Understanding Blood Pressure Variability: Spectral Indices As A Function Of Gender And Age

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KEYWORDS

Blood pressure variability, African-Americans, aging, emotion recognition

ABSTRACT

Typically, blood pressure variability has been calculated by taking the simple mathematical standard deviations of a collection of discrete blood pressure (BP) measurements. Recently, spectral analytic techniques have been employed to examine beat-to-beat blood pressure variability and the underlying autonomic adjustments associated with the performance of various tasks. In the present study, beat-to-beat blood pressure was examined in 104 older African-Americans males and females who were part of the Healthy Aging in Nationally Diverse Longitudinal Samples (HANDLS) Study. Participants evaluated faces and sentences depicting emotional content and rested before (Baseline) and after (Recovery) the tasks. There were no significant gender effects in any analyses. In addition, there were no significant task effects. However, there was a trend for both low and high frequency systolic blood pressure variability to decrease linearly from baseline, through faces and sentences to recovery. Interestingly, both systolic and diastolic high frequency blood pressure variability was greater in older as compared to younger adults. Increased blood pressure variability has been associated with greater sheer stress and greater end organ damage. These results will explicate the effects of aging on cardiovascular disease risk. Overall, these data indicate that blood pressure variability derived via spectral analytic techniques is a useful tool for understanding cardiodynamics and may provide a more in-depth analysis of blood pressure response.

INTRODUCTION

Blood pressure is usually assessed on the basis of systolic (pressure during the cardiac systole or contraction: SBP) and diastolic (pressure during the cardiac diastole or relaxation: DBP) pressures. While SBP indexes the pressure while the blood is being pumped to the periphery, DBP is the pressure in the vessels during venous return. Hence, DBP reflects vascular sympathetically mediated processes whereas SBP is a combination of flow and resistance parameters. However, these parameters do no necessarily capture the intricate interplay of the

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different sub-systems that influence them. Blood pressure variability (BPV) is the normal spontaneous variation in blood pressure over time that tells us something unique about the cardiodynamics of the system. Although the origins of BPV are not well understood, increased BPV has been associated with greater sheer stress and greater end organ damage [1].

Typically, BPV has been calculated by taking the simple mathematical standard deviation of a collection of discrete blood pressure (BP) measurements. Recently, spectral analytic techniques have been employed to examine beat-to-beat BPV and the underlying autonomic adjustments associated with the performance of various tasks. Previous research indicates that blood pressure and BPV are multiply determined by physical and psychological factors.

Emotional processing has been shown to worsen as we age and be more difficult for men than for women. Poor emotional processing has been linked to elevated cardiovascular responses particularly blood pressure and total peripheral resistance [2] [3]. This led us to examine the effects of aging and gender on BPV derived from spectral estimates of the beat-to-beat variability of SBP and DBP during emotional processing tasks.

METHODS

Beat-to-beat blood pressure and heart rate was examined in 104 older African-Americans males (n=50) and females (n=54) who were part of the Healthy Aging in Nationally Diverse Longitudinal Samples (HANDLS) Study. Continuous blood pressure was assessed while participants evaluated faces and sentences depicting emotional content and rested before (5-minute Baseline) and after (5-minute Recovery) the tasks. The order of faces and sentences sessions were randomized. Digital tachograms of continuous RR-intervals were obtained from recordings of a Portapres monitor (TNO biomedical instrumentation, Amsterdam, The Netherlands). The demographic variable age was dichotomized by means of median split using age 50 and higher as the older group.

Systolic and diastolic BPV were calculated on the blood pressure time series using a standard Fast Fourier Transform (FFT) algorithm to decompose the signal into characteristic components highlighting the frequency bands described below:

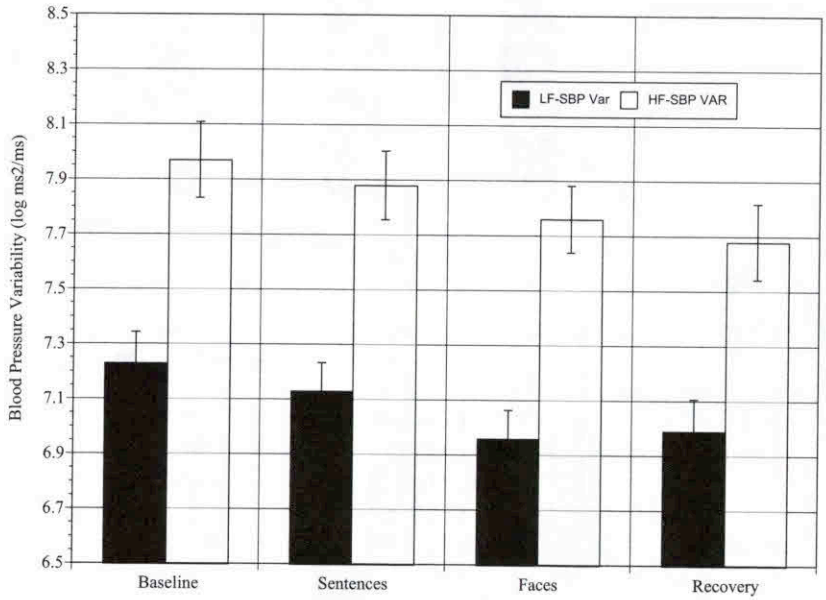
	Band (Hz)
Very Low Frequency	0.020 – 0.060
Low Frequency	0.061 – 0.145
High Frequency	0.146 – 0.400

The data were natural log transformed in order to account for skewness in the data and then analyzed in a 2 (age – Older vs. Younger) X 4 (Task – Baseline, Sentences, Faces, Recovery) Repeated Measures ANOVA.

RESULTS

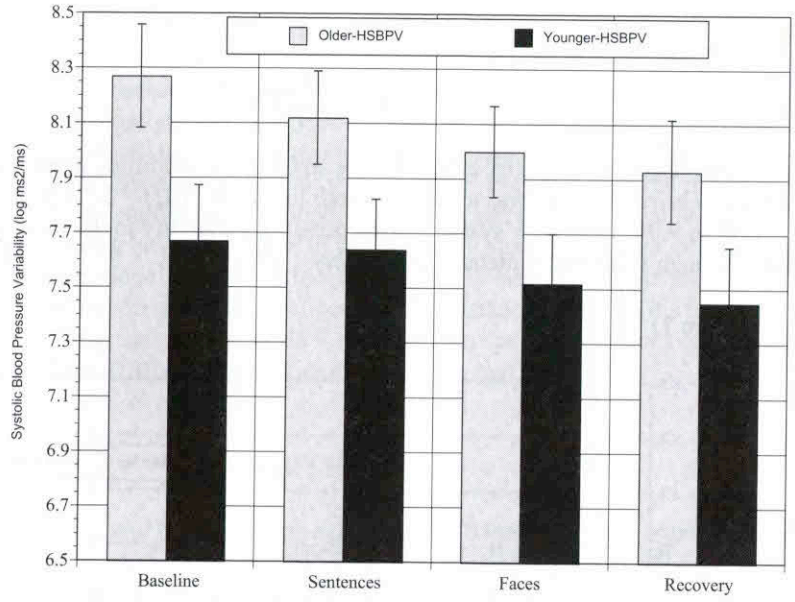
There were no significant gender effects in any analyses. In addition, there were no significant task effects. However, there was a trend for both low [F (1, 102) = 3.39, p =. 06] and high [F (1, 102) = 2.92, p =.09] frequency systolic blood pressure variability to decrease linearly from baseline, through faces and sentences to recovery

(Figure 1)

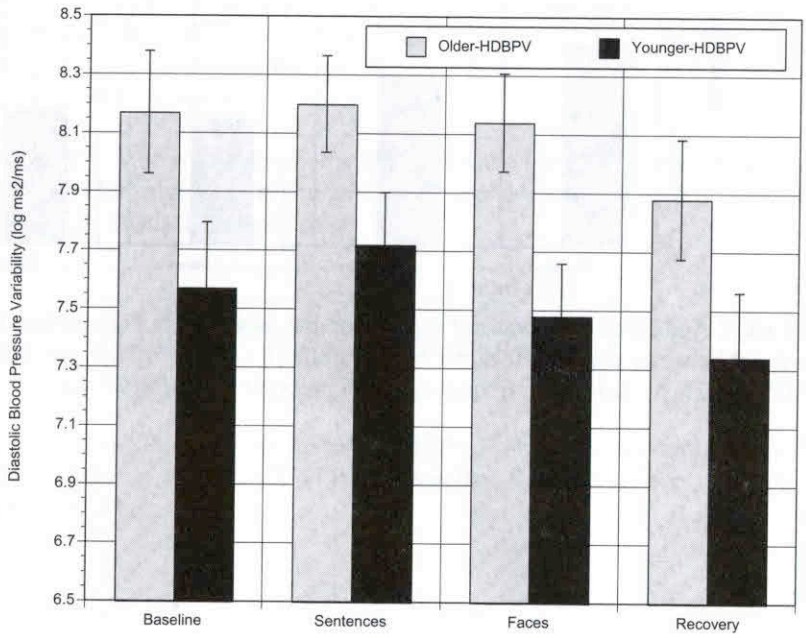


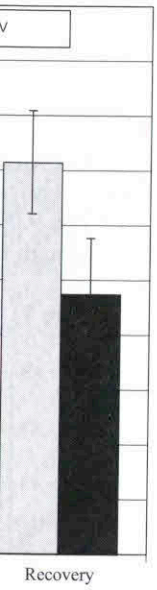
The Task X Age Interaction was not significant, but as shown in Figures 2 and 3, there were significant between subject effects for both systolic [F (1, 102) = 7.29, p =. 008] and diastolic [F (1, 102) = 8.77, p =.004] high frequency blood pressure variability.

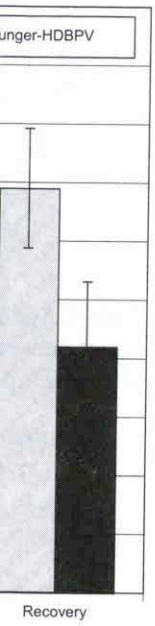
(Figure 2)



(Figure 3)







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CONCLUSIONS

Whereas the origins of BPV are not well known, two definite spectral components appear -- a low frequency component (.10 Hz) and a high frequency component (.25 Hz). The low frequency component has been thought to reflect sympathetically mediated responses while the high frequency component has been related to parasympathetic adjustments. However, a functional perspective suggests that increased BPV is associated with increased shear stress and end organ damage. Since both systolic and diastolic measures of BPV are increased with aging in this African-American sample, the elevated measures of BPV are consistent with previous results linking increased shear stress and end organ damage with increased BPV. The increase in BPV may be a result of increased vascular stiffness and a shift to a more sympathetically mediated mode of cardiovascular responding both of which are known to increase with age. These results suggest that blood pressure variability derived via spectral analytic techniques is a useful tool for understanding cardiodynamics in older African-American men and women.

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