

# Chronobiologic Analyses of LF/HF exposed distinct Age-Related Changes



James Fleming<sup>1</sup>, Kuniaki Otsuka<sup>2</sup>, Germaine Cornelissen<sup>3</sup>: for ACEHRV Investigators

<sup>1</sup>University of Minnesota, Twin Cities; <sup>2</sup>Tokyo Women's Medical University, Tokyo, Japan; <sup>3</sup>Halberg Chronobiology Center, UMTC

## Introduction

Heart rate variability (HRV) can be used as a tool to measure the autonomic control of the heart, and as a predictor of pathological aptitude in healthy individuals. LF and HF spectral powers are known to vary with respect to circadian rhythm. The LF/HF ratio therefore presents as an index of the autonomic regulation of the heart's activity, and although this view has been recently challenged, many studies support that it provides valuable insight to the individual's health. Time-frequency analyses of HRV data are common, but few have used this approach to compare the age-related changes in circadian waveform of LF/HF. The various harmonics (24h, 12h, 8h, 6h, 4.8h, 4h, 3.4h, 3h) contributing to defining the circadian rhythm of LF/HF assessed in different age groups may reveal how the autonomic of the heart change over time.

## Methods

**Subjects:** 58 healthy subjects from Asia, Europe and North America (19-84 y.o.; 38 male, 20 female) volunteered to monitor ECG data around the clock for a minimum of seven days.

Subjects were then subdivided into four age groups (18-35; 36-50; 51-65, 66+ y.o., groups 1-4 respectively).

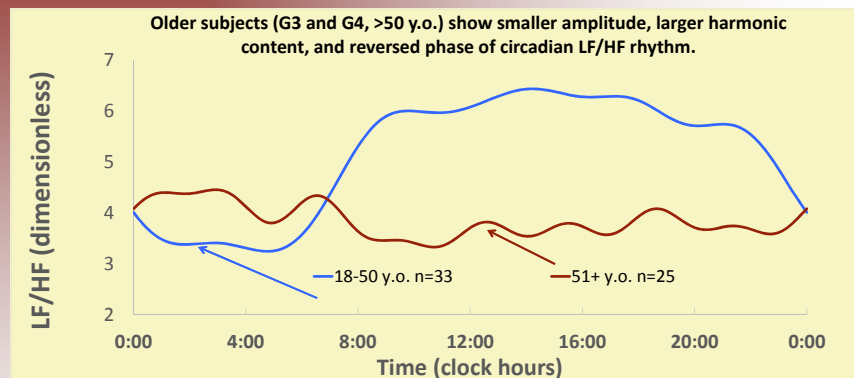
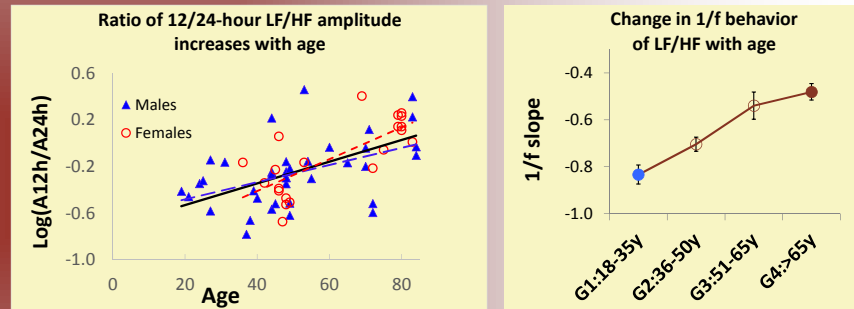
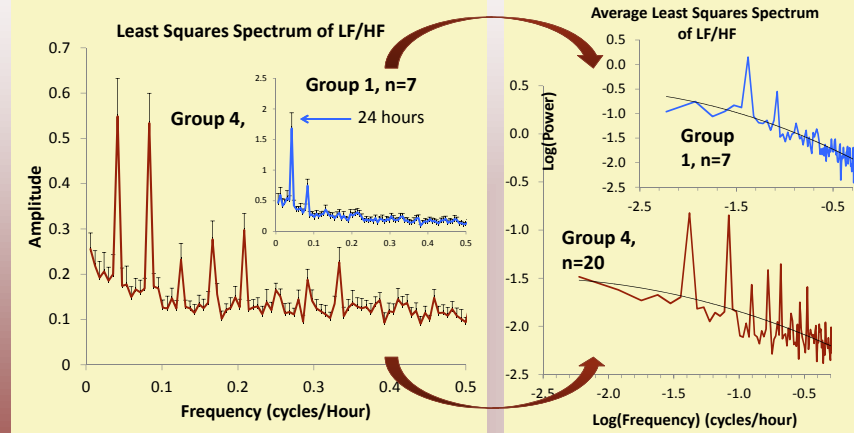
**Analysis:** LF/HF data were analyzed by least squares spectra. Amplitudes and phases were assessed at Fourier frequencies in the range of 1 cycle per week to 1 cycle per hour. Average phase-weighted and phase-unweighted amplitude spectra were computed for each age group.

## Results

A prominent circadian rhythm presented in all four age groups, with the largest relative LF/HF amplitude consistently falling at ~0.04 cycles/hour (24h cycle). Peaks were also consistent at the harmonics (at periods of 12h, 8h, 6h, 4.8h, 4h, 3.4 and 3h).

The harmonic content of the circadian waveform increased with age, as visualized by the statistically significant increase with age in the 12:24h amplitude ratio ( $P < 0.005$  in both males and females) and the difference in overall reconstructed waveform between the two younger and the two older age groups.

Females had lower LF/HF and smaller circadian amplitudes than males ( $P < 0.002$ ). The average (MESOR) followed a quadratic trend with age, with maxima reached in mid-adulthood. In addition to the smaller 24h amplitude, subjects in the older age groups had a large shift in circadian acrophase from daytime to nighttime.



## Conclusions

Apart from confirming known changes in average LF/HF with respect to gender and age, we found that LF/HF harmonic content increases with age. We have shown that the autonomic regulation of the heart is subject to cyclic patterns regardless of age, but also that there are predictable changes in the circadian pattern of LF/HF. The increasing trend in  $\log(A_{12h}/A_{24h})$  suggests that the circadian rhythm wanes with age and becomes less synchronized.