A Bit About Me…

• Light form of rickets and told by MD that I couldn't play ANY sport
• Judo and skiing since the age of 6yrs
• Cycling from 11yrs of age
• Triathlon
• Nutritionist and PT, LifeGuard
• Researcher

Disclosure: I have no financial interests in any of the companies by me mentioned in this presentation and I am not paid to represent or take commissions on any of their products. Any reference is for educational/monitoring purposes only.

The information in this presentation are for didactical use only for health professionals. These information are not intended to treat or diagnose and Alessandro Ferretti can not be held responsible for the use or misuse of such information.
Establishing Evidence Based Treatments With Heart Rate Variability HRV
...is it the biggest block to therapy?
How do we know the true impact of our stress?
Why I can not improve my health…?

PALEO DIET

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Goals

- Jas wanted to feel more energised
- Improve glucose metabolism
- Improve cognition
- Lose excess adiposity
- Better understand how her environment affects her health
Significance of Heart Rate Variability

- HRV is a marker that provides a good indication of **Sympathetic activation** (High Life-load and/or inflammation) \(^1,2\)

- Regular HRV measurements identify changes between **sympathetic** (fight or flight) and **parasympathetic** (rest and recovery) nervous systems \(^1,2,3,4\).

- Useful means to **identify individual stressors** and recovery \(^3,4,5\)
Daily Stress 24hr Monitoring

- **Stress reactions**: 15 min with the best daytime recovery. Recovery during leisure time enhances your overall coping.

- **Physical activity**: 15 min with the strongest stress reactions.

- **Heart rate**: The sleep period was shorter than recommended and recovery was poor.

**STRESS AND RECOVERY**

- **% of stress reactions**: 65% more than usual, 40 - 60% normal, < 40%.
- **% of recovery**: 14% < 25% low, 20 - 29% moderate, ≥ 30% good.

**WORK**

- **No work period**

**PHYSICAL ACTIVITY**

- **Total duration of physical activity**: 1 hr 20min of which fitness-improving physical activity 42min. In addition, there was 1hr 3min of daily physical activity.

**ENERGY EXPENDITURE**

- **Total energy expenditure**: 2963 kcal
  - Physical activity 716 kcal
  - Other 1975 kcal
- **Daily physical activity**: 273 kcal

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Findings

• Jas seems to have a high sympathetic activation exceeding substantially her parasympathetic activity.

• Sometimes when she thinks that she is relaxing, she isn’t.

• During the day both mental and metabolic resources are in deficit.

• Sleep recovery is poor.
Daily Stress 24hr Monitoring

- **BODY RESOURCES**
  - Starting level
  - Resources increased and decreased

- **STRESS AND RECOVERY**
  - Stress reactions, Recovery, Physical activity, Daily physical activity, Significant recovery period

- **SLEEP**
  - Length of Sleep:
    - Your average: Moderate (6h 20min)
      - In your age group average is 7h 32min.
  - % of Recovery:
    - Your average: Poor (18%)
  - % of Recovery during Sleep:
    - Your average: Poor (43%)

- **PHYSICAL ACTIVITY**
  - Physical activity index
  - The measurement included one workout with a fitness-improving Training Effect.

- **ENERGY EXPENDITURE**
  - Energy expenditure (kcal):
    - Steps: 6933, 5860, 5048

**Note:**
- Illness Chronic Stress
Daily HRV Morning Reading
What is Heart Rate Variability?
The Heart Beat

- **Time**: 0.2 sec
- **Voltage**: 1 mV
- **Voltage**: 0.1 mV
- **Time**: 0.04 sec
- **RR Interval**
- **QRS Complex**
- **T Wave**
- **ST Segment**
- **U Wave**
- **P Wave**
- **PR**
- **QRS**
- **QT**
HRV Across Groups

Untrained
Trained
Athletes
OTS
Heart Rate Variability

• A healthy, well-rested body will produce a larger gaps (lower HR) with higher variability between them (higher HRV) than a stressed-out, under-recovered body.

• Heart Rate is not always accurate as affected by many factors.

• Most important value in HRV is rMSSD.

• There are 3 types of measurements:
  - Whilst your body is at rest to determine baseline - i.e. first thing in the morning.
  - At specific times to measure how the environment is influencing performance/physiology - i.e. before and after food.
  - 24hr ongoing measurement to understand body resources - i.e. over a few days.
Is HRV a useful clinical tool?
Areas of Research

• CVD: post Myocardial Infarction survival rate.

• Psychophysiology (stress, depression, panic attacks, PTSD, etc).

• Sport performance (recovery, training planning etc).

• Inflammation:
  - Diseases, sport performance.

• Sleep disturbance.

• Diabetes.
Diabetes CVD


Decreased heart rate variability may predict the progression of carotid atherosclerosis in type 2 diabetes.
Gottsäter A¹, Ahlgren AR, Taimour S, Sundkvist G.

Abstract
Heart rate variability (HRV), a measure of autonomic function, can predict survival outcomes. Cardiovascular disease is a known complication of diabetes, and we aimed to determine if autonomic dysfunction was associated with carotid artery atherosclerotic plaques in type 2 diabetic patients. We assessed frequency domain HRV from power spectral analysis of 24 h Holter ECG recordings, expiration/inspiration (E/I) ratio during deep breathing, acceleration index (AI) of R-R interval in response to head-up tilt, and the degree of carotid artery atherosclerosis in 61 type-2 diabetic patients (39 males, 45-69 years). Studies were carried out 5-6 years after diagnosis (baseline) and repeated 8 years after diagnosis (follow-up). At baseline, patients diagnosed with autonomic neuropathy, with abnormal E/I ratio and abnormal AI measurements, had decreased low frequency (LF) HRV. Baseline E/I ratio correlated with day \( (r = 0.34; P < 0.001) \) and night-time \( (r = 0.44; P < 0.001) \) LF power. Night-time HRV did not differ in patients with and without autonomic neuropathy. Reduced common carotid artery diameter and atherosclerotic intima-media thickness (IMT) both correlated with HRV at baseline. At follow-up, all HRV variables decreased significantly. Furthermore, patients with lower LF power at baseline, had a larger increase in the thickness of the carotid bulb intima-media at follow-up. Our results show that LF HRV power is associated with the extent and progression of carotid atherosclerosis in type 2 diabetes. A low LF HRV may predict the progression of atherosclerosis in these patients.

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Psychosocial Disorders

Heart rate and heart rate variability in panic, social anxiety, obsessive–compulsive, and generalized anxiety disorders at baseline and in response to relaxation and hyperventilation

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Abstract

It remains unclear if diminished high frequency heart rate variability (HF-HRV) can be found across anxiety disorders. HF-HRV and heart rate (HR) were examined in panic (PD), generalized anxiety (GAD), social anxiety (SAD), and obsessive–compulsive disorder (OCD) relative to healthy controls at baseline and during anxiety stressors. All disorders evidenced diminished baseline HF-HRV relative to controls. Baseline HRV differences were maintained throughout relaxation. For hyperventilation, PD and GAD demonstrated greater HR than controls. Psychotropic medication did not account for HF-HRV differences except in OCD. Age and sex evidenced multiple main effects. Findings suggest that low baseline HF-HRV represents a common index for inhibitory deficits across PD, GAD, and SAD, which is consistent with the notion of autonomic inflexibility in anxiety disorders. Elevated HR responses to hyperventilation, however, are specific to PD and GAD.

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A pilot study on quantification of training load: The use of HRV in training practice

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Abstract
Recent laboratory studies have suggested that heart rate variability (HRV) may be an appropriate criterion for training load (TL) quantification. The aim of this study was to validate a novel HRV index that may be used to assess TL in field conditions. Eleven well-trained long-distance male runners performed four exercises of different duration and intensity. TL was evaluated using Foster and Banister methods. In addition, HRV measurements were performed 5 minutes before exercise and 5 and 30 minutes after exercise. We calculated HRV index (TLHRV) based on the ratio between HRV decrease during exercise and HRV increase during recovery. HRV decrease during exercise was strongly correlated with exercise intensity (R = −0.70; p < 0.01) but not with exercise duration or training volume. TLHRV index was correlated with Foster (R = 0.61; p = 0.01) and Banister (R = 0.57; p = 0.01) methods. This study confirms that HRV changes during exercise and recovery phase are affected by both intensity and physiological impact of the exercise. Since the TLHRV formula takes into account the disturbance and the return to homeostatic balance induced by exercise, this new method provides an objective and rational TL index. However, some simplification of the protocol measurement could be envisaged for field use.
Use of HRV in clinical practice
How can we apply in clinical practice?

- Track a baseline (snapshot):
  - Stress, inflammation, sleep, training sessions etc.
- Track impact of the environment (mainly ongoing):
  - Impact of specific activities,
  - Impact of dietary and supplement changes.
How do we measure HRV?

• Heart Monitor with apps as ‘snapshot’ (see Appendix)
  - One morning measurement upon waking lasting 1-2 minutes.

• Heart Monitor with apps as ‘24hr recording’ (see Appendix)
  - Ongoing measurement over the duration of several days.

• Camera Optical Lens (PPG) on fingertips (phones) or finger (OURA) are alternative to heart monitors.
  - Wrist monitors - Kit Quality? (see Appendix)
Apps

iThlete

EliteHRV

HRV4Training
FirstBeat BodyGuard2
Establishing Baseline

• Tailor programme to the individual.

• Find HRV Baseline and familiarise how it changes in relation to the environment.

• Maintain constant parameters: time and length of measurements, breathing, posture etc.

• Monitor HRV, resting HR and glucose levels (and Ketones if relevant).

• Begin at a medium level and progress gradually, noticing when the HRV drops.
HRV - Common negative factors
Designing a Protocol using HRV
Designing a Protocol

• Start with identifying all the biggest contributors to symptoms and look for the cause:
  
  - Many systems are at play when considering overall health - performance & recovery capacity, including mental, physical & physiological aspects.
  
  - Try to gain a complete picture of the individual; remember to include questions about habits, rest & sleep patterns.

• Leverage on motivation: 80/20 rule
  
  - Black & white visualisation of triggers and findings.
Let’s revisit Jas…

• Her reaction to stress was very clearly highlighted via HRV.
  
  - This was reflected in glucose levels. Stress response acting via glucocorticoids eventually affecting insulin resistance.
  
  - Contributing to her weight, energy and fasting and post prandial glucose levels.

• Food reactions?
First set of data
Changes made based on HRV

• Awareness:
  - Track HRV daily first thing in the morning
  - Integrating visualisation/meditation every morning
  - Structure the day
  - Daily walks interacting with nature

• Management of Triggers:
  - No emails until 10:00am
  - Focus on self for the first part of the day
  - Food selection
  - Create an evening routine to switch off from work
Follow up data
Follow up data

LIFESTYLE ASSESSMENT SUMMARY

- Age: 49
- Height (cm): 167
- Weight (kg): 63
- Body Mass Index: 22.6

Assessment: 18.07.2015 - 18.07.2015

BODY RESOURCES

STRESS AND RECOVERY

- Positive
- Negative

% OF RECOVERY:

- Good
- Moderate
- Poor

% OF RECOVERY DURING SLEEP:

- Good
- Moderate
- Poor

PHYSICAL ACTIVITY

PHYSICAL ACTIVITY INDEX:

- Good
- Moderate
- Poor

ENERGY EXPENDITURE

ENERGY EXPENDITURE (kcal):

- Other expenditure
- Daily physical activity
- Physical activity

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Conclusions on HRV

• Powerful tool available to use in clinical practice.

• Precise detection of inflammation and sympathetic activation.

• Very inexpensive options available.

• Quick & easy to measure.
Appendix
HRV apps and devices

• HR, HRV Monitor (Polar H7, Zephyr, Armour, FirstBeat).

• Camera Optical Lens (PPG) on fingertips (phones) or finger (OURA)- Optical wrist monitors seem not to be reliable.

• HRV app (HRV4Training iOS, iThlete iOS/Android, EliteHRV iOS/Android, HRVLogger iOS, Stressed Out iOS).

• Sleep monitor app (‘Sleep Cycle’, ‘Sleep Time’, Beddit)

• For in depth reviews of most common devices go to - www.dcrainmaker.com
HRV Apps

- Biocom Technologies
- Biofeedback Stone
- Bioforce HRV
- BLE Heart Rate & HRV Recorder
- Breathe Sync™
- CardioMood HRV Expert
- Elite HRV
- emWave2 and emWave PRO
- Firstbeat Technologies
- FitPal
- Health Reviser
- HRV4Training
- Inner Balance
- iRelief
- iThlete
- MyCalmBeat
- OPzone Connect
- Somatic Vision Alive
- SweetBeat
- Vitness Rx

www.wikipedia.org/wiki/Heart_rate_variability
References


