Gender as a determinant of the relationship between somatotype and left atrio-ventricular end-systolic ratio in normal subjects

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Aims and objectives

The purpose of the study was to assess the role of gender on the dynamics of left atrio-ventricular end-systolic volumetric ratio in normal subjects categorized in order of increasing body habitus.
Methods and materials

This prospective study was carried out in the city of Rostov-on-Don, Russian Federation between 2004-2006, using 147 apparently healthy volunteer first year students of Rostov State Medical University, aged 17-23 years. Seventy three were males, while 74 were females. Informed consent was obtained from all the volunteers and the protocol of the study was approved by the University Review Board for scientific research.

Anthropometry was performed on all the subjects using standard anthropometry kit, which comprised of stadiometer, weighing scale, small caliper for biepicondylar breadth measurements of the humerus and femur (elbow and knee joints), flexible tape measure, skinfold calipers and anthropometer. Height and girth were recorded to the nearest mm, biepicondylar diameters to the nearest 0.5mm, and skinfolds (anterior and posterior arm, upper and lower hip) to the nearest 0.1mm. Weight was recorded to the nearest 100g.

Somatotype was computed using the table of variables proposed by R. N. Dorokhov and V. G. Petrukhin (1989).

For the echocardiographic examination, a commercially available echocardiograph (Acuson Aspen Multihertz) was used. M-mode images were obtained from the parasternal long axis window with the subjects in partial left decubitus position and in held expiration when possible. Standard measurements were made using ASE recommendations. Left ventricular (LV) volume (V) was calculated using Teicholz formula: \( V = \frac{7}{(2.4+D)} \times D^3 \), where D is the LV internal dimension. Left atrial (LA) volume (V) was calculated from the apical 4-chamber view according to Dodge's method using the single plane area-length formula: \( V = \frac{8A^2}{3#L} \), where A represents the enclosed area of the atrial chamber in systole, and L is the shared axis running from the apex to the base. Left atrio-ventricular end-systolic volumetric ratio (LAVESVR) was obtained by dividing the end-systolic volume (ESV) of the LA by ESV of the LV.

Color Doppler flow recordings were used to search for mitral, aortic, tricuspid and pulmonic valvular regurgitation or stenosis, the presence of which were excluding factors in this study. All the subjects were not known to be hypertensive, confirmed by measurement of arterial blood pressure before the echocardiographic examination after having rested in supine position in a dimly lit room for about 10 minutes.

Statistica 6.0 (Stat Soft USA) software was used for data management and analysis. Data are presented as mean±SD, atrio-ventricular end-systolic volumetric ratio (LAVESVR) and graphs of LAVESVR against somatotype.
Results

One hundred and forty seven individuals were included in our study, out of which 73 were males while 74 were females. The mean ages were 18.4±0.2 and 18.8±0.3 years for males and females respectively, mean weights were 69.48±1.23 and 56.84±1.03 kg respectively, and mean heights were 178.41±0.99 and 165.19±0.72 cm respectively. Individuals were grouped in order of increasing body build (somatotype) into nanosomatic (I), microsomatic (II), micromesosomatic (III), mesosomatic (IV), mesomacrosomatic (V), macrosomatic (VI) and megalosolatic (VII), using the the Somatoplot of Dorokhov and Petrukhin. In this study, no individuals with types I and VII somatotypes were found.

LV end-systolic volumes are higher in males than in females (Table 1). Similarly, LV end-systolic volumes in each of the somatotype groups are higher in males than in females. The highest observed LVESV in female macrosomatics (26.68±2.35 ml) is lower than lowest value observed in male microsomatics (32.82±3.22 ml).

There is a steady rise in LA and LV ESV in males as body habitus increases from microsomatic to macrosomatic types (6.54±0.76 ml - 13±1.38 ml and 32.82±3.22 - 39.40±2.64 respectively). LAVESVR also rises with increasing body habitus: 0.20-0.34 microsomatic to macrosomatic respectively (fig.1).

LVESV shows a similar pattern in female somatotypes (22.71±1.63 ml - 26.68±2.35 ml microsomatic to macrosomatic respectively). However, in females there is an inverse relationship between LAESV and somatotype: 8.89±0.99 ml (7.21±0.88 ml microsomatic to macrosomatic respectively). LAVESVR also decreases with increasing body habitus in females: 0.39-0.28 microsomatic to macrosomatic respectively (fig. 2).
**Table 1:** M±SD for left atrial and left ventricular end-systolic volumes and atrio-ventricular end-systolic volumetric ratios in adolescents and young adults of different somatotypes.

<table>
<thead>
<tr>
<th>Somatotypes</th>
<th>All</th>
<th>II</th>
<th>III</th>
<th>IV</th>
<th>V</th>
<th>VI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Males (n=23)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAESV</td>
<td>9.75±0.61</td>
<td>6.54±0.76</td>
<td>8.17±0.79</td>
<td>8.92±2.01</td>
<td>10.53±1.39</td>
<td>13.60±1.38</td>
</tr>
<tr>
<td>LVESV</td>
<td>35.21±1.09</td>
<td>32.82±3.22</td>
<td>31.50±2.14</td>
<td>33.63±2.69</td>
<td>36.22±1.80</td>
<td>39.40±2.64</td>
</tr>
<tr>
<td>LAVESVR</td>
<td>0.28</td>
<td>0.20</td>
<td>0.26</td>
<td>0.27</td>
<td>0.29</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Females (n=24)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LAESV</td>
<td>8.11±0.39</td>
<td>8.89±0.99</td>
<td>8.85±1.55</td>
<td>7.78±0.79</td>
<td>7.94±0.97</td>
<td>7.21±0.88</td>
</tr>
<tr>
<td>LVESV</td>
<td>25.66±0.98</td>
<td>22.71±1.63</td>
<td>24.86±2.31</td>
<td>26.28±2.29</td>
<td>25.84±2.40</td>
<td>26.68±2.35</td>
</tr>
<tr>
<td>LAVESVR</td>
<td>0.32</td>
<td>0.39</td>
<td>0.36</td>
<td>0.30</td>
<td>0.31</td>
<td>0.28</td>
</tr>
</tbody>
</table>

II – Micromesomorphic, III – Micromesomorphic, IV – Mesomorphic, V – Mesomacromesomorphic, VI – Macromesomorphic. LAESV – left atrial end-systolic volume (ml), LVESV – left ventricular end-systolic volume (ml), LAVESVR – left atrio-ventricular end-systolic volumetric ratio.
**Fig. 1:** Graph of Left atrio-ventricular end-systolic volumetric ratio (y-axis) against somatotype (x-axis) in male subjects aged 17-23 yrs.

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Fig. 2: Graph of Left atrio-ventricular end-systolic volumetric ratio (y-axis) against somatotype (x-axis) in female subjects aged 17-23 yrs.

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Conclusion

In all the categorized somatotype groups, left ventricular end-systolic volume is higher in males than in females. In both males and females, there is a steady rise in left ventricular end-systolic volumes with increasing body habitus from microsomatic to macrosomatic. The highest observed left ventricular end-systolic volume in female macrosomatics is lower than lowest value observed in male microsomatics. While left atrial end-systolic volumes and atrio-ventricular end-systolic volumetric ratios rise with increasing body habitus in males, these parameters are inversely related to somatotype in females.
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