# Effects of Meditation on Heart Rate Stability

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## Abstract

*Relaxation or meditation is expected to slow the heart rate and produce more stable rate changes. However, there is little information on specific effects of meditation training. In this study we compared heart rate stability during normal and meditation conditions.*

*ECGs were recorded with ethical permission from normal subjects while seated, over 30-minute periods. The first set of control recordings were made with no instruction other than to remain still without talking. The subjects were then given instruction on relaxation and meditation techniques before a second similar 30-minute study period. These two recordings were made on separate days. Twelve subjects were enroled with a mean age of 36 years. Subjects of these ages were more likely to experience heart rate changes than older subjects*

*The mean RR interval across all subjects during the first control recordings was 837±150 ms (mean±SD) and during relaxation and meditation 846±136, with no significant difference. In spite of no difference in mean RR interval, the RR variability (average subject SD) during meditation actually increased from 53±18 ms to 65±24 ms ($p<0.05$). In addition, it can be noted that when examining the beat-to-beat changes, the SD of beat-to-beat RR interval changes was less than that for the original RR distribution for both the control recordings and meditation recordings (both $p<0.001$). This effect was more pronounced during meditation.*

*The expected effect of lower heart rates and lower heart rate variability during meditation did not occur, probably due to the slower and deeper breathing during meditation inducing greater changes.*

## 1. Introduction

Relaxation or meditation is expected to slow the heart rate and produce more stable rate changes. However, there is little information on specific effects of meditation training. In this study we compared heart rate stability during normal and meditation conditions.

Heart rate analysis has been used in many clinical studies, including for diabetes [1], heart transplant [2,3], Alzheimer's disease and vascular dementia [4], and sleep [5], as well as for studies of multifractal characteristics [6], variation over 24 hours [7], during sleep [8,9] and Zen meditation [10-12].

For such studies, it is important to have information on stability of heart rate over extended recording periods.

We therefore in this study chose to analyse stability over 30 minute periods.

In addition, we also analysed the effect of meditation in comparison with relaxed normal breathing.

## 2. Methods

ECGs were recorded over a 30-min period, and analysed for changes in heart rate for all subjects, and the effect of meditation with controlled respiration analysed.

### 2.1. Study subjects

Twelve subjects with no known cardiac disease were enroled, and gave ethical consent. Their ages were 36±14 years (mean ± standard deviation).

None of the subjects exhibited any ectopic beat during the recording periods.

### 2.2. Study conditions

Subjects were given time for normal relaxation, but without any controlled conditions. After the study was explained, subjects were then asked to sit on an office chair, while a single channel ECG was recorded to a computer for offline analysis. After a few weeks, subjects were instructed briefly in Zen meditation techniques including respiratory exercise for lower abdominal muscle respiration [10], and rerecorded in similar conditions.

Subjects were asked to remain seated and still, without talking for the 30 minute recording period.

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## 2.3. ECG recordings

Single lead ECGs were obtained with three electrodes applied directly to the chest. The ECG amplifier gain was set at 1000. The output of the amplifier was connected to an analogue-to-digital converter at a sample rate of 250 Hz, and stored to a computer for off-line analysis (Figure 1).

## 2.4. QRS detection

ECG were filtered using time domain Savitzky-Golay filtering [13,14] and each ECG beat was detected by identifying the fast response associated with each QRS as well as by coarse grained local maxima procedures, followed by a cardiologist's confirmation.

## 2.5. Heart rate analysis

The inter beat RR intervals were determined and the instantaneous inter beat heart rate calculated.

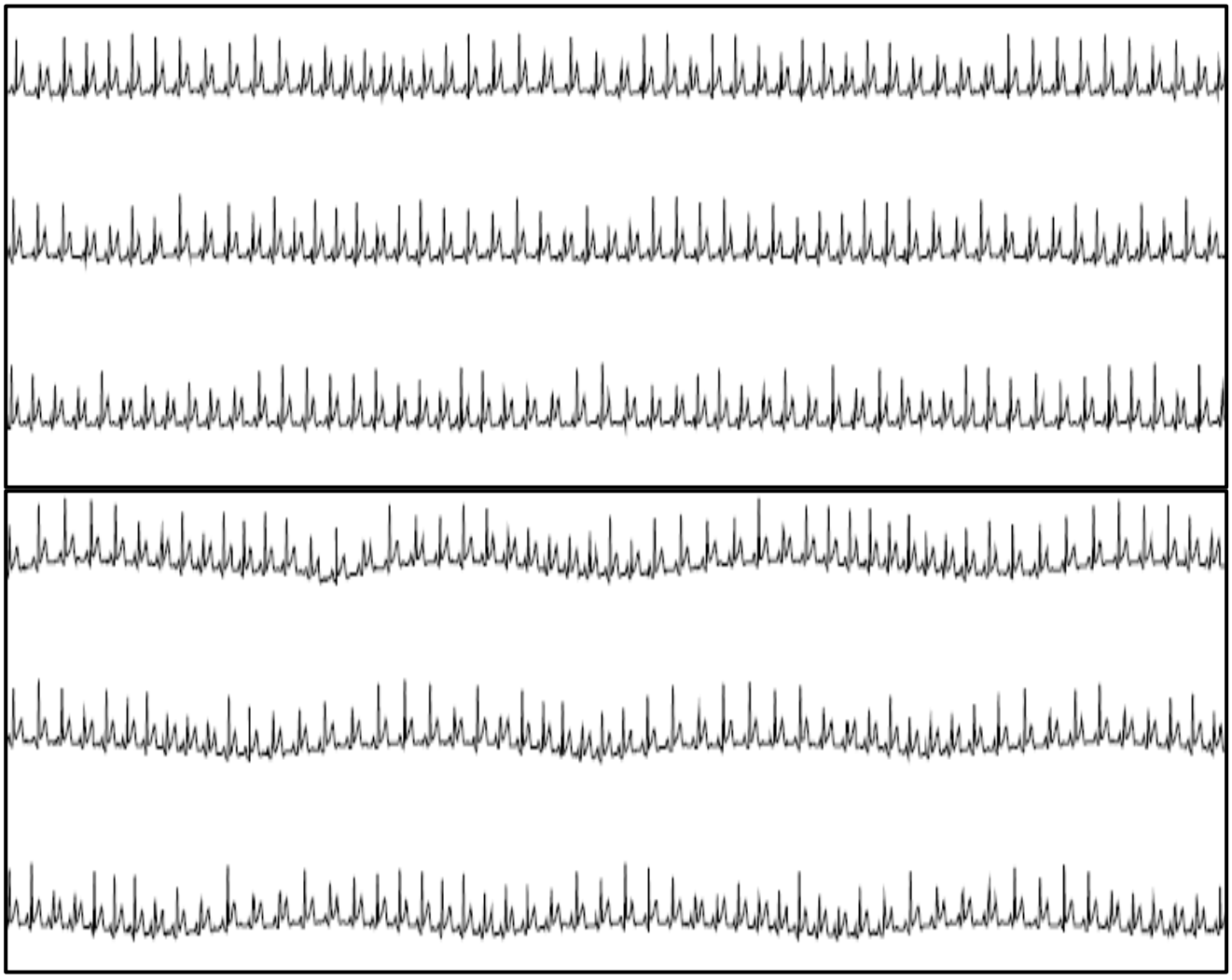

Figure 1. ECG examples from the same subject for relaxation (above) and during meditation (below).
Two minutes from each 30-min recording is shown. It can be seen that regular respiratory changes are larger during meditation.

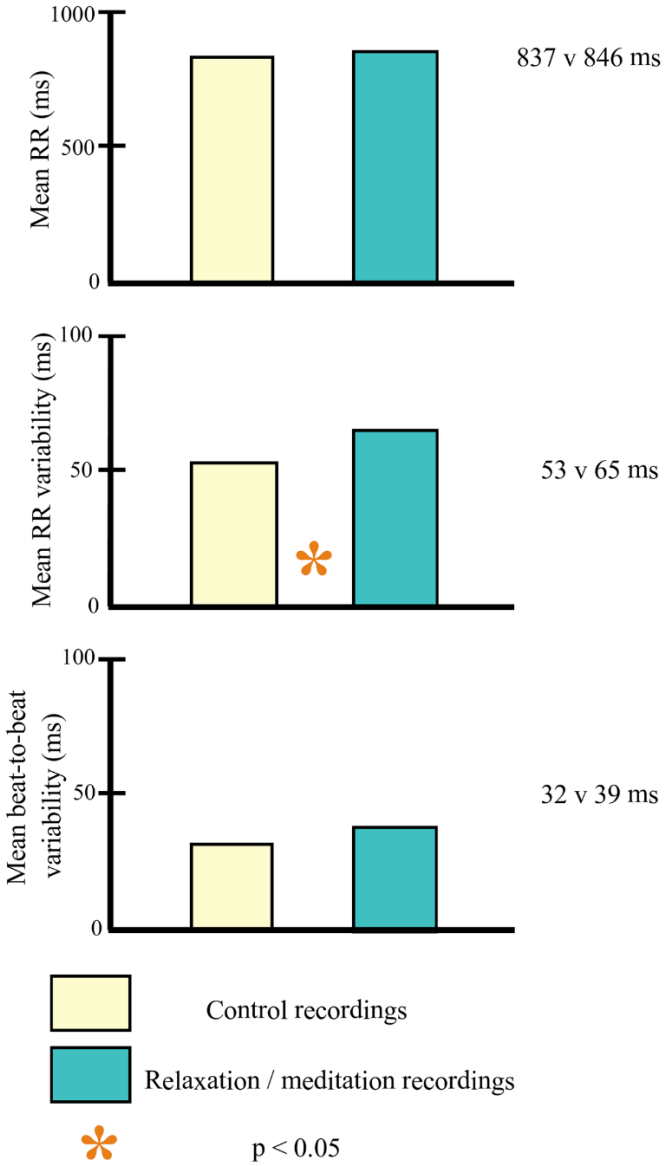


Figure 2. The mean RR interval across all subjects during the first control recordings (top) was 837±150 ms (mean±SD) and during relaxation and meditation 846±136, with no significant difference. The mean RR variability (average subject SD) during meditation (middle) actually increased from 53±18 ms to 65±24 ms ($p<0.05$). There was no significant difference for mean beat-to-beat variability (bottom).

## 3. Results

### 3.1. Comparison of heart rate between control and meditation periods

The mean RR interval across all subjects during the first control recordings was 837±150 ms (mean±SD) and during relaxation and meditation 846±136, with no significant difference (Figure 2).

### 3.2. Comparison of beat-to-beat heart rate variability between control and meditation periods

In spite of no difference in mean RR interval, the RR variability (average subject SD) during meditation actually increased from 53±18 ms to 65±24 ms ($p<0.05$) (Figure 2).

### 3.3. Comparison of variability in beat-to-beat heart rate changes between control and meditation periods

The mean variability of beat-to-beat RR interval was less than that for the original RR distribution for both the control recordings and meditation recordings (both $p<0.001$). This effect was more pronounced during meditation (Figure 2).

## 4. Discussion and conclusion

The expected effect of lower heart rates and lower heart rate variability during meditation did not occur, probably due to the slower and deeper breathing during meditation inducing greater changes [15].

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