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***Research Paper***

# Anthropometric assessment of women worker in selected hosiery units of Ludhiana City

■ Kanchan Shilla, Pushpinder Sandhu **and** Sharan Bir Kaur Bal

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■ **ABSTRACT :** The present study was conducted to assess the anthropometry of women worker in hosiery units of Ludhiana City using survey method on a sample of 120 women workers. Data pertaining to anthropometric measurements of women worker in hosiery units was collected by using duly pretested and finalized interview schedule. Anthropometer was used to record anthropometric data of workers. It was observed that mean standing height, popliteal height, elbow height, horizontal side way arm reach, frontal horizontal arm reach, sitting height, shoulder height, eye height and vertical arm reach of the respondents were 157.73 ±6.27 cm; 53.94 ±3.55 cm 100.34 ±7.04 cm; 189.08 ±8.89 cm; 39.83 ±2.67 cm; 86.45 ±5.75 cm; 65.53 ±8.13 cm; 73.67 ±11.69 cm and 197.60 ±8.05 cm, respectively.

■ **KEY WORDS:** Women worker, Anthropometry, Hosiery units

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See end of the paper for authors' affiliations

**Kanchan Shilla**
Department of Family Resource Management, College of Home Science, Punjab Agricultural University, Ludhiana (Punjab) India

Anthropometry refers to the measurement of the human body dimensions. Anthropometry plays an important role to ensure the human operator's comfort and well-being with the work and workplace. Anthropometric data determines the suitability of engineering drawings, clothing design, ergonomic and architectural design for workplace, where statistical data about the human body dimensions are used to evaluate and optimize the products. Anthropometry is a set of quantitative techniques which has been used for identification of the human physical variations by measuring, recording and analyzing specific dimensions of the human body such as height, weight etc. Anthropometric data of people varies from race to race and other dominant determinant *i.e.* genetic makeup of individual, lifestyles, environmental influence and age. Variations in human body dimensions of populations lead to requirement of regular updating of anthropometric data collections. However, in humanizing work place, it plays a pivotal role. Therefore, it becomes important to co-relate the dimensions of the body for the suitability of work station. Major dimension considered in this study were standing height, popliteal height, elbow height horizontal, vertical arm reaches and eye height. Criteria for analysing these dimensions were based on design of the work station, where hosiery workers were working.

## ■ RESEARCH METHODS

Field survey was conducted on casual women workers engaged in hosiery industry in the Ludhiana city.

A pretested and pre-structured interview schedule was used to collect the relevant anthropometric data of respondents to assess the human body dimensions of the hosiery worker in the Ludhiana city. For conducting the field survey, out of industrial hosiery hubs of Ludhiana city, two localities were purposively selected. The selected localities had many hosiery units in close vicinity. Out of each selected locality, six hosiery units were also purposely selected where women workers have strong strength. Out of each unit, 10 female workers were randomly selected. Criteria for selecting these workers were; who were regularly employed by hosiery owners and who have been working there for 3-5 years. Thus the total constituted sample was 120 respondents. The results were analyzed using simple percentages and mean score were presented in the form of table.

## ■ RESEARCH FINDINGS AND DISCUSSION

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

### Anthropometric measurements :

*Standing height :*

It can be seen from Table that 51.66 per cent of respondents were falling in height category of 156-165 cm (medium height); followed by 35.83 per cent respondents who were short; means their height was less than 155 cm and very few (12.5 %) of respondents were tall with height more than 165 cm. Mean standing height of respondents was 157.73 cm. Standing height of women in construction industry of Ludhiana city was in the range of 158.4±4.08 cm as revealed by Bharara (2012), 155.49±3.93 cm as revealed by Gupta (2012) and mean score of standing height of women in spinning industry was 155.06 cm as revealed by Nauriyal (2006). It can be concluded that generally these women were not tall; as per norms of Asian race. However, average height of Indian women is 164.0 cm as revealed in ICMR report, 2010; and respondents in present investigation were shorter in height.

*Popliteal height :*

Popliteal height is the vertical distance from the floor to the popliteal angle at the underside of the knee where the tendon of the biceps femoris muscle inserts into the lower leg. Table revealed that 61.66 per cent of respondents had popliteal height above 55 cm. One forth of respondents (25.00 %) was having popliteal height of 51-55 cm and 13.33 per cent respondents had their popliteal height not more than 50 cm. Mean height was 53.94 cm; which differed marginally from the popliteal height of women in Punjab as analysed by Bharara (2012), Gupta (2012), Nauriyal (2006) and Kaur (2012). This may be due to the reason that selected populations in these studies had varied values of standing height.

*Elbow height :*

This height was taken on subjects in standing posture, and measurement at elbow point (while arm is at $90^0$ bend) was taken. This height is determinant for work surface height, when work is to be performed in standing position. Table revealed that 41.66 per cent of respondents had elbow height more than 100 cm; followed by 31.66 per cent respondents who measured their elbow height in the range of 96-100 cm and 26.66 per cent of respondents were diagnosed as having their elbow height not more than 95 cm.

Mean elbow height was 100.34 ±7.04 cm. Malik (2005) also disclosed in her study that the mean elbow height of women engaged in household activities was 40.73, 39.46 and 36.76 inches in case of tall, medium and short heights, respectively. However, these results are in line with studies conducted on Indian women by Malik (2005) and Kaur (2012).

### Horizontal arm reach :

Horizontal reaches are major determinant for space allotment for smooth flow of work.

*Side ways:*

Table showed that 45 per cent respondents had horizontal arm reach (in sideways) in range of 186-200 cm; followed by 42.5 per cent respondents who were having side way reach not more than 185 cm and 12.5 per cent respondents had their side way reach more than 200 cm. Mean horizontal side way reach was 189.08 cm. Activities which require movement in gathering tools and supplies; and even split ups of a particular task may require more side way space e.g. preparation for cooking, drafting, etc. However, in the present study, limited space movement is required for the hosiery workers as per work allotted to them (fine work requiring folded arm movement only). Moreover, there are less

movements sideways; so a space around 186-200 cm seems sufficient for satisfactory performance of such work.

*Frontal:*

This reach pertains to reach in front of worker for determining depth of work top. It is also seen in Table that 39.16 per cent of respondents had frontal horizontal arm reach in category of 39-40 cm; and same number of respondents had this reach more than 40 cm. However 21.66 percentages of respondents had frontal horizontal arm reach less than 38 cm. Mean frontal horizontal arm reach was 39.83 cm. It is also important to note here that a work space deeper than required also puts extra strain on body as worker has to bend too steep forward; putting pressure on intra- vertebral discs; which may lead

**Table 1 : Anthropometric measurements (cm) of selected women worker in hosiery units (n= 120)**

| Anthropometric measurement | No | Percentage | Mean (± S.D.) |
|---|---|---|---|
| **Standing height (in cm)** | | | |
| Upto 155 | 43 | 35.83 | 157.73 (± 6.27) |
| 156-165 | 62 | 51.66 | |
| Above 165 | 15 | 12.50 | |
| **Popliteal height(in cm)** | | | |
| Upto 50 | 16 | 13.33 | 53.94 (± 3.55) |
| 51-55 | 30 | 25.00 | |
| Above 55 | 74 | 61.66 | |
| **Elbow height(in cm)** | | | |
| Upto 95 | 32 | 26.66 | 100.34 (±7.04) |
| 96-100 | 38 | 31.66 | |
| Above 100 | 50 | 41.66 | |
| **Horizontal Arm Reach -** | | | |
| Side ways (in cm) | | | |
| Upto 185 | 51 | 42.50 | 189.08 (± 8.89) |
| 186-200 | 54 | 45.00 | |
| Above 200 | 15 | 12.50 | |
| Frontal (in cm) | | | |
| Upto 38 | 26 | 21.66 | 39.83 (±2.67) |
| 39-40 | 47 | 39.16 | |
| Above 40 | 47 | 39.16 | |
| Sitting height (in cm) | | | |
| Upto 85 | 51 | 42.50 | 86.45 (±5.75) |
| 86-95 | 54 | 45.00 | |
| Above 95 | 15 | 12.50 | |
| Shoulder height (in cm) | | | |
| Upto 60 | 39 | 32.50 | 65.53 (±8.13) |
| 61-75 | 61 | 50.83 | |
| Above 75 | 20 | 16.66 | |
| Eye height (in cm) | | | |
| Upto 50 | 6 | 5.00 | 73.67 (±11.69) |
| 51-75 | 41 | 34.16 | |
| Above 75 | 73 | 60.83 | |
| **Vertical Arm Reach(in cm)** | | | |
| Upto 190 | 4 | 3.33 | 197.60 (±8.05) |
| 191-200 | 83 | 69.16 | |
| Above 200 | 33 | 27.50 | |

to back problem. Many studies conducted in past pointed out such difficulties felt by workers due to steep depth of shelves. Malik (2005) too mentioned that workers had to bend too much to reach out to deeper shelves and felt pain in back. A study conducted by Kaur (2012) yielded similar data, when horizontal reaches of respondents were worked out.

*Sitting height :*

The sitting height of the respondents presented in Table revealed that 45 per cent of respondent had sitting height in the range of 86-95 cm; followed by 42.50 per cent respondents whose sitting height was less than 85 cm and 12.50 per cent respondents had their sitting height more than 95 cm. Mean sitting height was 86.45 cm. Importance of sitting height is more in present study as women workers in hosiery industry sat down to do work like thread cutting, button stitching, hemming, repairing. Results of Malik (2005) and Kaur (2012) are also in line with the present investigation.

*Shoulder height :*

Shoulder height is taken both in standing and sitting position wherein the measurement of distance between shoulders joint to ground level is taken. In present study, this measurement is taken in sitting posture, since workers had disclosed performing of hosiery related work in sitting posture. Shoulder height of respondents is given in Table; and it can be seen that almost half (50.83 %) of the respondents had their shoulder height in the range of 61 to 75 cm; followed by 32.5 per cent respondents who had shoulder height less than 60 cm and 12.50 per cent respondents had it more than 75 cm. Reaching out above shoulder height puts static strain on arm muscles and induces undesired fatigue. So work station should be so designed that all supplies remain within the shoulder height. It was also seen in a study conducted by Malik (2005) on women engaged in household activities that the shoulder height was in the range of 52.58, 50.92 and 47.80 inches in case of tall, medium and short heights respondents, respectively. Mean shoulder height in the present study was 65.53 cm. These results are in line with Kaur (2012) who did the Postural analysis of rural and urban homemakers during kitchen storage activities.

*Eye height :*

Eye height was measurement of height from eye balls to the floor, and is taken both in standing and sitting position. For the present study this was taken in sitting posture, since mostly women worked in sitting position. Table reveals that 60.83 per cent of respondents had eye height more than 75 cm; whereas 34.16 per cent of respondent had eye height in range of 51-75 cm and only 5 per cent of respondents had eye height less than 50 cm. Mean eye height was 73.67 cm. Eye height is directly related to the height of the person. However, in the present study since the measurement is taken on respondents in sitting position; height of the upper trunk matters a lot and is critical in fixation of eye gaze. These findings are supported by results revealed by Malik (2005) and Kaur (2012) also. Eye height is pivotal in making work place congenial and less harmful to worker in terms of health because, if the distance between eye gaze and work point (specially, if it is finer work like, hemming, mending, embroidery work etc.) then there will be undue strain on neck; and the eyes will also get fatigued. Eye height as documented by Malik (2005) in her study; was found to be 43.73, 42.52 and 41.35 inches in case of tall, medium and short respondents, respectively. It can thus be concluded that workplace and work needs to be designed in accordance with the relevant anthropometric dimensions of the worker; to make it worker friendly. Therefore, there is relevance in presenting this data and correlating the existing dimensions with standard ones for designing ergonomically sound work centers.

*Vertical arm reach :*

The vertical distance between a standing surface and the tip of the right middle finger when the arm is extended overhead as high as possible is measured on an anthropometric scale. Vertical arm reaches are taken in standing position, with fully stretched arms. Table showed that 69.16 per cent of respondents had their vertical arm reach in range of 191-200 cm; followed by 27.50 per cent respondents who had their vertical arm reach more than 200 cm and 3.33 per cent had their vertical arm reach less than 190 cm. Mean vertical arm reach was 197.60 cm. Vertical arm reaches are more critical in designing work stations where worker performs work in standing posture like working in standing type kitchen, ironing while standing on a counter or in a manufacturing units, if the worker, is doing work standing at counter.

## Conclusion :

The results of present study revealed that anthropometric dimensions (in cm) of selected sample were: standing height- 157.73 (+6.27), popliteal height-53.94 (+3.55); elbow height-100.34 (+7.04), side way horizontal reach-189.08 (+8.89); frontal horizontal reach-39.83 (+2.67), sitting height-86.45 (+5.75), shoulder height-65.53 (+8.13), eye height-73.67 (+11.69) and vertical arm reach-197.60 (+8.05), respectively.

Authors' affiliations:
**Pushpinder Sandhu and Sharan Bir Kaur Bal,** Department of Family Resource Management, College of Home Science, Punjab Agricultural University, Ludhiana (Punjab) India

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