High job control enhances vagal recovery in media work

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Background  Job strain has been linked to increased risk of cardiovascular diseases. In modern media work, time pressures, rapidly changing situations, computer work and irregular working hours are common. Heart rate variability (HRV) has been widely used to monitor sympathovagal balance. Autonomic imbalance may play an additive role in the development of cardiovascular diseases.

Aims  To study the effects of work demands and job control on the autonomic nervous system recovery among the media personnel.

Methods  From the cross-sectional postal survey of the employees in Finnish Broadcasting Company (n = 874), three age cohorts (n = 132) were randomly selected for an analysis of HRV in 24 h electrocardiography recordings.

Results  In the middle-aged group, those who experienced high job control had significantly better vagal recovery than those with low or moderate control (P < 0.01). Among young and ageing employees, job control did not associate with autonomic recovery.

Conclusions  High job control over work rather than low demands seemed to enhance autonomic recovery in middle-aged media workers. This was independent of poor health habits such as smoking, physical inactivity or alcohol consumption.

Key words  Autonomic nervous system; media work; recovery.

Introduction  Job strain has been linked to increased risk of cardiovascular diseases [1,2]. Low job control, rather than high job demands, plays an important role in work-related stress disorders [3]. “Good” stress with stimulation and challenges promotes health, but chronic stress predisposes to poor health outcomes. In modern media work, time pressures, rapidly changing situations, computer work and irregular working hours are common. In a recent Finnish study, a quarter of media employees reported being under much or very much stress, and one-sixth of them had non-standard work schedules [4].

Heart rate variability (HRV) has been widely used to monitor sympathovagal balance. Autonomic imbalance may augment the development of cardiovascular diseases [5]. Long-term electrocardiography (ECG) recordings provide information from recovery periods during and after working days [6]. The estimation of vagal activity by HRV analyses reflects the recovery of the body after daily activities [7].

The aim of this study was to evaluate the effects of level of job control and work demands on cardiovascular autonomic recovery among media workers.

Methods  A standardized questionnaire was mailed to all employees of the Finnish Broadcasting Company with irregular shift work (n = 750) and to randomly selected controls (n = 750) in the same company with regular daytime work. The work duties of the media personnel included journalism, broadcasting, programme production,
technical support and administration. Seventy employees from both groups (regular daytime work and irregular shift work) were randomly selected for clinical examinations.

The questionnaire covered demographic items, employment details, general health experience, physical health status, insomnia symptoms, psychosocial status, stress, work satisfaction and performance. The characteristics of the demand–control balance at work were evaluated using a validated questionnaire [8]. The employees were divided into groups according to their answers about the level of control (low, intermediate or high) and demand (low, intermediate or high) they experienced at work.

For the present study, the subjects from both work groups were pooled and divided into three age groups: the ‘youngest group’ was aged 25–35 years, the ‘middle-aged group’ was 36–45 years and the ‘ageing group’ was 46–62 years.

Physiological measurements were performed, including 24 h ECG recordings. The time–domain parameters of the recordings were calculated using special software for long-term ECG recordings (Century 2000, BMS Inc., St Louis, USA). The hourly means of the root mean square of the standard deviation (SD) of the adjacent R-R intervals (RMSSD) were selected to represent autonomic nervous system (ANS)-related cardiovascular control. The time–domain HRV values were calculated during the period between 6.00 p.m. and 8.00 a.m. (next day).

The profiles of the cardiovascular autonomic indices between the groups were analysed using an analysis of variance with repeated measures (SPSS 12.01 for Windows, Chicago, IL, USA). The comparison of single hourly means between the groups was made using non-parametric tests (Kruskal–Wallis). The chi-square test was used to study associations between categorical variables. P-values <0.05 were considered statistically significant. The RMSSD values were logarithmically transformed (ln RMSSD) due to the skewness of the distribution.

All patients gave written informed consent. Study protocols were approved by the Ethics Committees of the Hospital District of Helsinki and Uusimaa, Helsinki, Finland.

Results

The overall response rate was 874 of 1500 or 58% (53% of men). The response rate in the irregular shift work group was 82% (57% men) and in the regular daytime work group 34% (47% men). The mean age of invited subjects was 43.0 (SD 10.4) years in irregular shift work and 44.8 (SD 10.2) years in day work. The mean age of males in shift work was 45.0 (SD 10.6) years and of females 42.6 (SD 10.7) years (P < 0.001); the corresponding figures for daytime workers were 47.4 (SD 9.7) and 45.5 (SD 10.1) years (non-significant), respectively. The mean age of the whole group was 41.3 (SD 10.3) years and the mean body mass index was 24.5 (SD 3.9).

In the youngest group, 39% reported low, 26% moderate and 35% high job control (Table 1). In the middle-aged group, the reported levels of job control were 51, 28 and 21%, respectively, and in the ageing group, the reported levels of job control were 43, 18 and 39%, respectively. In the youngest group, 35% of the employees reported low demands at work, 29% intermediate demands and 36% high demands. In the middle-aged group, the levels of job demand reported were 38, 21 and 41%, and in the ageing group, the levels of job demand reported were 43, 30 and 27, respectively. These characteristics did not differ significantly between the groups. In the ageing group, the male subjects predominated significantly compared to other age groups (P < 0.05).

There were, however, no significant differences in gender distribution of job control–related age groups. Hypertension was more common in older groups and migraine in the younger groups (Table 1). Forty-nine per cent in the youngest group, 53% in the middle-aged group and 63% in the ageing group were married. Singles were 51, 26 and 13%, respectively. Twenty-one per cent in the middle-aged group and 24% in the ageing group were divorced or widowed. Marital status did not differ in job control–related age groups.

During the day and early evening, there was no difference between level of job control and parasympathetic activity in the middle-aged but during the recovery period (from 6.00 p.m. to 8.00 a.m.) between working days, those who experienced high job control at work had higher parasympathetic activity (P < 0.01 high job control versus low or intermediate control). The difference was especially prominent during sleep (Figure 1). In the other age groups, ANS recovery was not significantly different between the employees with high or low job control.

Hundred and thirty-two ECG recordings were analysed after eight recordings were excluded from further analyses due to short duration (n = 3) or cardiac dysrhythmias (n = 5). During the night (1.00 a.m. to 4.00 a.m.), the hourly mean of ln RMSSD increased from 3.78 ± 0.82 to 3.93 ± 0.49 ms in the youngest group with high demands and from 3.76 ± 0.83 to 3.80 ± 0.81 ms among the same group with low demands. In the middle-aged group, the respective increases were from 3.70 ± 0.75 to 3.84 ± 0.70 ms and from 3.78 ± 0.7 to 3.82 ± 0.75 ms. In the ageing group with high demands, the mean hourly ln RMSSD increased during the night from 3.47 ± 0.75 to 3.60 ± 0.63 ms, and among the same employees with low demands, it increased from 3.49 ± 0.83 to 3.55 ± 0.88 ms. The profiles did not differ significantly.

During workdays, the median time spent in bed by the young media workers was 8 h (range 4.5–10) compared to 7.75 h (range 2–12) by the middle-aged workers and 7 h (5.2–10.5) by the ageing workers. The time spent in bed did not differ significantly between the age groups.
The main finding was that high levels of control at work, rather than low demands, enhance parasympathetic activity during recovery periods. The health habits of the three age groups were similar and thus the groups can be considered comparable. The effect of high levels of control on vagal recovery was most prominent in those aged 36–45 years. The high demands of modern media work consist of time pressures, a continuous flow of information, often irregular working hours and rapidly changing technology. Over two-thirds of the employees reported subjective high or at least moderately increased demands in their work. Despite the high work demands in this population of Finnish media workers, however, it is high levels of job control that appear to count when the ANS is recovering after work. Reduced job control and effort–reward imbalance have especially been associated with unfavourable cardiac health [9].

The overall response rate to the baseline questionnaire in the day work group was low. This was partly expected as the study was transparently targeted to examine the health effects of irregular shift work. However, the invited subjects and respondents in the shift work and day work groups were similar as regards gender and age. Moreover, the population enrolled for more detailed physiological measurements was randomly selected and may be considered representative. Usually, the possible

### Table 1. Characteristics of the three age groups of Finnish media workers

<table>
<thead>
<tr>
<th>Age groups, years</th>
<th>25–35</th>
<th>36–45</th>
<th>46–62</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>49</td>
<td>39</td>
<td>44</td>
</tr>
<tr>
<td>n (%)</td>
<td>49 (42)</td>
<td>39 (43)</td>
<td>44 (57)</td>
</tr>
<tr>
<td>Male</td>
<td>49 (42)</td>
<td>39 (43)</td>
<td>44 (57)</td>
</tr>
<tr>
<td>Regular smoking</td>
<td>12 (25)</td>
<td>9 (23)</td>
<td>12 (27)</td>
</tr>
<tr>
<td>Yes</td>
<td>12 (25)</td>
<td>9 (23)</td>
<td>12 (27)</td>
</tr>
<tr>
<td>No</td>
<td>37 (75)</td>
<td>30 (77)</td>
<td>32 (73)</td>
</tr>
<tr>
<td>Regular physical activity</td>
<td>42 (86)</td>
<td>29 (75)</td>
<td>38 (86)</td>
</tr>
<tr>
<td>Yes</td>
<td>42 (86)</td>
<td>29 (75)</td>
<td>38 (86)</td>
</tr>
<tr>
<td>No</td>
<td>7 (14)</td>
<td>10 (25)</td>
<td>6 (14)</td>
</tr>
<tr>
<td>Alcohol consumption</td>
<td>17 (35)</td>
<td>16 (42)</td>
<td>17 (39)</td>
</tr>
<tr>
<td>&lt;5 doses/week</td>
<td>17 (35)</td>
<td>16 (42)</td>
<td>17 (39)</td>
</tr>
<tr>
<td>5–10 doses/week</td>
<td>18 (37)</td>
<td>12 (32)</td>
<td>16 (37)</td>
</tr>
<tr>
<td>&gt;10 doses/week</td>
<td>14 (28)</td>
<td>10 (26)</td>
<td>11 (24)</td>
</tr>
<tr>
<td>Main physical diseases</td>
<td>1 (2)</td>
<td>7 (18)</td>
<td>9 (20)*</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1 (2)</td>
<td>7 (18)</td>
<td>9 (20)*</td>
</tr>
<tr>
<td>Low back pain</td>
<td>3 (6)</td>
<td>5 (13)</td>
<td>7 (17)</td>
</tr>
<tr>
<td>Obstructive lung disease</td>
<td>0 (0)</td>
<td>2 (5)</td>
<td>4 (9)</td>
</tr>
<tr>
<td>Migraine</td>
<td>8 (17)</td>
<td>5 (13)</td>
<td>0 (0)*</td>
</tr>
<tr>
<td>Job control</td>
<td>19 (39)</td>
<td>20 (51)</td>
<td>19 (43)</td>
</tr>
<tr>
<td>Low</td>
<td>19 (39)</td>
<td>20 (51)</td>
<td>19 (43)</td>
</tr>
<tr>
<td>Moderate</td>
<td>13 (26)</td>
<td>11 (28)</td>
<td>8 (18)</td>
</tr>
<tr>
<td>High</td>
<td>17 (35)</td>
<td>8 (21)</td>
<td>17 (39)</td>
</tr>
</tbody>
</table>

Chi-square test for trend over three age groups: *P-value.

### Discussion

The main finding was that high levels of control at work, rather than low demands, enhance parasympathetic activity during recovery periods. The health habits of the three age groups were similar and thus the groups can be considered comparable. The effect of high levels of control on vagal recovery was most prominent in those aged 36–45 years. The high demands of modern media work consist of time pressures, a continuous flow of information, often irregular working hours and rapidly changing technology. Over two-thirds of the employees reported subjective high or at least moderately increased demands in their work. Despite the high work demands in this population of Finnish media workers, however, it is high levels of job control that appear to count when the ANS is recovering after work. Reduced job control and effort–reward imbalance have especially been associated with unfavourable cardiac health [9].

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### Figure 1. Autonomic cardiovascular balance (hourly means of RMSSD of HRV, bars indicate the standard error of mean) during recovery period (from 6:00 p.m. to 8:00 a.m.) among Finnish media workers (n = 132): a, aged 25–35 years (n = 49); b, aged 36–45 years (n = 39) and c, aged 46–62 years (n = 44). ***P-value < 0.01, high job control group compared to moderate or low control group.

RMSSD is the root mean square of the standard deviation of the adjacent R-R intervals.
selection bias in questionnaires is towards more distressed subjects and thus the present results probably do not overestimate the role of high control in work-related stress prevention.

Co-morbidities affect the ANS. In the present study, hypertension was more common in older groups and migraine in the younger groups. The incidence of these diseases was similar to the normal Finnish population, which reduces the likelihood of selection bias [10]. Also, depressive mood, alexithymia and other personal psychological characteristics play an important role in the management of stress. Unfortunately, the psychological distress was only assessed in relation to work factors and physical symptoms.

Physiologically, chronic stress causes prolonged arousal of the sympathetic ANS and insufficient vagal recovery after stress [11]. In this population, significant differences were found during sleep after the working day. Poor recovery of ANS balance has recently been reported to increase the risk of cardiovascular death among the Finnish industrial working population [12].

Long-term ECG recordings can be analysed by several techniques. RMSSD is one of the commonest time–domain analyses. It reflects attenuated vagal and augmented sympathetic activity in the autonomic balance. Decreased RMSSD has been associated with the development of cardiovascular disorders [13]. Analysis of the hourly RMSSD profile of Finnish media workers revealed low job control–related attenuation of vagal recovery, especially among the middle-aged employees. It is possible that low control in high demand jobs increases the allostatic load and thus prevents the positive effects of high demands on performance capacity, thereby attenuating good recovery. In a recent Finnish study, the nightly profile of time–domain indices of HRV were associated with the stress levels of workers [14].

Strategies in occupational and organizational management should perhaps focus on the age period of 30–50 years. This could prevent the onset of pathological processes or contribute to their early detection. Younger workers are still establishing their place in working life, while older workers, on the other hand, may have developed functional coping strategies. The present results support the view that the duration of stress exposure has an impact on the physiological changes.

### Funding

Finnish Work Environment Fund (102110).

### Conflicts of interest

None declared.

### References


### Key points

- High job control over work rather than low demands seemed to enhance autonomic recovery in middle-aged media workers.
- Recognition of this may be important to prevent the development of pathological cardiovascular processes.