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Improvement in Heart Rate Variability Without Treatment: A Case Study

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Abstract *Less* health care may be *better* health care. Health care based on clinical testing is a logical approach, but if there is a "bad" result it may be only temporary. The clinician would not know about this though unless there is follow-up testing. To study the notion that a clinical test finding may improve over time, without any treatment, the author measured his autonomic nervous system with heart rate variability on 30 different days, twice per day to see how well the paired readings might agree. Results showed substantial improvement in the second reading compared to the first, and this difference was statistically significant ($p < 0.0001$) with a large effect size (of 2.0). This finding is an example of why it may be prudent to perform follow-up testing prior to clinical decision-making to avoid the problem of unnecessary treatment.

Keywords: *Heart rate variability, spontaneous improvement, unnecessary treatment*

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1. Introduction

Less health care may be better health care [1]. Thus, a more conservative approach, where letting well-enough alone can be a prudent approach to achieving good health care. As renowned Harvard Medical School professor Oliver Wendel Holmes, MD said (in the 1800s), the young doctor "feels uneasy if he is not continually doing something to stir up his patient's internal arrangements," whereas the old doctor "takes things more quietly and is much more willing to let well enough alone" [2].

This case study focuses on testing the autonomic nervous system (ANS) using heart rate variability (HRV), to see how persistent an HRV finding is in an individual. Specifically, the author was curious to see if there was agreement between measurements obtained at different times of the day, without treatment. A literature search in Google Scholar and PubMed on 3-6-24 did not reveal any studies on the topic of HRV spontaneously improving. If HRV tends to improve on its own over time, then practitioners who use it for clinical decision-making, such as the author, a chiropractor, may wish to consider follow-up testing to avoid the potential problem of unnecessary treatment. In the author's case, it may help prevent unnecessary spinal adjustment in his patients.

2. Methods

The study was found to meet the exempt criteria by the Institutional Review Board at Purdue University Global. The individual in this case report is the author, who measured his own HRV using the app *Camera Heart Rate Variability* [4], which has good R-R time agreement with gold standard EKG [5]. The HRV metric used is the *root mean square of successive differences* between beats (rMSSD, measured in milliseconds [ms]). As a standard HRV metric, rMSSD measures the variability of time between heart beats. In general, higher variability represents a nervous system that is more dynamic and adaptive compared to lower variability [3]. This is important since the nervous system, particularly the ANS, controls many vital functions such as heart rate, blood pressure, and digestion. The terms HRV and rMSSD are used interchangeably in this report.

Data collection began January 22, 2024, and ended when there was a total of 30 different days of measurements. The number *30* was selected since it provides a good likelihood that normal distribution of the data is present [6].

The first of the two daily measurements was obtained shortly after awakening in the morning, between 4:00 AM and 7:45 AM ("early" readings). Measurement was obtained while in the supine position after at least 5-minutes of supine rest. The second measurement was obtained later in the morning between 9:15 AM and 10:15 AM ("later" readings). These readings were also obtained in the supine position and also after at least 5-minutes of supine rest. No treatment, exercise, medication, etc., occurred between the readings.

Analysis

The author analyzed the data. Data normality for both times of day (two data sets) was further assessed using the method of Kolmogorov and Smirnov (KS). The paired t test for differences was used between *early* rMSSD versus *later* rMSSD. Data were analyzed in GraphPad InStat (for KS and t test); and Excel (for chart construction). Two-sided p-values < the conventional alpha level of 0.05 were considered statistically significant. Effect size, using a pooled standard deviation was also included. (Although ES is typically used in the context of testing a treatment, let the reader recall that the body has a way of treating itself.) Effect sizes of 0.5 or greater represent a large (practical, clinically significant) change [7]. Trendline analysis was also included to see if the overall trend of both measurement times (early and later) agreed. The trendlines are automatically constructed by the Excel software.

3. Results

The KS test showed a normal distribution for both early and later HRV data sets ($p > 0.1$). Table 1 shows the raw data. In all but two of the 30 days (Feb 7 and Feb 21) there was an improvement (increase) in HRV from early morning to later morning.

Difference

Mean HRV nearly doubled from early to later readings, from 25.9 ms early versus 49.7 ms later. This increase (of 23.8 ms) represents a 92% improvement and is statistically significant ($p < 0.0001$) with a very large effect size (of 2.0; Table 2; Figure 1).

Trends

Both times, early and later, showed the same overall trend (of improvement) over the course of the study period, as shown by the essentially parallel (and upward) trendlines in (Figure 2).

Table 1. Raw data

Date	Early HRV	Later HRV	rMSSD difference
1/22/24	18.2	45.5	27.3
1/23/24	13.2	37.0	23.8
1/24/24	18.4	38.6	20.2
1/25/24	22.1	35.4	13.3
1/27/24	24.3	33.0	8.7
1/28/24	23.8	88.9	65.1
1/29/24	21.1	46.7	25.6
1/31/24	26.3	54.1	27.8
2/1/24	31.2	57.8	26.6
2/2/24	22.3	49.0	26.7
2/4/24	19.2	25.7	6.5
2/5/24	19.1	31.0	11.9
2/6/24	22.3	57.5	35.2
2/7/24	34.4	30.4	-4.0
2/8/24	25.1	71.9	46.8
2/9/24	33.3	58.1	24.8
2/11/24	22.6	52.1	29.5
2/12/24	31.5	49.4	17.9
2/13/24	27.3	42.4	15.1
2/14/24	30.8	62.4	31.6
2/15/24	29.2	72.5	43.3
2/18/24	39.5	65.5	26.0
2/19/24	24.5	43.0	18.5
2/20/24	25.0	35.8	10.8
2/21/24	32.8	24.8	-8.0
2/22/24	33.4	35.4	2.0
2/23/24	28.8	62.4	33.6
2/26/24	20.6	59.1	38.5
2/27/24	32.3	52.4	20.1
2/28/24	23.9	71.8	47.9
n	30	30	30
Mean	25.9	49.7	23.8
SD	6.0	15.7	15.7

Table 2. Paired t test results for differences

Variables	Improvement (ms)	p value	ES
Early vs later HRV	23.8	< 0.0001	2.0

HRV is heart rate variability (rMSSD, in milliseconds (ms). p value is from the paired t test. ES is effect size.

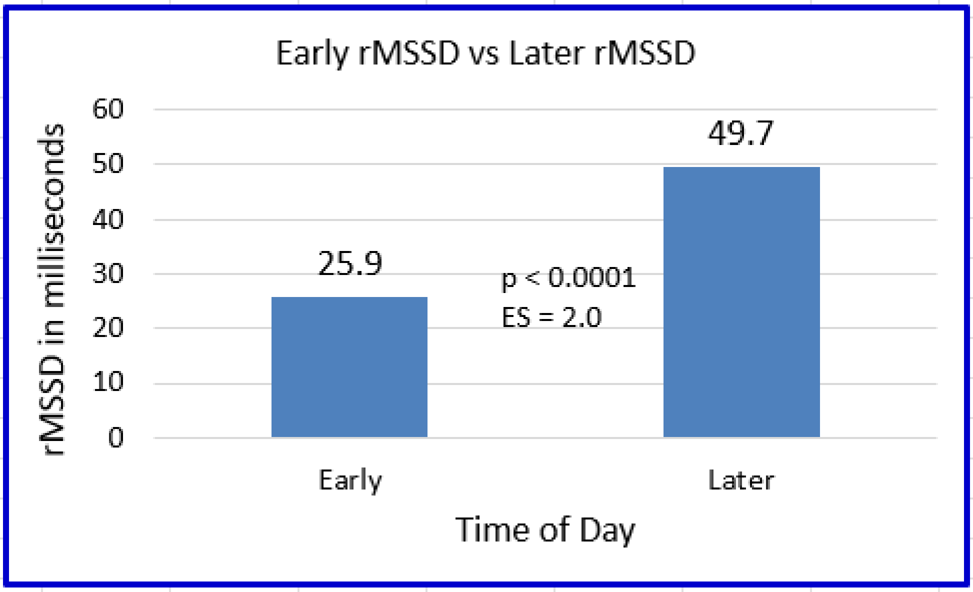

Figure 1. Early mean rMSSD vs later mean rMSSD. ES is effect size

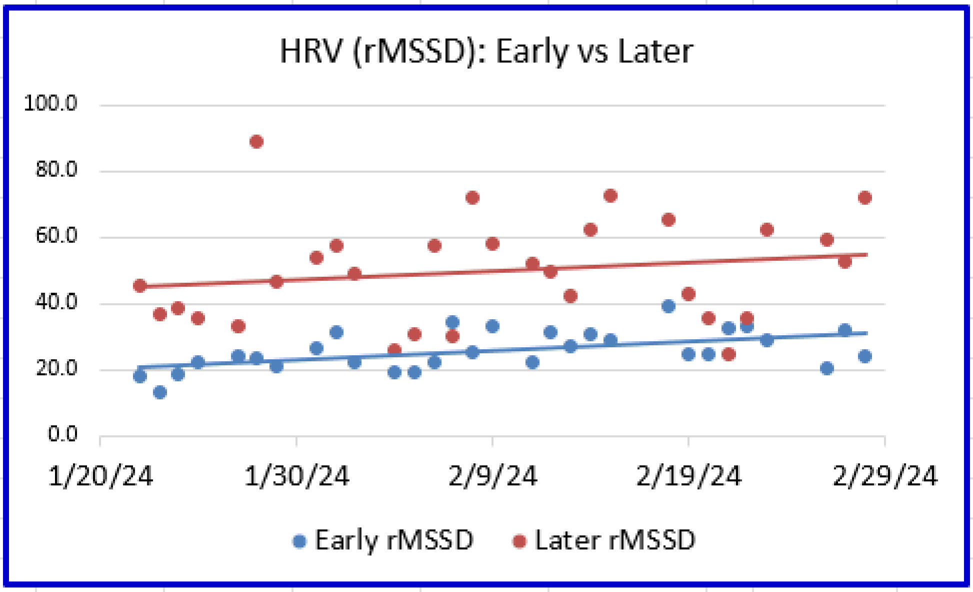

Figure 2. Scatter plot with trendlines for early and late rMSSD

4. Discussion

Heart rate variability increased (improved) from early to mid-morning in this case, without any treatment according to both the early and the later HRV readings. This may be of interest to clinicians who have a focus on autonomic health. If a patient has a "bad" HRV reading, it may behoove both clinician and patient to re-test to see if there is improvement, on its own, without treatment. If it *does* improve then treatment may not be needed. Even just minutes between readings could reveal good improvement, as shown in a case study published on one of the author's chiropractic patients [8]. In that case [8], there was marked improvement between just the first two ANS measurements, just minutes apart on her first visit. The author decided to take the watchful waiting approach in that case and the patient agreed. The patient reported that she felt much better later that day, thanks to her body's striving to heal itself. Unnecessary treatment (spinal adjustment in this case) was avoided.

Limitations to the study include those typically attached to case studies, eg, that the findings may apply only to the individual patient being studied.

5. Conclusion

This case study is an example of how a clinical test result such as heart rate variability may improve on its own, without treatment. When considering such improvement, the clinician may decide that treatment is not necessary. Further research on HRV and other clinical tests in other individuals would be a reasonable next step to help prevent the problem of unnecessary treatment. In the present case study, heart rate variability improved on its own, without treatment, in just a matter of hours.

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