**Short Communication**

**Relief of Work Stress after Weekend and Holiday Season in High School Teachers**

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There is a widespread belief that teaching is a highly stressful occupation9). Early retirement for reasons of disability (burnout and mental health problems) among Finnish educators has doubled in the 1990s compared to all other occupations5). The persistent sympathetic drive and reduced vagal tone attenuate the recovering capacity after stress. They may contribute in the development of diseases such as the metabolic syndrome and cardiac diseases3). Recent studies report an association of heart rate variability with general health4). The autonomic nervous system and hormonal responses maintain together the equilibrium of organ functions. Both psychological5) and physiological7, 8) stress can affect cardiovascular functioning i.e. heart beat intervals (RRI) and their variability. The fluctuations in circulatory parameters reflect the rapid and long term adaptation to stressors. These oscillations can be presented in power bands by methods of signal processing and spectral analysis9). Total power (variance of the index of the overall capacity of the system. The high frequency band (HF, 0.15–0.40 Hz) is mainly the index of the vagal (parasympathetic) and low frequency band (LF, 0.04–0.15 Hz), at least partly an index of the sympathetic component of the autonomic nervous system.

The aim of the present study was to evaluate the profile of autonomic control of the circulatory system in high school teachers during a workday, weekend and holiday season.

**Subjects and Methods**

The study subjects consisted of 9 (5 male, 4 female) healthy teachers with a mean age of 42 yr (range 37 to 54 yr) who had worked for at least 5 yr under a high school system. They were screened for good health and no medication. Age, gender and body mass index (BMI) had no statistically significant effect on heart rate variability and blood pressure (MANOVA) in these subjects. They all gave their full informed consent to participate in the study. The study protocol was approved by the Ethics Committee of the University of Kuopio.

The autonomic function tests were performed at 11:00–16:00 during the workday in April. The same tests were repeated the same daytime in each subject after the weekend in May, four weeks after the first measurement. The third measurement was performed in July on during the holidays (the subjects had been at least 6 weeks on holiday before the measurements). The use of alcohol and smoking were prohibited 24 h before the measurement and there were 4 h without eating before the tests. The subjects were also asked not to change their diet during the study or their activity level in leisure time. The electrocardiogram (ECG) was recorded with a three-channel Mingograph 34 ECG apparatus (Siemens, Elema, Sweden). All data acquisition and analyses were performed with a menu-driven software package (CAFTS, Medikro Ltd, Kuopio, Finland). The subjects performed a series of tests. The order of tests was the same for all subjects: 5-min controlled breathing, deep breathing and active orthostatic test. The tests were performed under laboratory conditions. The ambient temperature was 21°C (SD 1.5°C) and the relative humidity was 60% (SD 4%).

Spectral estimates of R-R intervals were obtained from stationary regions of registrations. Total power (variance) was divided into three frequency bands: very low frequency (0.0 to 0.04 Hz), low frequency (0.04 to 0.15 Hz) and high frequency (0.15 to 0.40 Hz) bands and were expressed in absolute units in milliseconds squared (ms²). In addition, the LF to HF ratio was calculated. In the deep breathing test, the subjects breathed for 60 s with maximal vital capacity with a respiratory cycle of 10 s (0.1 Hz). Four breathing cycles were analysed. During each cycle, the ratio of the longest R-R interval to the shortest R-R interval was calculated and the mean of the four ratios was taken as the expiration to inspiration ratio (E/I ratio).

Systolic and diastolic pressures were measured with a calibrated aneroid sphygmomanometer at the end of the resting period and at 1, 3 and 6 min in the standing position. Subjective sensations of stress were recorded by using the visual analogue scale (VAS) before the circulation tests. The results of VAS were reported in millimetres (range 0–100 mm with end points of no stress and high stress).

Repeted measures ANOVAs with three levels for periods (workday, weekend, holiday) were conducted to assess the variation in cardiovascular reaction. Period differences were tested by Bonferron, post hoc test. Correlations between perceived strain (VAS) and HRV/BP were determined with the Pearson correlation coefficient.
Results

In the controlled breathing test HF power increased during the holiday season and approached significance ($p=0.079$). The LF/HF ratio, VLF and LF power components did not differ significantly among the three measurements. No statistically significant difference in E/I among the three measurements was found in the deep breathing test (workday, $1.28 \pm 0.15$; weekend, $1.34 \pm 0.17$; holiday, $1.28 \pm 0.13$).

In the active orthostatic test (see means Table 1) TP, VLF power and the LF/HF ratio tended to increase in the upright position during the holiday season compared to the workday ($p=0.071$, $p=0.089$, $p=0.091$, respectively). In general, HRV and its components decreased during the change of body position from the supine to the upright position. Systolic blood pressure decreased significantly at rest in the supine position during the holidays ($p=0.044$) compared to the working days (SBP (mmHg) workday, $133–25$; weekend, $129–24$; holiday, $122–17$).

The subjective sensations of stress decreased during the follow up time, respectively. On workdays one of the teachers was highly stressed (VAS=90 mm) and the others were moderately stressed (mean 53 mm). At the weekend all the teachers still felt a little stressed (mean 12 mm). The subjective sensation of stress decreased significantly during the holiday season compared to the workdays ($p=0.041$). VAS and SBP were positively correlated on working days ($r=0.90$, $p<0.01$), at weekends ($r=0.62$, $p<0.05$) and negatively on holidays ($r=-0.40$, $p<0.33$). In general, HRV tended to correlate negatively with VAS. This reached significance in the active orthostatic and controlled breathing test in the supine position with TP ($r=-0.69$, $p=0.039$, $-0.72$, $p=0.038$, respectively) on the working days.

Discussion

The major finding of this study is that systolic blood pressure at rest decreased in these subjects significantly during the holiday season compared to the workdays. Weekend rest was not enough. Such a result has not been published earlier. A teacher’s work is mentally stressful. These results suggest that sufficient rest is desirable and may be beneficial for health by reducing physiological reaction during the holiday season. Generally RR interval increases are associated with decreases in stress. In our study work stress tended to recover in the parasympathetic part during the holiday season but not after the weekend. Apparently the teachers’ autonomic nervous system did not recover during the weekend. We have not found any other teacher stress studies where heart rate variation has been analysed by the power spectral analysis method, although there is much published research about teacher stress. The follow-up period of our study was short, and the study population was rather small. These aspects restrict the possibility to draw general conclusions. The sequence of measurements was the same for all participants i.e. workday first, then weekend and finally the holiday, for obvious practical reasons. In the first measurements HR was high and the HF component low, then they remained fairly stable in the weekend and holiday measurements. This may due the fact that the participants became used to the procedure. Also climatic changes (spring vs. summer) may have influenced physiological function. Overall, our findings suggest that in high school teachers, cardiac autonomic control varies throughout the three repeated measurements. We found no statistically significant differences between the workday and the weekend rest. Positive recovery in cardiac autonomic control was found only during the holiday season.

Table 1. Heart rate variation (HRV) in the supine and upright positions in the active orthostatic test

<table>
<thead>
<tr>
<th></th>
<th>N=9</th>
<th>Workday</th>
<th>Weekend</th>
<th>Holiday</th>
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</thead>
<tbody>
<tr>
<td>HRV</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TP (ms²)</td>
<td>Supine</td>
<td>3,553 – 1,515</td>
<td>3,273 – 2,820</td>
<td>3,721 – 2,771</td>
</tr>
<tr>
<td></td>
<td>Upright</td>
<td>1,954 – 1,398</td>
<td>2,572 – 4,524</td>
<td>3,539 – 4,029</td>
</tr>
<tr>
<td>VLF (ms²)</td>
<td>Supine</td>
<td>1,455 – 910</td>
<td>1,478 – 1,386</td>
<td>1,673 – 1,801</td>
</tr>
<tr>
<td></td>
<td>Upright</td>
<td>1,043 – 749</td>
<td>1,270 – 1,389</td>
<td>1,508 – 602</td>
</tr>
<tr>
<td>LF (ms²)</td>
<td>Supine</td>
<td>1,110 – 622</td>
<td>993 – 950</td>
<td>1,161 – 873</td>
</tr>
<tr>
<td></td>
<td>Upright</td>
<td>581 – 468</td>
<td>666 – 808</td>
<td>747 – 613</td>
</tr>
<tr>
<td>HF (ms²)</td>
<td>Supine</td>
<td>1,032 – 669</td>
<td>836 – 981</td>
<td>954 – 1,142</td>
</tr>
<tr>
<td></td>
<td>Upright</td>
<td>317 – 503</td>
<td>416 – 754</td>
<td>527 – 237</td>
</tr>
<tr>
<td>LF/HF (%)</td>
<td>Supine</td>
<td>149 – 81</td>
<td>151 – 68</td>
<td>206 – 100</td>
</tr>
<tr>
<td></td>
<td>Upright</td>
<td>334 – 411</td>
<td>467 – 292</td>
<td>504 – 357</td>
</tr>
</tbody>
</table>

Results as mean–SD. TP=total power, VLF=very low frequency, LF=low frequency, HF=high frequency of heart rate variation.
References


