Testing the Furniture Dimension Match Levels with Anthropometry among Indian Working Women of Defence Laboratories

LR Varte, S Rawat, I Singh, D Majumdar

It is postulated that women employees in an office have increased risk of developing back pain due to the nature of their sedentary office work. Increased exposure to computers and related workstation, uncomfortable office furniture, types of jobs performed and the length of working hours/years have been identified as potential risk factors for back pain. Reasons for discomfort can be unchanging sitting position and/or a general lack of movement. In one study that investigated the incidence of back pain related to furniture dimension in Indian women, as much as 25.3% of the study population complained of back pain and for those who used the computer >6 hours daily, there was a statistically significant chance of developing back pain. Despite many reports on mismatch of furniture dimension leading to musculoskeletal disorders (MSD) in India, there is still no specific legislation or standard for the definition of the appropriate furniture characteristics to be used by office workers. This situation can be a consequence of both the lack of knowledge from the governmental authorities and the lack of a representative anthropometric database of the concerned population.

A total of 1072 women employees with a mean age of 40.2 (SD 10.6) years working in different research laboratories all over the country volunteered for this study. Seventeen laboratories were visited to obtain this sample size during 2009–2010. Five laboratories from Bangalore and Pune were classified as group A, nine laboratories from Delhi as group B, and three laboratories from Chandigarh and Dehradun formed group C. Laboratories were grouped together based mainly on their regional location proximity. All the subjects were given prior information about the study and signed informed consent was obtained. Anthropometric measurements such as stature, sitting shoulder height, popliteal height, hip width, thigh thickness, and buttock-popliteal length were measured using an anthropometer (GPM, Swiss). Seat height, seat width, seat depth, seat to desk clearance, backrest height, desk length, and desk breadth were measured with a retractable steel tape.

Data analysis computed descriptive statistics to describe the physical characteristics and furniture dimensions to evaluate the level of mismatch or match between the volunteers and the furniture used by them. A match criterion was defined between anthropometry and the median furniture dimensions (all 942 furniture were individually measured, hence the median
was considered for the equation). We re-
placed the office furniture measure in 
each match criterion equation. Then, the 
established limits and body dimensions 
of the women were compared and three 
categories were defined in the case of the 
two-way equations: the limit was consid-
ered “Match” when the anthropometric 
measure was between the limits; consid-
ered “High mismatch” when the minimum 
limit of the criterion equation was higher 
than the anthropometric measure; and 
“Low mismatch” when the maximum limit 
of the criterion equation was lower than 
the anthropometric measure. For the one-
way equations only two categories or levels 
were defined: “Match” and “Mismatch.”

Table 1 shows the furniture dimensions 
for the three studied groups. Results indi-
cated that seat height, considered the 
first point to be taken into account for any 
furniture dimension design, was not ap-
propriate for the workers popliteal height 
by as much as 49.13%, 53.87% and 12.97% 
in the three studied groups, respectively. 
It was also found that 49.35%, 48.48% 
and 51.89% of hip width was mismatched 
with their seat width in Lab A, in Lab B, 
and in Lab C, respectively. Buttock pop-
litel length against the seat depth, thigh 
thickness against seat to desk clearance, 
hip width against seat width, back rest 
height against sitting shoulder height, 
showed higher level of mismatch between 
anthropometry and furniture sizes. This 
reflected that the dimensions of female 
employees’ furniture were quite ill fitted to 
their anthropometric body dimensions. Al-
though fatigue may be caused by sitting for 
long periods and long duration of mental 
concentration, mismatch between the fur-
niture and body dimensions may intensify 
the problem of fatigue. Studies have shown 
that any deviation of dimensions of furni-
ture from the anthropometric dimensions 
may cause physiological and biomechani-
cal load on the musculoskeletal system.  

Therefore, a study on the present nature 
of working Indian women in relation to 
their anthropometric measurements and 
furniture dimension is of paramount im-
portance.

The ability to adjust the chair height was 
present in some chairs belonging to senior 
officers. However, except for a few of them, 
this feature was not used. Some used cush-
ions to adjust their sitting heights. Most of 
the furniture measured had been in use for 
some years. Only one laboratory reported 
that they had redone their whole furniture 
and acquired new ones. A common prob-
lem reported was the use of old furniture, 
which had been purchased quite a long 
time back. Changing the furniture by using 
newer improved ergonomically designed 
furniture can reduce the number of people 
with musculoskeletal disease and cases of 
mismatch. One way could be dissemina-
tion of information and awareness; anoth-
er is by small interventions. For example, 
using a back cushion to sit and support the 
back and using footrests to raise the foot 
level. Overall, in our interactions with the 
women workers, many did not know that a 
slight adjustment of the computer screen 
height or increase in sitting plane or re-
location of sitting angle could make their 
workplace more comfortable and they re-
ported an improvement because of these 
slight changes.

While there are several potential limi-
tations of the current study, this was the 
first of its kind in the defence research and 
development sector. We did not check if 
the commercially available furniture in the 
market would match the laboratory work-
ers anthropometry, though it is felt that 
using ergonomically designed furniture 
compatible to their body dimensions with 
general awareness of ergonomic principle 
could help in reducing musculoskeletal 
disease. Ergonomic intervention in furni-
ture acquisition, design, both for male and 
female employees in government sector is
lacking. Policy makers, government authorities, and R&D organizations can look into the aspect of undertaking a large scale representative anthropometric database of the working population, which is very much required in the organized sector, and much more so, in the unorganized sectors.

Conflicts of Interest: None declared.

References


### Table 1: Furniture and anthropometric dimension of three studied laboratory groups. Values are 5th, 50th, and 95th percentiles.

<table>
<thead>
<tr>
<th>Furniture dimension (cm)</th>
<th>Group A (n=460)</th>
<th>Group B (n=297)</th>
<th>Group C (n=185)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seat height (SH)</td>
<td>41.0, 46.0, 54.0</td>
<td>42.5, 46.0, 51.1</td>
<td>43.0, 46.0, 54.0</td>
</tr>
<tr>
<td>Seat width (SW)</td>
<td>42.5, 46.0, 53.0</td>
<td>42.0, 46.0, 50.6</td>
<td>42.2, 46.0, 50.0</td>
</tr>
<tr>
<td>Seat depth (SD)</td>
<td>40.0, 45.0, 51.0</td>
<td>41.0, 45.0, 50.0</td>
<td>40.0, 44.0, 50.26</td>
</tr>
<tr>
<td>Seat to desk clearance (SDC)</td>
<td>16.5, 27.3, 34.8</td>
<td>17.6, 26.3, 33.8</td>
<td>18.2, 26.6, 34.4</td>
</tr>
<tr>
<td>Backrest height (BKH)</td>
<td>36.0, 48.0, 62.0</td>
<td>29.0, 44.0, 63.4</td>
<td>39.2, 45.0, 57.0</td>
</tr>
<tr>
<td>Desk length (DL)</td>
<td>119.0, 150.0, 183.0</td>
<td>100.4, 136.0, 183.0</td>
<td>113.4, 138.0, 184.0</td>
</tr>
<tr>
<td>Desk breadth (DB)</td>
<td>60.0, 76.0, 93.0</td>
<td>60.0, 71.5, 92.0</td>
<td>60.0, 75.5, 93.0</td>
</tr>
</tbody>
</table>

### Anthropometric measurements (cm)

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Group A (n=460)</th>
<th>Group B (n=297)</th>
<th>Group C (n=185)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stature (ST)</td>
<td>144.59, 154.30, 164.02</td>
<td>146.70, 155.50, 164.60</td>
<td>145.04, 154.60, 164.96</td>
</tr>
<tr>
<td>Popliteal height (PH)</td>
<td>33.80, 36.00, 39.40</td>
<td>33.08, 36.00, 39.30</td>
<td>33.30, 35.90, 38.58</td>
</tr>
<tr>
<td>Buttock-popliteal length (BPL)</td>
<td>37.49, 41.60, 45.50</td>
<td>36.40, 40.70, 45.20</td>
<td>37.50, 40.60, 45.48</td>
</tr>
<tr>
<td>Sitting shoulder height (SSH)</td>
<td>49.69, 54.40, 59.30</td>
<td>51.30, 55.50, 60.20</td>
<td>51.42, 55.50, 59.88</td>
</tr>
<tr>
<td>Hip width (HW)</td>
<td>29.79, 34.50, 40.91</td>
<td>28.97, 33.10, 40.15</td>
<td>28.52, 33.10, 38.56</td>
</tr>
<tr>
<td>Thigh thickness (TT)</td>
<td>10.60, 13.30, 16.00</td>
<td>9.10, 12.60, 15.62</td>
<td>10.50, 12.60, 15.30</td>
</tr>
</tbody>
</table>