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Introduction of application of gini coefficient to heart rate variability spectrum for mental stress evaluation

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Background: The Gini coefficient is a statistical tool generally used by economists to quantify income inequality. To our best knowledge, this is the first study to apply the Gini coefficient to power spectral of Heart Rate Variability (HRV).

Objectives: 1) Use the Gini coefficient to measure the inequality in distribution of frequency bands of HRV during rest and under mental stress. 2) To evaluate the Gini coefficient as a psychophysiological indicator of mental stress in comparison to traditional HRV indices.

Methods: Thirteen healthy subjects (19 ± 1.5 years) participated. Their RR intervals were obtained by electrocardiogram during rest (five minutes) and during mental stress (arithmetic challenge; five minutes) and were used to derive estimates of power spectral densities of HRV. Spectral Gini Coefficient (SpG) was proposed to measure the inequality in the power distribution of the RR intervals in each of HRV bands. SpG from each band was compared with its respective traditional index of HRV during the conditions of rest and mental stress.

Results: There was a significant decrease in HF power as well as significant increases in heart rate, LF power, LF2 power and LF/HF during mental stress. There was also a significant increase in SpG (LF) and SpG (LF2) during mental stress. Coefficient of variation showed SpG has more homogeneity compared to the traditional index of HRV during mental stress. The Pearson Correlation showed poor correlation between traditional and spectral indices of HRV except for LF and SpG (LF2).

Conclusions: Gini coefficient of zero means that the power is distributed equally for all frequencies and Gini coefficient of 1 suggests that there is a single frequency with all the power within a specific spectral bandwidth. In other words, increase in Gini coefficient value suggests that there are fewer frequencies, with the most power within that frequency band compared to before. Spectral inequality of heart rate variability analyzed from the Gini coefficient is an independent and homogeneous psychophysiological indicator of mental stress.

Biography

Shreya Ghiya is a registered physical therapist, certified Kinesiotaping practitioner and researcher currently working in USA. She is highly motivated to address and manage orthopedic and cardiovascular pathologies using various physical therapy principles. Her research interests include Yogic breathing exercises, mediation techniques, cardiovascular physiology and heart rate variability and pain mechanisms.

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