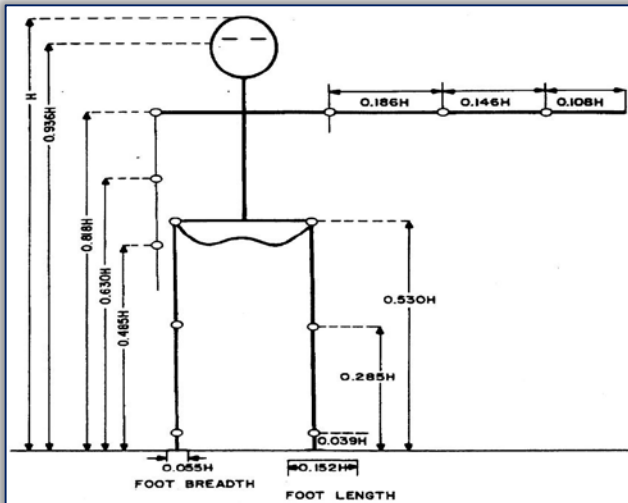


Figure 1. Segment lengths expressed as ratio of stature (Roebuck et.al, 1975)

standing position for long duration should be 15 cm below the elbow height. Thus the ideal height of workstation or dicing board in case of poultry dressing in horizontal plane has to be 910 mm.

The maximum reach for a male north Indian was 741.4 mm from the centre of the shoulder joint of the body (Figure 1). Two arcs were drawn with radius of 741.4 mm each centred at the centre of the right and left shoulder joints (Figure 2).

The elbow height from ground is 0.63 times the total height of the person (Figure 1). Thus the average elbow height for north Indian farm worker will be 1060 mm. OSHA (2004) envisages that for the heavy work like meat cutting, the workstation should be below elbow height and Magnusson and Örtengren (1987) arrived at the conclusion that a table height of 17 to 22 cm below elbow height resulted in low loadings on both the low back and the shoulders. Helander (1995) further specified that the standard height of work station in vertical plane for working in

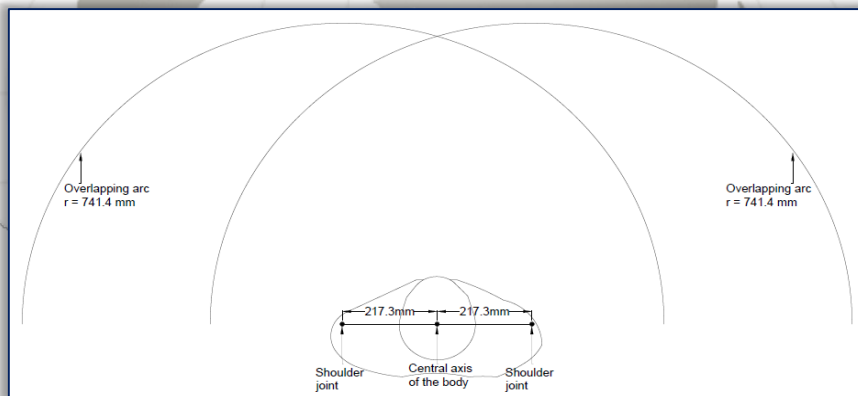


Figure 2. Development of workspace envelope for an average north Indian population in horizontal plane A two-dimensional template in 1:5 scale was drawn in plan and elevation following the method used by Zander (1972). The reach of north Indian farm worker (Fig 2) was used for drawing the workspace envelope in this template. The locations of different components of poultry tables surveyed were superimposed on the already prepared two dimensional template of workspace envelope in both plan and elevation.

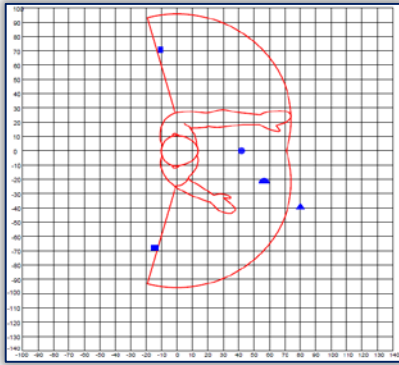
### Comparison of locations of different components on different poultry dressing tables

The components of poultry dressing tables surveyed were arranged spatially in both horizontal and vertical planes and their locations were compared with respect to developed workspace envelope. Meat cutting is categorized as the heavy task (McGorrya et al., 2003; Wang and Shanmugam, 2009; OSHA, 2004) and therefore in the developed workspace envelope, the dicing board should be kept in most efficient work area i.e. in front of the worker's central axis of the body and with outer edge of square measuring 250 x 250 mm overlapping at center of outer edge of the reach (Department of Occupational Safety and Health, Malaysia, 2002).

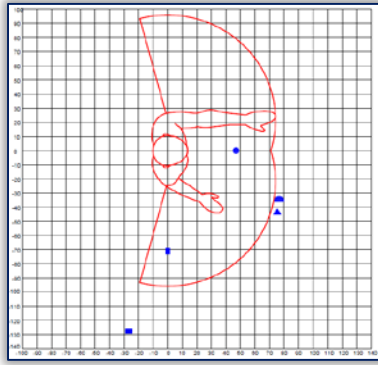
### 3. RESULTS

Different components of different poultry dressing tables were superimposed on the developed workspace envelope in both horizontal (Figure 3) and vertical planes (Figure 4). The locations of different components with respect to workspace envelope in horizontal and vertical planes were combined and shown in Figure 5 (a) and 5 (b), respectively. The components were classified as located within the workspace envelope and outside the workspace envelope with respect to particular plane. The components were also classified as inside workspace envelope in both horizontal and vertical planes and outside workspace envelope in either or both horizontal and vertical planes (Table 3).

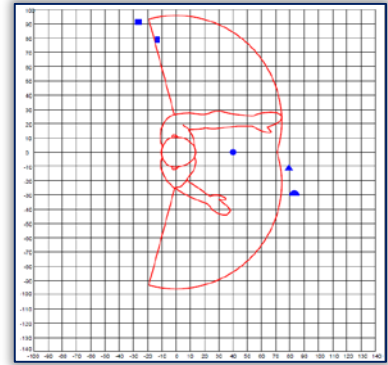




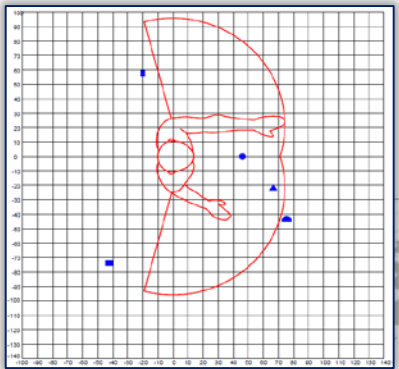
Poultry Dressing Table A



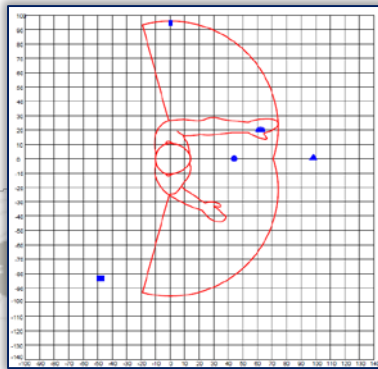
Poultry Dressing Table B



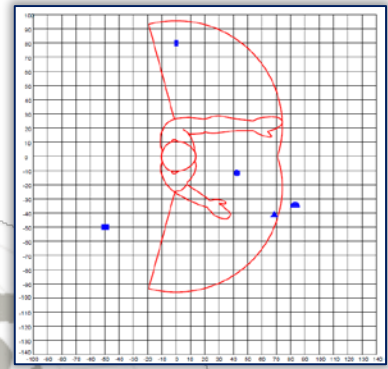
Poultry Dressing Table C



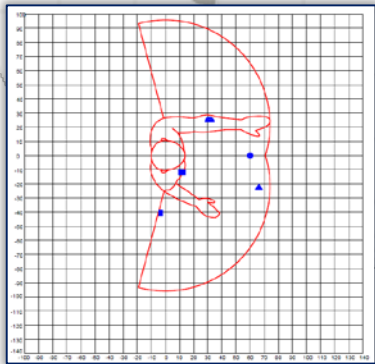
Poultry Dressing Table D



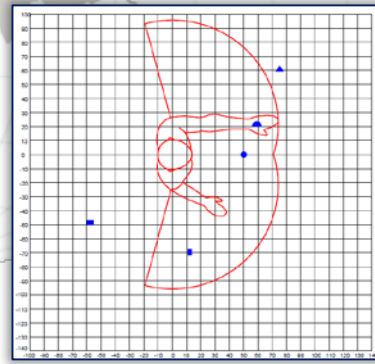
Poultry Dressing Table E



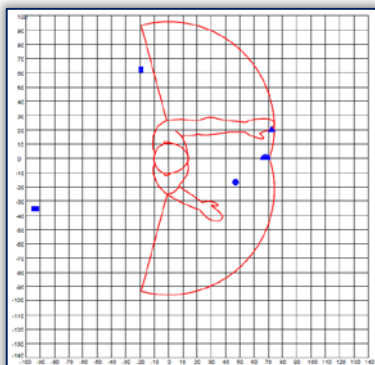
Poultry Dressing Table F



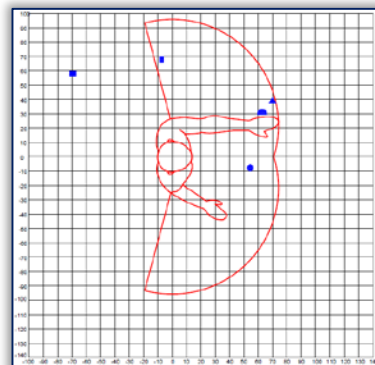
Poultry Dressing Table G



Poultry Dressing Table H



Poultry Dressing Table I

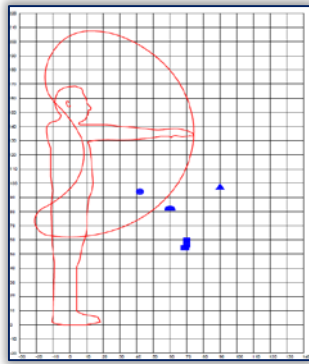


Poultry Dressing Table J

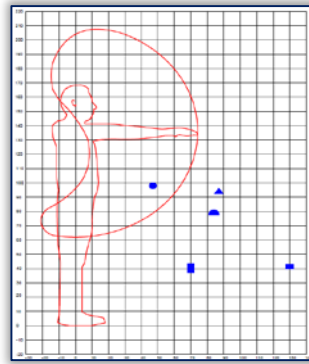
Figure 3. Location of different components of poultry dressing table with respect to workspace envelopes in horizontal plane (A-J)

●=Dicing board, ▲=Weighing balance, ■=Washing bucket, ■=Dustbin, ▣=Meat Holding Bowl

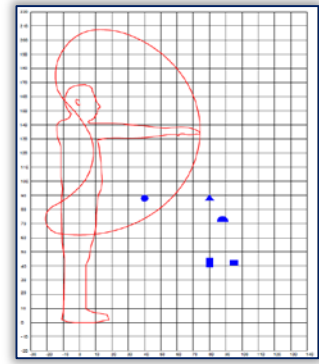




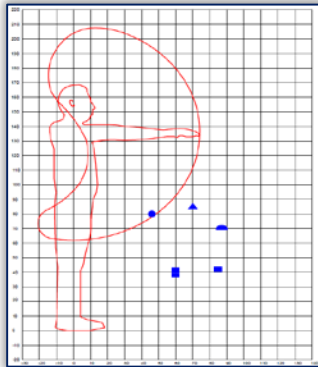
Poultry Dressing Table A



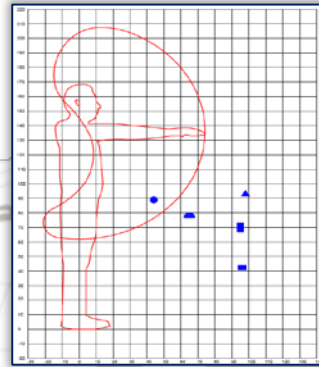
Poultry Dressing Table B



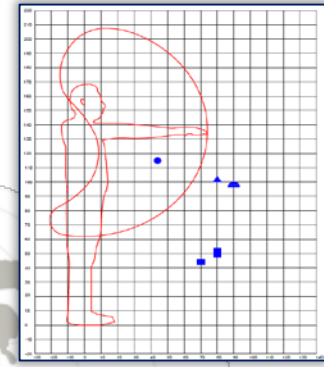
Poultry Dressing Table C



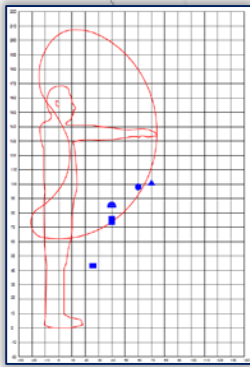
Poultry Dressing Table D



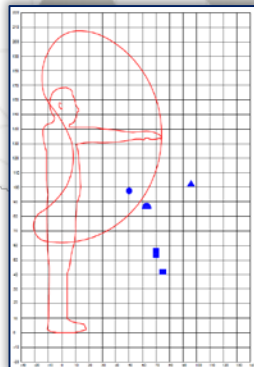
Poultry Dressing Table E



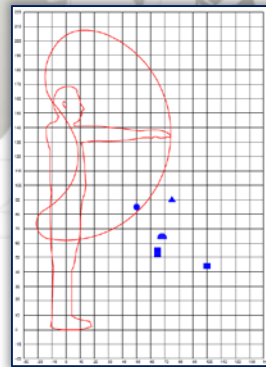
Poultry Dressing Table F



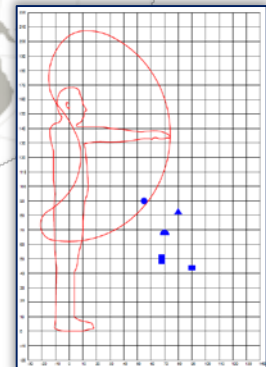
Poultry Dressing Table G



Poultry Dressing Table H



Poultry Dressing Table I



Poultry Dressing Table J

Figure 4. Location of different components of poultry dressing table with respect to workspace envelope in vertical plane (A- J)

●=Dicing board, ▲=Weighing balance, ▣=Washing bucket, ■=Dustbin, ▽=Meat Holding Bowl

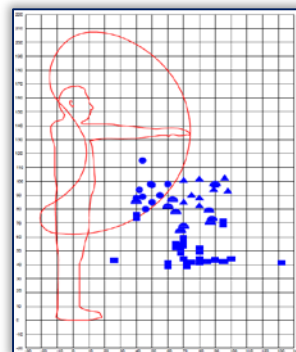
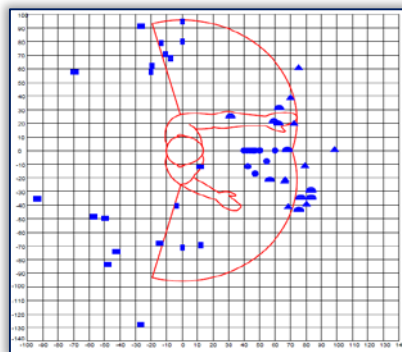


Figure 5. Location of different components of different poultry dressing table with respect to workspace envelopes in horizontal plane (a) and vertical plane (b) (poultry dressing tables A- J) where, ●=Dicing board, ▲=Weighing balance, ▣=Washing bucket, ■=Dustbin, ▽=Meat Holding Bowl





Table 3. Location of poultry dressing table components with respect to workspace envelope

Poultry Dressing Table	Plane	Dicing board	Weighing Balance	Washing bucket	Dustbin	Meat Holding Bowl
A	Horizontal	I	O	O	I	I
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
B	Horizontal	I	O	O	I	O
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
C	Horizontal	I	O	O	I	O
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
D	Horizontal	I	I	O	O	O
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
E	Horizontal	I	O	O	I	I
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
F	Horizontal	I	I	O	I	O
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
G	Horizontal	I	I	I	I	I
	Vertical	I	O	O	I	I
	Location	#	X	X	#	#
H	Horizontal	I	O	O	I	I
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
I	Horizontal	I	I	O	O	I
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X
J	Horizontal	I	I	O	I	I
	Vertical	I	O	O	O	O
	Location	#	X	X	X	X

where, I = inside workspace envelope, O = outside workspace envelope, # = inside workspace envelope in both horizontal and vertical plane, X = outside workspace envelope in either or both horizontal and vertical plane.

≡ Dicing board

Dicing boards were placed in the workspace envelope in both horizontal and vertical planes in all poultry dressing tables (Table 3) but did not fall in the optimum workspace area for table G, H, I, and J.

≡ Weighing balance

Weighing balances were located outside the workspace envelope in either or both the planes in all poultry dressing tables (Table 3). It was inside the horizontal workspace envelope in table D, F, G, I, J and outside the vertical workspace envelope in all the poultry dressing table.

≡ Washing bucket

Washing buckets were out of workspace envelope in both the plane in all poultry dressing tables (Table 3) except in table G where it was inside the horizontal workspace envelope.

≡ Meat holding bowl

Except for G where it fell inside the workspace envelope in both horizontal and vertical planes, all other meat holding bowls were out of workspace envelope in either or both the planes in all poultry dressing tables (Table 3). In tables B, C, D and F, meat holding bowls were situated outside the workspace envelope in both the planes and in tables A, E, H, I, and J it was outside the vertical plane.

≡ Dustbin

All the dustbins were out of workspace envelope in either or both the planes in all poultry dressing tables (Table 3) except in table G where dustbin was inside the workspace envelope in both horizontal and vertical planes. Sparing table G, dustbins were outside the vertical workspace envelope in all the tables. In table D and I, dustbins were located outside the workspace envelope in both the planes.

**4. DISCUSSIONS**

The results clearly indicated that the most of the components of poultry dressing tables fell outside the workspace envelope. Therefore, the poultry butchers have to adopt uncomfortable postures and stretch their limits to reach at the different components while dressing the poultry birds. Mean duration of work per day and average number of working days per week among meat cutters (butchers) in West Bengal, India was reported to be 10.4±2.1 hrs and 6 days respectively in unorganized sector (Gangopadhyay et





al., 2003). So they face awkward bending, stretching and forceful exertion for a long duration of time. This causes unnecessary stress to them and may lead to musculoskeletal disorders (MSDs). Gangopadhyay et al. (2003) while studying the upper extremity cumulative trauma disorders (CTD) in different unorganized sectors also found out that about 72 % of meat cutters were engaged in their profession since more than 10 years and 80% responded in affirmation about discomfort feeling (pain-75%, numbness-40%, swelling-40% and stiffness-55%). They further concluded that in case of meat cutting activity which is highly repetitive activity- non-neural wrist posture, flexion, extension, forceful exertion with heavy tools used for long periods were the main causes of upper extremity CTD.

The heights of the tables do not match with the developed ideal height of the table which is 910 mm for north Indian farm workers. Table F height is 980 mm which is higher and all other tables height were lower than the recommended height of the table. Therefore, the poultry workers bent their backs and waist while performing the different tasks of poultry dressing exerting undue stress on their different body parts. The tables were of varied shape which did not confirm with the arc shape of the workspace envelope in horizontal plane.

Dicing boards of tables G, H, I, and J being away from the optimum workspace area force the butcher to adopt awkward posture every time to perform the task. They bent forward to reach the dicing board and this leads to unnecessary stress on their back.

Poultry butchers using the tables A, B, C, E, and H have to stretch their arms to reach at the weighing balance while weighing the meat. This resulted in the exertion on waist and shoulder joints as also reported by Tichauer (1973). Lying of weighing balance below the vertical plane would lead to bending and stress on back, waist and shoulder joints.

Washing buckets were kept on the floor of the shop. Their average height was 447 mm from the ground so to wash the poultry carcasses, butchers have to bend excessively. Keeping washing buckets out of the workspace envelope in both the planes causes bending and stretching of different body parts causing musculoskeletal disorders.

Meat holding bowls of tables B, C, D and F were outside the horizontal plane of workspace envelope requiring the butchers to extend their limits. In all the tables except G, the meat holding bowls were outside (below) the vertical plane although they were kept on the tables. Outside the vertical plane meant that the meat workers stretched their limits to reach the component.

Dustbins in all the cases except in the case of table G were below the vertical workspace envelope (Fig 3.3). All the dustbins were kept on the floor and average height of the dustbins was 541 mm from the ground. This implies that while using dustbins meat workers have to bend compromising their posture thus deviating from the normal posture.

## 5. CONCLUSIONS

The location of components of poultry dressing table mostly fell outside the workspace envelope for an average north Indian farm population. Dicing boards were placed in the workspace envelope in all poultry dressing tables but did not fall in the optimum work area for heavy task in tables G, H, I, and J. Weighing balances and washing buckets were out of workspace envelope in all the poultry dressing tables. All the meat holding bowls were out of workspace envelope with the exception of table G. In case of tables B, C, D and F, meat holding bowls were outside the horizontal plane of workspace envelope but it was in the optimum work area in table G. Except for G, all the dustbins were out of workspace.

Most of the washing buckets, dustbins and meat holding bowls were placed below the workspace envelope in vertical plane and this will force the butchers to bend every time to perform the task requiring undue effort leading to physical disorders. Meat cutting is categorized as heavy work. That is why the dicing board should be kept in the most efficient work area. There should be provision of washing carcass on the table itself. A meat holding bowl with provision to store the unsold meat temporarily should also be provided on the table top. For work requiring heavy force (e.g., some cutting or deboning), the table should be below elbow height. Proper workstation height minimizes excessive forward trunk bending and lifting of the arms while dressing poultry. Therefore, the components of poultry dressing table should be kept on the table top to reduce drudgery to the poultry meat butchers. Efforts should be made to design and develop a poultry dressing table where all the components should fall within the optimum reach of workspace envelope of a person or at least within the maximum reach of workspace envelope.

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