Cardiovascular reactions to psychological stress: the influence of demographic variables

Douglas Carroll, Lesley K Harrison, Derek W Johnston, Graeme Ford, Kate Hunt, Geoff Der, Patrick West

Large magnitude cardiovascular reactions to psychological stress have been implicated in the development and expression of cardiovascular disease. Given that cardiovascular disease varies as a function of demographic variables such as age, sex, and socioeconomic status (SES), it is surprising that there are few substantive data on the effects of such variables on the magnitude of cardiovascular reactions to stress. Although counter examples exist, small scale studies have reported greater heart rate reactions to stress in women, irrespective of stage of the menstrual cycle.2 Age has also been found to influence cardiovascular reactivity, with younger cohorts showing larger heart rate but lower systolic blood pressure reactions to stress.3 Finally, the one published study that has examined SES variations in reactivity found larger systolic blood pressure reactions to stress in higher occupational groups.4 Thus, the available data suggest that cardiovascular reactions to psychological stress are patterned by age, sex, and SES in a manner that is not wholly commensurate with the demographic stratification of cardiovascular disease prevalence. The present analyses of cardiovascular reactions to stress in three substantial age cohorts, which included both men and women and individuals varying in SES, allowed further examination of the demography of cardiovascular reactivity.

Participants, methods, and results

The present data were collected as part of the West of Scotland Twenty-07 Study.5 Heart rate (HR) and systolic and diastolic blood pressure (SBP and DBP) were measured at rest and twice in response to a three minute mental arithmetic stress in 1900 people using a semi-automatic sphygmomanometer. Occasional recording problems lead to loss of data for 90 participants. Data for a further 153 participants, in receipt of anti-hypertensive medication, were excluded. This left an effective sample of 1657, comprising 594 23 year olds, 630 43 year olds, and 433 65 year olds, of whom 898 were women and 759 were men. Nine hundred and sixteen of the sample came from non-manual working households and 741 from manual working households. The summary HR, SBP, and DBP data are presented in table 1. Activity during the stress was the average of the two readings and reactivity was computed as the difference between this average and the resting value. Resting SBP and DBP increased with age (p < 0.001 in both cases) whereas resting HR tended to decrease with age (p = 0.03). As expected, resting HR was higher and resting SBP and DBP lower in women than men (p < 0.001 in each case). Resting SBP was higher (p < 0.05) in people from manual compared with non-manual households. HR reactivity decreased as an orderly function of age (p < 0.001), whereas SBP reactivity was higher in the older two cohorts (p = 0.001). SBP (p < 0.001) and HR (p < 0.02) reactivity were lower in women than in men. Finally, HR reactivity was higher in people from non-manual compared with manual households (p < 0.001).

The sex and SES analysis were repeated using age as a covariate; the outcomes were identical to those reported above. However, separate analyses within each of the age cohorts indicated that the effects of sex and SES were significant mainly in the older two cohorts. Analysis of the mental arithmetic performance revealed that performance deteriorated with age (p < 0.001), was poorer in women than in men (p < 0.001), and was better in people from non-manual households (p < 0.001). Nevertheless, analysis of the reactivity data using performance as a covariate yielded the same outcomes as those reported above, with the exception of the sex effect for HR reactivity, which was no longer significant (p = 0.17). Finally, the SES analysis was repeated using own, rather than household, occupational class, again dichotomised as manual and non-manual. People from non-manual social classes again showed higher HR reactions to the mental arithmetic stress (p < 0.001); in this

Table 1 Average (SD) HR, SBP, and DBP at rest and in reaction to the mental stress

<table>
<thead>
<tr>
<th>Age cohort</th>
<th>HR Rest</th>
<th>HR Reactivity</th>
<th>SBP Rest</th>
<th>SBP Reactivity</th>
<th>DBP Rest</th>
<th>DBP Reactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>23</td>
<td>67.5 (11.0)</td>
<td>10.1 (10.8)</td>
<td>120.0 (15.1)</td>
<td>10.1 (10.3)</td>
<td>73.4 (10.1)</td>
<td>6.8 (9.1)</td>
</tr>
<tr>
<td>43</td>
<td>66.8 (11.2)</td>
<td>7.7 (10.0)</td>
<td>127.1 (18.1)</td>
<td>12.4 (11.7)</td>
<td>80.6 (11.1)</td>
<td>7.3 (8.3)</td>
</tr>
<tr>
<td>65</td>
<td>65.7 (10.0)</td>
<td>6.2 (8.1)</td>
<td>144.3 (21.7)</td>
<td>12.4 (13.9)</td>
<td>83.8 (11.2)</td>
<td>7.1 (9.1)</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>64.8 (10.5)</td>
<td>8.8 (9.9)</td>
<td>134.7 (18.2)</td>
<td>12.8 (12.0)</td>
<td>81.3 (11.2)</td>
<td>7.3 (8.8)</td>
</tr>
<tr>
<td>Female</td>
<td>68.4 (10.9)</td>
<td>7.6 (10.0)</td>
<td>124.3 (21.1)</td>
<td>10.5 (11.7)</td>
<td>76.8 (11.5)</td>
<td>6.8 (8.8)</td>
</tr>
<tr>
<td>SES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-manual</td>
<td>66.5 (10.4)</td>
<td>9.1 (10.0)</td>
<td>128.2 (19.9)</td>
<td>11.8 (11.8)</td>
<td>78.5 (11.3)</td>
<td>7.3 (8.5)</td>
</tr>
<tr>
<td>Manual</td>
<td>67.0 (11.4)</td>
<td>7.1 (9.8)</td>
<td>130.2 (21.2)</td>
<td>11.3 (12.0)</td>
<td>79.2 (12.0)</td>
<td>6.8 (9.2)</td>
</tr>
</tbody>
</table>

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case, however, DBP reactions were also higher in the non-manual group (p = 0.03).

Comment
The prevalence of cardiovascular disease is greater in men, in manual social classes, and increases with age. The inconsistent effects of age on cardiovascular reactivity, although broadly in line with the results of a previous cohort study, make it unlikely that reactivity mediates the association between age and cardiovascular disease. In contrast, the increased risk of cardiovascular disease in men is paralleled by higher SBP and HR reactivity. Whether own or household SES was used in the present analyses, it was those from the non-manual social classes who displayed higher cardiovascular reactions. Given that a previous study\(^1\) reported a similar direction of effect, the influence of SES on cardiovascular disease is probably not mediated by variations in cardiovascular reactions to stress.

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