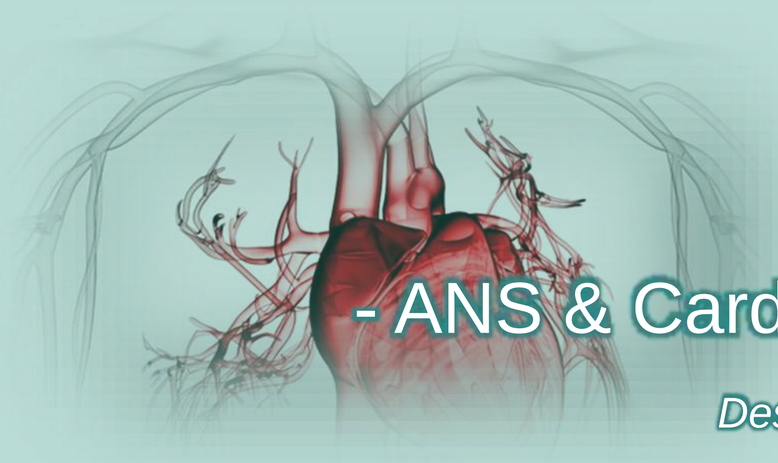
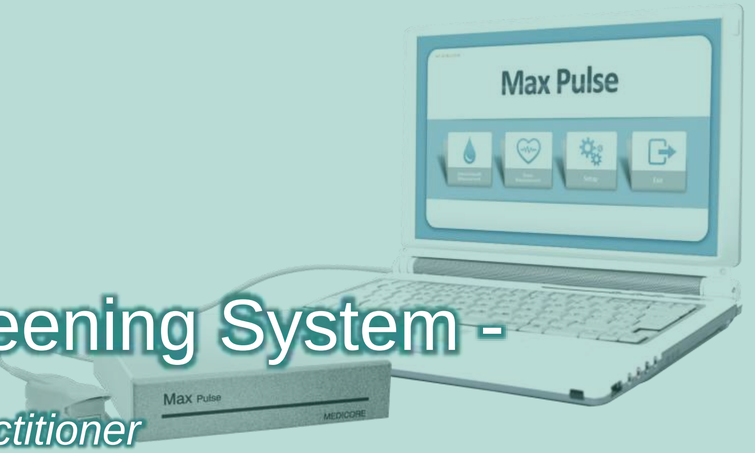


Max Pulse

- ANS & Cardiovascular Health Screening System -

Designed for Cardiologist & General Practitioner



MEDICORE

AT THE CORE OF MEDICAL TECHNOLOGY

Company Profile

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- C.E.O: Young Shin, Cho
- Field of Business: Medical Devices / Software / IoHT Web Service
- Foundation Date: Aug. 14th, 1999
- Annual Sales Volume: USD $12M
- Address:
  - H.Q & R&D Center: 3F Samwoo B/D, 13-8, Baekjegobunro 20gil, Songpa-gu, Seoul, Korea
  - Factory: No.801~803, Joonganginnotech, 148, Sagimakgolro, Jungwon-gu, Seongnam-si, Gyunggi-do, Korea

Our Success is to Encourage Everyone

to Live a Healthy Life...

Our History

- Established

2000
- Development of Infrared Thermography Device
- Development of ANS Analyzer

2001 ~ 2009
- Built Asian HRV Reference for the 1st in the world
- Built HRV Reference for pediatric & teenager
- Acquired Patents of ANS Analyzer in Korea & Japan
- FDA/CE/CFDA approval for SA-3000P

2010~2018
- Acquired Patents of APG Analyzer in Korea
- FDA/CE/CFDA approval for Max Pulse
- CE/FCC/CFDA/MHLW approval for Smart Pulse
- CE/CFDA approval for IRIS XP

2018 ~
- Development of Healthcare Web/Cloud Platform
- Development of IRIS-QT for monitoring of COVID-19

Our Products

We are a leading manufacturer of Medical Devices for **the World-Class Cardiovascular Screening & Digital Infrared Thermography Imaging Technology**.

SA-3000P

ANS Analyzer
For Professional Use

Smart Pulse

The World's Only
Personal Cardiovascular
Screening Device

Max Pulse

State of The Art
ANS & Cardiovascular
Health Analyzer

IRIS-XP

Digital Infrared Thermography System

IRIS-QT

Digital Infrared Thermography System for Quarantine

Part 1. Max Pulse ?

Max Pulse?

The Test Analyzes

- Overall Cardiovascular Health
- Heart Rate Variability & Mean Heart Rate
- Elasticity of Artery & Peripheral (Arterial Stiffness)
- Aging of Blood Vessel & Blood Circulation
- Mental/Physical Stress & Resilience to Stress
- Autonomic Nervous System Function

The Max Pulse provides measurements using Heart Rate Variability & Accelerated Plethysmography to access overall **Cardiovascular and Autonomic Nervous System Function**

It is a useful tool in assisting health-care practitioners, technicians, and individuals in the early detection of cardiovascular related issues. The test will also help assess nutraceutical and/or pharmaceutical needs.

Through periodic screenings and treatments (exercise, diet, and supplementation etc.), one is able to monitor the effectiveness of these changes and how they relate to the person’s cardiovascular, autonomic, and overall health status.

Why Should You Use Max Pulse?

High Usability

- **Easy, User-friendly [1 MIN Screening Available], 100% Non-invasive (FDA Class 2)**
- Compatible with both Windows & Mac OS
- Support 7 Languages (English/German/Spanish/Chinese/Japanese/Thai/Korean)

Unique

- **Cardiovascular Screening (World-Top Class APG analysis technology)**
- **Autonomic Nervous System Function Test (World-Top Class HRV analysis technology)**
- Widely applicable from Pediatric to Adults
- **Provide both Asian & Western Clinical Reference (The World's Only)**

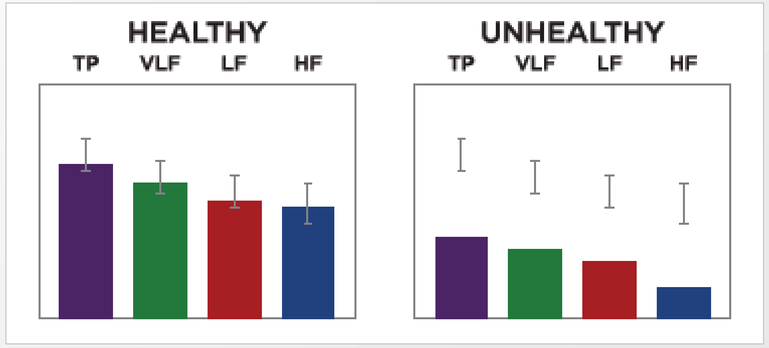
Reliability

- **Built ASIAN Reference for the 1st in the world**
- **FDA, CE, CFDA, MHLW approved**
- Acquired Patents of HRV & APG Analyzer in Japan & Korea
- Development on the basis of more than 200 clinical papers including SCI Level

What Max Pulse Screening Will Tell You - HRV -

FREQUENCY DOMAIN ANALYSIS:

TP: Total Power, combination of the 3 frequencies
VLF: Very Low Frequency
LF: Low Frequency
HF: High Frequency



Reduction of TP: Decreased ANS function, decrease in regulatory competence and a decrease in the ability to cope with environmental change.
Reduction of VLF: Decrease in the bodies ability to regulate body temperature and hormone levels.
Reduction of LF: Loss of energy, fatigue, insufficient sleep and lethargy.
Reduction of HF: Chronic stress, aging, reduced electrical stability of the heart.

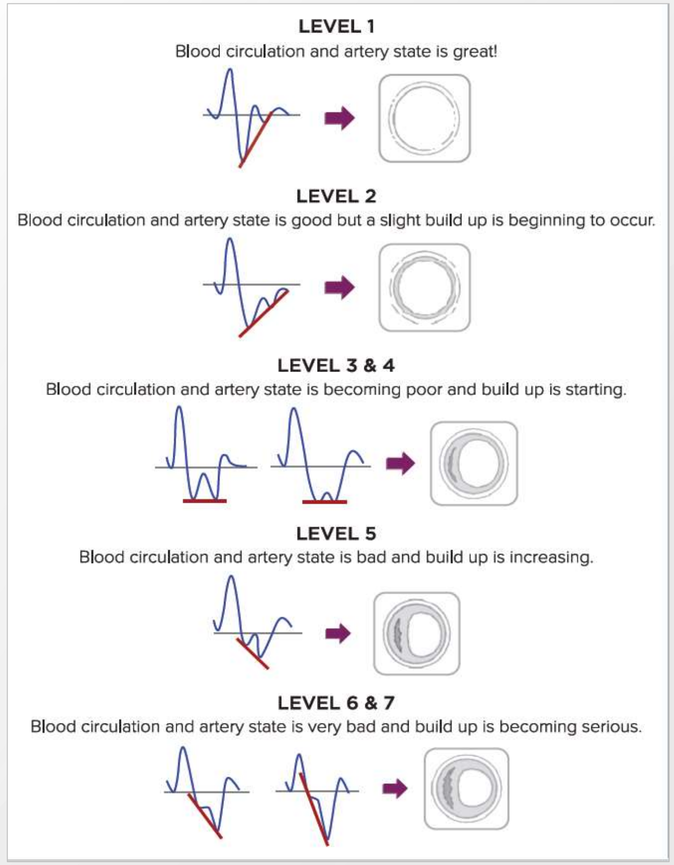
ANS Activity: It indicates the activity of Autonomic Nervous System function and its regulation competence.

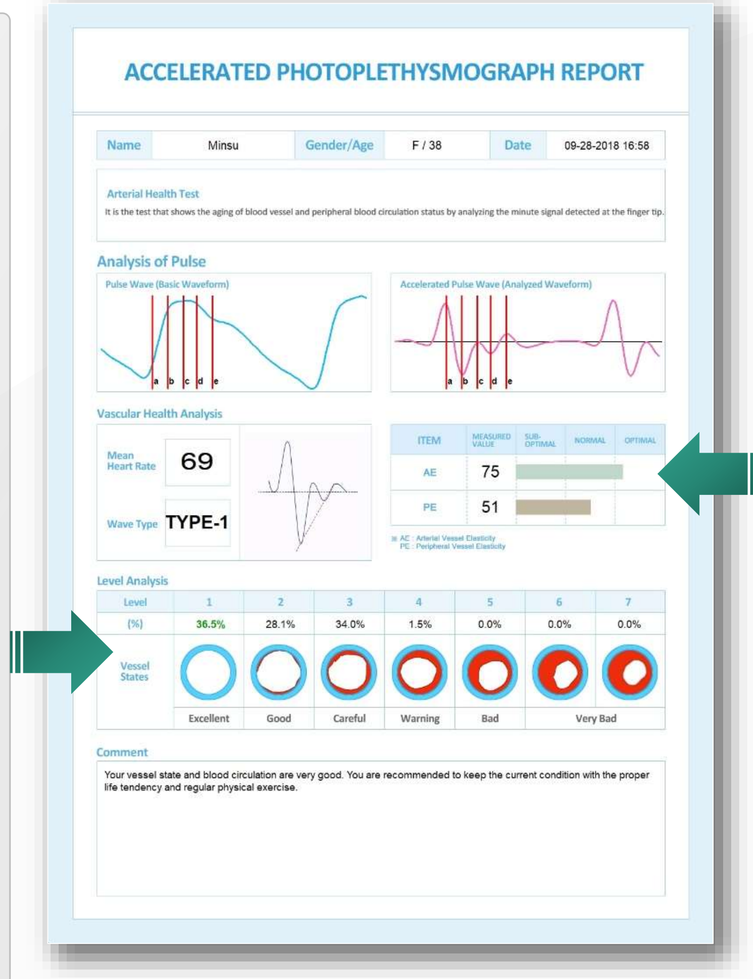
Electro Cardiac Stability: It is decreased because of chronic stress and lowered Electro Cardiac Stability may make a risk of cardiac disorder.

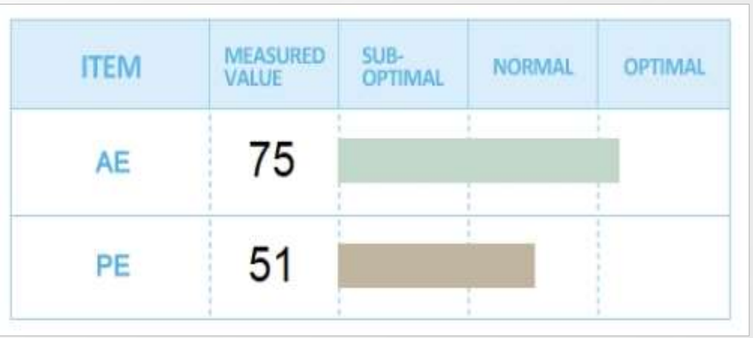
Stress Resilience: As an indicator of how much we are adaptable to the stress, it will be greatly resistant to the stress in the healthy people under the same stress while it will be lower in resistance
for the unhealthy people if they lose the resistant ability in the body or have a weak autonomic nerve system function.

What Max Pulse Screening Will Tell You - APG -

Wave Type: It displays the distribution of the aging level in percentage for your blood vessel by 7 Types.
(The percentages may be spread out or 100% in a given wave type)







Arterial Elasticity: It shows the degree of the blood flow and contraction power of artery from the heart to other parts of the body.

Peripheral Elasticity: It shows the degree of the blood circulation of peripheral blood vessel delivering to the furthest from the heart.

Clinical Research

How to Build ASIAN HRV Reference?

1. Clinical reference research at 8 major hospitals in Korea

- Pusan University Hospital
- Donga University Hospital
- Seoul Baek Hospital of Inje University
- Eulgy University Hospital
- Ihwa University Hospital
- Dankuk University Hospital
- Ghil University of Ghachun Medical College
- Sungshim University of Hanlim University

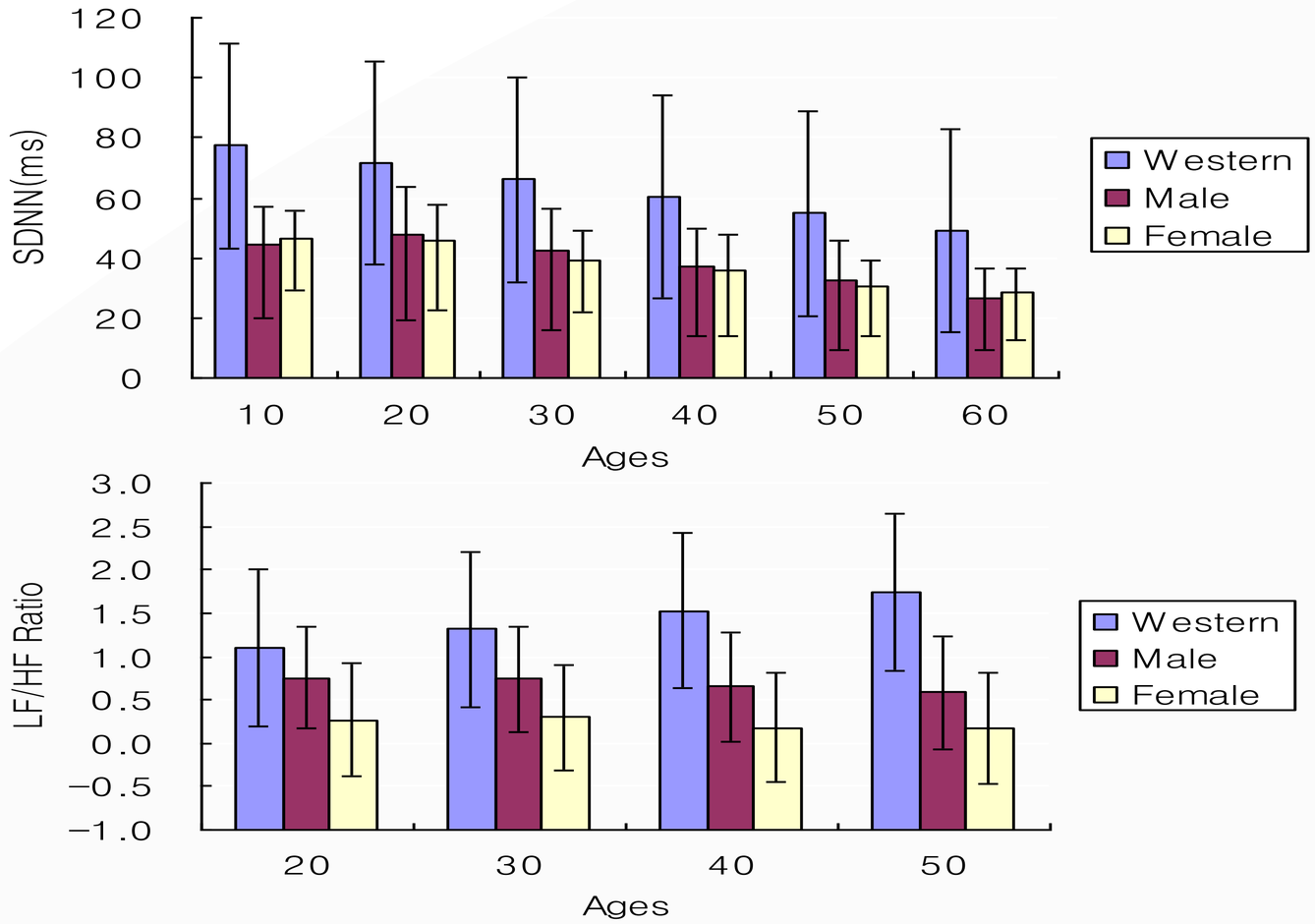
2. Clinical research for 2 years (from May 2001 to June 2003)

3. Acquired 3,600 normal cases

4. Build ASIAN HRV Reference for the 1st in the world and get its Patent

Comparison for Asian & Western Reference

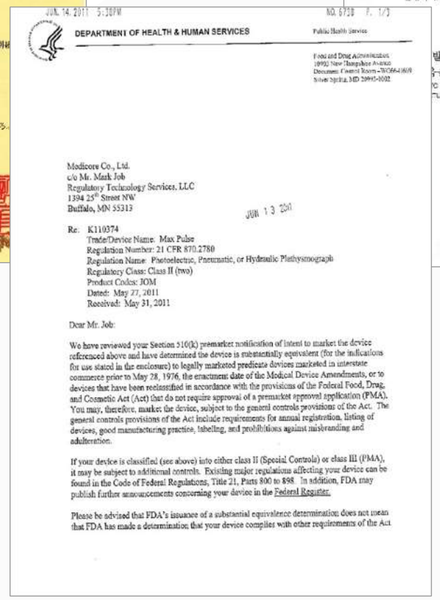
Difference of Reference Value between Asian and Western people



Certificates & Patents

CFDA

HRV Patent



FDA

HRV Patent

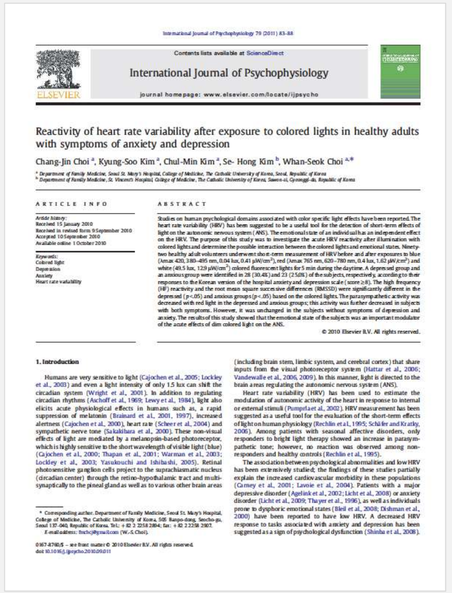
CE

APG Patent

MHLW

Clinical Papers

We have published more than
200 Clinical Papers including SCI Level
using our HRV/APG Analyzing System.



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journal homepage: www.elsevier.com/locate/ijpsycho

Reactivity of heart rate variability after exposure to colored lights in healthy adults with symptoms of anxiety and depression

Chang-Jin Choi [a], Kyung-Soo Kim [a], Chul-Min Kim [a], Se- Hong Kim [b], Whan-Seok Choi [a,*]

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Heart rate variability

ABSTRACT

Studies on human psychological domains associated with color specific light effects have been reported. The heart rate variability (HRV) has been suggested to be a useful tool for the detection of short-term effects of light on the autonomic nervous system (ANS). The emotional state of an individual has an independent effect on the HRV. The purpose of this study was to investigate the acute HRV reactivity after illumination with colored lights and determine the possible interaction between the colored lights and emotional states. Ninety-two healthy adult volunteers underwent short-term measurement of HRV before and after exposures to blue (mean 420, 180–495 nm, 0.94 lux, 0.41 μW/cm²), red (mean 705 nm, 820–780 nm, 0.4 lux, 1.82 μW/cm²), and white (49.5 lux, 129 μW/cm²) colored fluorescent lights for 5 min during the daytime. A depressed group and an anxious group were identified in 28 (30.4%) and 23 (25.0%) of the subjects, respectively, according to their responses to the Korean version of the hospital anxiety and depression scale (cutoff score ≥8). The high frequency (HF) reactivity and the root mean square successive differences (RMSSD) were significantly different in the depressed ($p<.05$) and anxious groups ($p<.05$) based on the colored lights. The parasympathetic activity was decreased with red light in the depressed and anxious groups; this activity was further decreased in subjects with both symptoms. However, it was unchanged in the subjects without symptoms of depression and anxiety. The results of this study showed that the emotional state of the subjects was an important modulator of the acute effects of dim colored light on the ANS.

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1. Introduction

Humans are very sensitive to light (Cajochen et al., 2005; Lockley et al., 2003) and even a light intensity of only 1.5 lux can shift the circadian system (Wright et al., 2001). In addition to regulating circadian rhythms (Aschoff et al., 1969; Lewy et al., 1984), light also elicits acute physiological effects in humans such as, a rapid suppression of melatonin (Brainard et al., 2001, 1997), increased alertness (Cajochen et al., 2000), heart rate (Scheer et al., 2004) and sympathetic nerve tone (Sakakibara et al., 2000). These non-visual effects of light are mediated by a melanopsin-based photoreceptor, which is highly sensitive to the short wavelength of visible light (blue) (Cajochen et al., 2000; Thapan et al., 2001; Wu-tsan et al., 2003; Lockley et al., 2003; Yasukouchi and Ishibashi, 2005). Retinal photosensitive ganglion cells project to the suprachiasmatic nucleus (circadian center) through the retino-hypothalamic tract and multi-synaptically to the pineal gland as well as to various other brain areas (including brain stem, limbic system, and cerebral cortex) that share inputs from the visual photoreceptor system (Hattar et al., 2006; Vandewalle et al., 2006, 2009). In this manner, light is directed to the brain areas regulating the autonomic nervous system (ANS).

Heart rate variability (HRV) has been used to estimate the modulations of autonomic activity of the heart in response to internal or external stimuli (Pomeplaet al., 2002). HRV measurement has been suggested as a useful tool for the evaluation of the short-term effects of light on human physiology (Bechlin et al., 1995; Schlotz and Kirsty, 2006). Among patients with seasonal affective disorders, only responders to bright light therapy showed an increase in parasympathetic tone; however, no reaction was observed among non-responders and healthy controls (Bechlin et al., 1985).

The association between psychological abnormalities and low HRV has been extensively studied; the findings of these studies partially explain the increased cardiovascular morbidity in these populations (Carney et al., 2005; Lanzie et al., 2004). Patients with a major depressive disorder (Agelink et al., 2002; Licht et al., 2008) or anxiety disorder (Licht et al., 2009; Thayer et al., 1996), as well as individuals prone to dysphoric emotional states (Bleil et al., 2008; Dishman et al., 2000) have been reported to have low HRV. A decreased HRV response to tasks associated with anxiety and depression has been suggested as a sign of psychological dysfunction (Shinba et al., 2008).

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The Impact of the Components of Metabolic Syndrome on Heart Rate Variability: Using the NCEP-ATP III and IDF Definitions

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From the *School of Public Health and Institute of Health and Environment, Seoul National University, Seoul, Republic of Korea; and †Department of Occupational and Environmental Medicine, Ajou University School of Medicine, Suwon, Republic of Korea

Background: *This study examined the relationship between metabolic syndrome (MetS) and heart rate variability (HRV) in Korean adults.*

Methods: *Data were collected from family health examinations performed from December 2003 through January 2004, and 1,041 subjects consisting of males and females aged 20–87 years were included in this study. Measurement of the 5-minute HRV and several examinations for MetS were completed. The HRV was analyzed in both the time domain with the standard deviation of NN (SDNN) intervals and the frequency domain with the low frequency (LF) and high frequency (HF) components. MetS was defined by the criteria of the National Cholesterol Education Program's Adult Treatment Panel III (NCEP-ATP III) and the International Diabetes Federation (IDF).*

Results: *There were significant differences in the MetS components and HRV indices between the two groups (with vs without MetS). The adjusted means of the HRV indices in the group with MetS were significantly lower than those in the group without MetS ($P < 0.05$). Furthermore, a significant negative correlation was found between all components of MetS and the HRV indices; additionally, as the number of MetS components increased, the HRV indices gradually decreased.*

Conclusions: *Decreased cardiac autonomic tone was strongly associated with an increased cardiovascular risk, and HRV measurement could become an indispensable part of evaluating one's risk of cardiovascular disease, though we currently do not have sufficient information to identify the cutoff values for the HRV indices. (PACE 2008; 31:584–591)*

heart rate variability, syndrome X, cardiovascular diseases, prevention

Introduction

Metabolic syndrome (MetS) is characterized by the clustering of glucose intolerance, insulin resistance, central obesity, dyslipidemia, and hypertension, each of which is a risk factor for cardiovascular disease.[1] This syndrome is increasing in importance due to its becoming more common in several countries[2–4] and because it is known to play an important role in cardiovascular morbidity and mortality and the development of diabetes.[5,6]

Heart rate variability (HRV), another predictor of cardiovascular disease, has been widely used to assess cardiac autonomic balance due to its non-invasive measurement and high reproducibility.[7,8] Decreased HRV is considered to be an accurate indicator of poor outcome in the general population[9] and in patients with cardiovascular disease, diabetes mellitus, and other conditions.[10,11] A recent study reported an association between HRV and MetS, suggesting that MetS disorders adversely affect cardiac autonomic control and reduced cardiac autonomic control contributes to an increased risk of cardiovascular events in individuals with these diseases.[12] Within this perspective, HRV is a good marker for monitoring cardiovascular autonomic responses and the progress of cardiovascular disease.[7,8] A remarkable increase in cardiovascular disease and diabetes has occurred over the past few decades,[13] and this increase has been accompanied by an elevation in the occurrence of MetS.[14] This study was undertaken to evaluate the association between MetS and various HRV indices in terms of time and frequency. For this purpose, we compared the differences in HRV indices (standard deviation of NN intervals, SDNN; high-frequency component, HF; and low-frequency component, LF) between groups with and without MetS. Furthermore, the HRV indices were analyzed in accordance with the number of MetS components using the criteria of the National Cholesterol Education Program's Adult Treatment

This study did not indicate potential conflicts of interest, including financial interests.

Address for reprints: Sung-Il Cho, Professor, School of Public Health and Institute of Health and Environment, Seoul National University, Chungno-gu Yongnon-dong 28, Seoul, Republic of Korea 110-799. Fax: +82-2-3273-1697; e-mail: scho@snu.ac.kr

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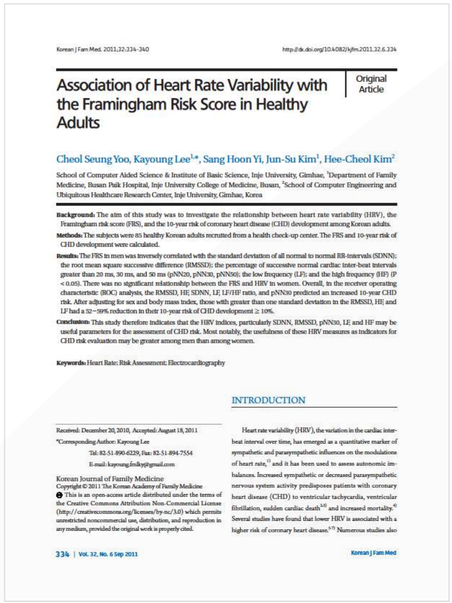

Korean J Fam Med. 2011;32:334-340 http://dx.doi.org/10.4082/kjfm.2011.32.6.334

Original Article

Association of Heart Rate Variability with the Framingham Risk Score in Healthy Adults

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Background: The aim of this study was to investigate the relationship between heart rate variability (HRV), the Framingham risk score (FRS), and the 10-year risk of coronary heart disease (CHD) development among Korean adults.

Methods: The subjects were 85 healthy Korean adults recruited from a health check-up center. The FRS and 10-year risk of CHD development were calculated.

Results: The FRS in men was inversely correlated with the standard deviation of all normal to normal RR-intervals (SDNN); the root mean square successive difference (RMSSD); the percentage of successive normal cardiac inter-beat intervals greater than 20 ms, 30 ms, and 50 ms (pNN20, pNN30, pNN50); the low frequency (LF); and the high frequency (HF) ($P < 0.05$). There was no significant relationship between the FRS and HRV in women. Overall, in the receiver operating characteristic (ROC) analysis, the RMSSD, HF, SDNN, LF, LF/HF ratio, and pNN30 predicted an increased 10-year CHD risk. After adjusting for sex and body mass index, those with greater than one standard deviation in the RMSSD, HF, and LF had a 32–59% reduction in their 10-year risk of CHD development ≥ 10%.

Conclusions: This study therefore indicates that the HRV indices, particularly SDNN, RMSSD, pNN30, LF, and HF may be useful parameters for the assessment of CHD risk. Most notably, the usefulness of these HRV measures as indicators for CHD risk evaluation may be greater among men than among women.

Keywords: Heart Rate; Risk Assessment; Electrocardiography

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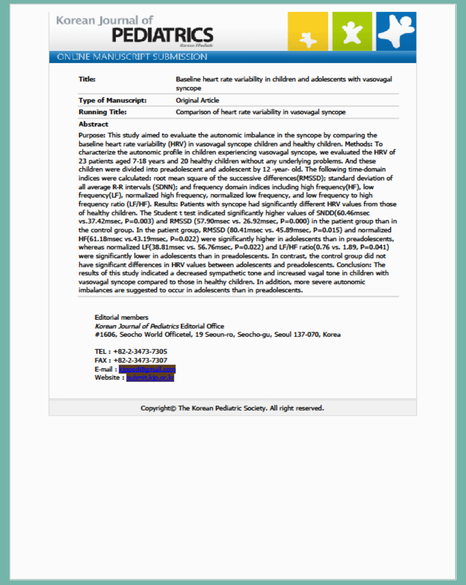
Korean Journal of Family Medicine

INTRODUCTION

Heart rate variability (HRV), the variation in the cardiac inter-beat interval over time, has emerged as a quantitative marker of sympathetic and parasympathetic influences on the modulations of heart rate,[1] and it has been used to assess autonomic imbalances. Increased sympathetic or decreased parasympathetic nervous system activity predisposes patients with coronary heart disease (CHD) to ventricular tachycardia, ventricular fibrillation, sudden cardiac death[2,3] and increased mortality.[4] Several studies have found that lower HRV is associated with a higher risk of coronary heart disease.[5,6] Numerous studies also



Korean Journal of PEDIATRICS

ONLINE MANUSCRIPT SUBMISSION

Title:	Baseline heart rate variability in children and adolescents with vasovagal syncope
Type of Manuscript:	Original Article
Running Title:	Comparison of heart rate variability in vasovagal syncope

Abstract

Purpose: This study aimed to evaluate the autonomic imbalance in the syncope by comparing the baseline heart rate variability (HRV) in vasovagal syncope children and healthy children. Methods: To characterize the autonomic profile in children experiencing vasovagal syncope, we evaluated the HRV of 23 patients aged 7-18 years and 20 healthy children without any underlying problems. And these children were divided into preadolescent and adolescent by 12 -year- old. The following time-domain indices were calculated: root mean square of the successive differences(RMSSD); standard deviation of all average R-R intervals (SDNN); and frequency domain indices including high frequency(HF), low frequency(LF), normalized high frequency, normalized low frequency, and low frequency to high frequency ratio (LF/HF). Results: Patients with syncope had significantly different HRV values from those of healthy children. The Student t test indicated significantly higher values of SNDD(60.46msec vs.37.42msec, P=0.003) and RMSSD (57.90msec vs. 26.92msec, P=0.000) in the patient group than in the control group. In the patient group, RMSSD (80.41msec vs. 45.89msec, P=0.015) and normalized HF(61.18msec vs.43.19msec, P=0.022) were significantly higher in adolescents than in preadolescents, whereas normalized LF(38.81msec vs. 56.76msec, P=0.022) and LF/HF ratio(0.76 vs. 1.89, P=0.041) were significantly lower in adolescents than in preadolescents. In contrast, the control group did not have significant differences in HRV values between adolescents and preadolescents. Conclusion: The results of this study indicated a decreased sympathetic tone and increased vagal tone in children with vasovagal syncope compared to those in healthy children. In addition, more severe autonomic imbalances are suggested to occur in adolescents than in preadolescents.

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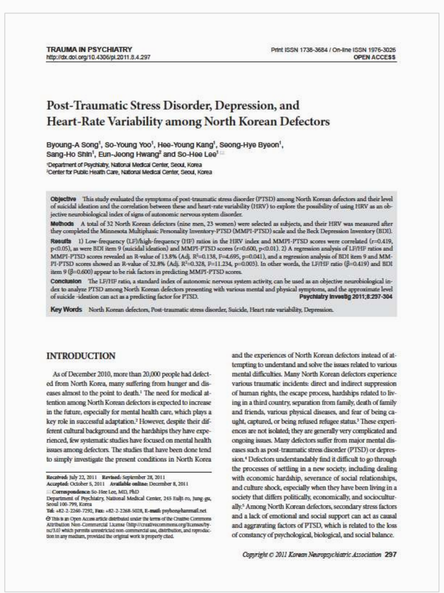

TRAUMA IN PSYCHIATRY
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Post-Traumatic Stress Disorder, Depression, and Heart-Rate Variability among North Korean Defectors

Byoung-A Song[1], So-Young Yoo[1], Hee-Young Kang[1], Seong-Hye Byeon[1], Sang-Ho Shin[1], Eun-Jeong Hwang[2] and So-Hee Lee[2]

[1]Department of Psychiatry, National Medical Center, Seoul, Korea
[2]Center for Public Health Care, National Medical Center, Seoul, Korea

Objective This study evaluated the symptoms of post-traumatic stress disorder (PTSD) among North Korean defectors and their level of suicidal ideation and the correlation between these and heart-rate variability (HRV) to explore the possibility of using HRV as an objective neurobiological index of signs of autonomic nervous system disorder.

Methods A total of 32 North Korean defectors (nine men, 23 women) were selected as subjects, and their HRV was measured after they completed the Minnesota Multiphasic Personality Inventory-PTSD (MMPI-PTSD) scale and the Beck Depression Inventory (BDI).

Results 1) Low-frequency (LF)/high-frequency (HF) ratios in the HRV index and MMPI-PTSD scores were correlated ($r=0.419$, $p<0.05$), as were BDI item 9 (suicidal ideation) and MMPI-PTSD scores ($r=0.600$, $p<0.01$). 2) A regression analysis of LF/HF ratios and MMPI-PTSD scores revealed an R-value of 13.9% (Adj. R²=0.138, F=4.695, p=0.042), and a regression analysis of BDI item 9 and MMPI-PTSD scores showed an R-value of 32.8% (Adj. R²=0.328, F=11.234, p=0.003). In other words, the LF/HF ratio (β=0.419) and BDI item 9 (β=0.600) appear to be risk factors in predicting MMPI-PTSD scores.

Conclusion The LF/HF ratio, a standard index of autonomic nervous system activity, can be used as an objective neurobiological index to analyze PTSD among North Korean defectors presenting with various mental and physical symptoms, and the approximate level of suicide -ideation can act as a predicting factor for PTSD.
Psychiatry Investig 2011;8:297-304

Key Words North Korean defectors, Post-traumatic stress disorder, Suicide, Heart rate variability, Depression.

INTRODUCTION

As of December 2010, more than 20,000 people had defected from North Korea, many suffering from hunger and diseases almost to the point to death.[1] The need for medical attention among North Korean defectors is expected to increase in the future, especially for mental health care, which plays a key role in successful adaptation.[2] However, despite their different cultural background and the hardships they have experienced, few systematic studies have focused on mental health issues among defectors. The studies that have been done tend to simply investigate the present conditions in North Korea and the experiences of North Korean defectors instead of attempting to understand and solve the issues related to various mental difficulties. Many North Korean defectors experience various traumatic incidents directly and indirect suppression of human rights, the escape process, hardships related to living in a third country, separation from family, death of family and friends, various physical diseases, and fear of being caught, captured, or being refused refugee status.[3] These experiences are not isolated; they are generally very complicated and ongoing issues. Many defectors suffer from major mental diseases such as post traumatic stress disorder (PTSD) or depression.[4] Defectors understandably find it difficult to go through the processes of settling in a new society, including dealing with economic hardship, severance of social relationships, and culture shock, especially when they have been living in a society that differs politically, economically, and sociocultur-ally.[5] Among North Korean defectors, secondary stress factors and a lack of emotional and social support can act as causal and aggravating factors of PTSD, which is related to the loss of constancy of psychological, biological, and social balance.

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ALLIANCE IN MOTION GLOBAL

Part 2. Background Theory

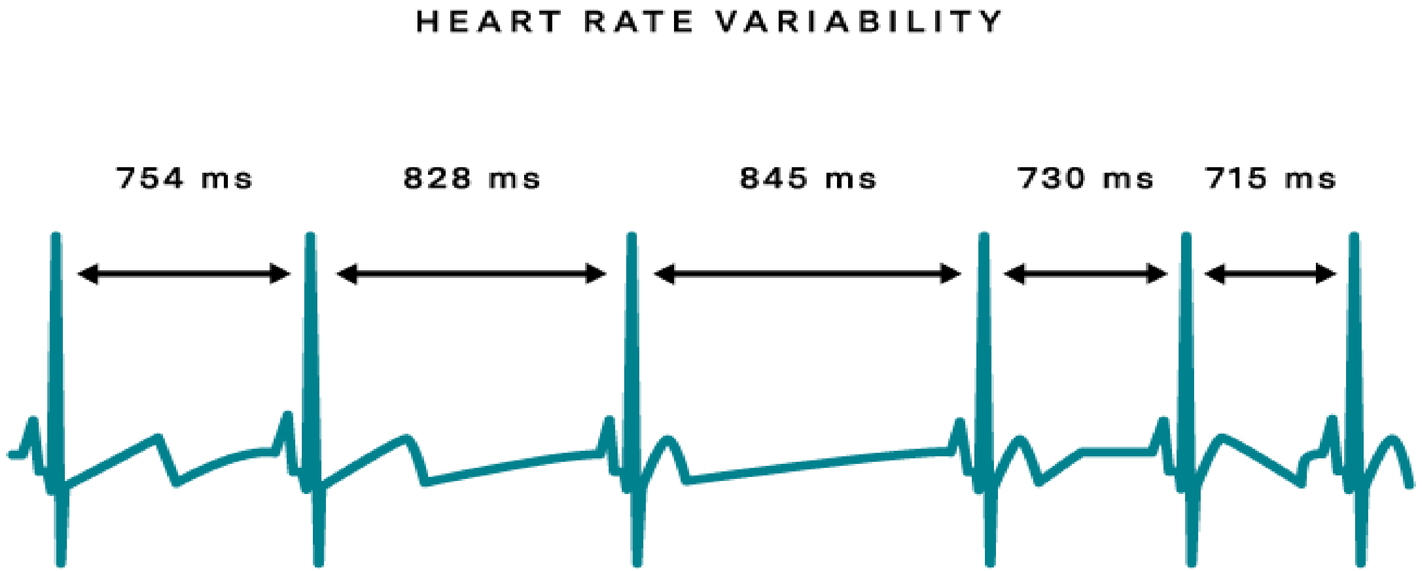
Background Theory

HRV theory → Autonomic Nervous System Function
Stress Assessment

APG theory → Vascular Health
Aging of Blood Vessel & Circulation

Part 3. How to Measure Stress & ANS Function [HRV]

Heart Rate Variability?



Heart rate variability or HRV is the physiological phenomenon of

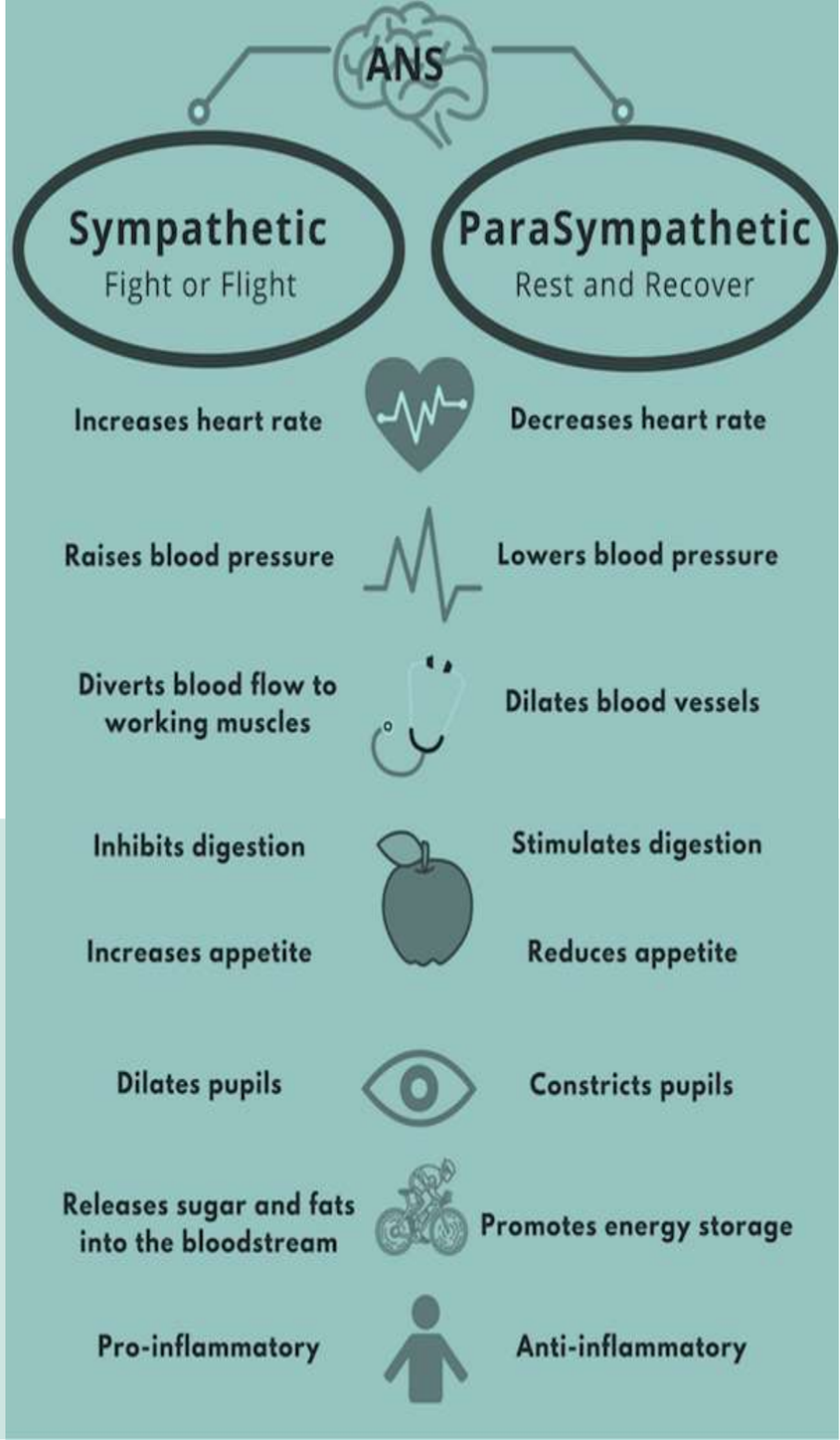
the variation in the time interval between consecutive heartbeats in milliseconds.

- Higher HRV has been found to be associated with reduced morbidity and mortality, and improved psychological well-being and quality of life.
- It’s not the same as the heart rate (beats per minute) increasing and decreasing as we go about our daily business.

HRV Reflects Autonomic Nervous System

HRV is regulated by the autonomic nervous system (ANS), and its sympathetic and parasympathetic branches, and HRV is commonly accepted as a non-invasive marker of ANS activity.

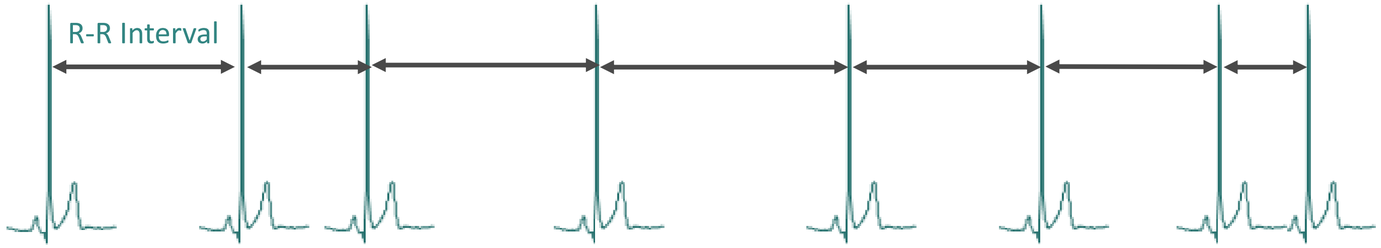
The ANS helps you respond to daily stressors and regulate some of your body's most important systems, including heart rate, respiration and digestion.



What is Autonomic Nervous System?

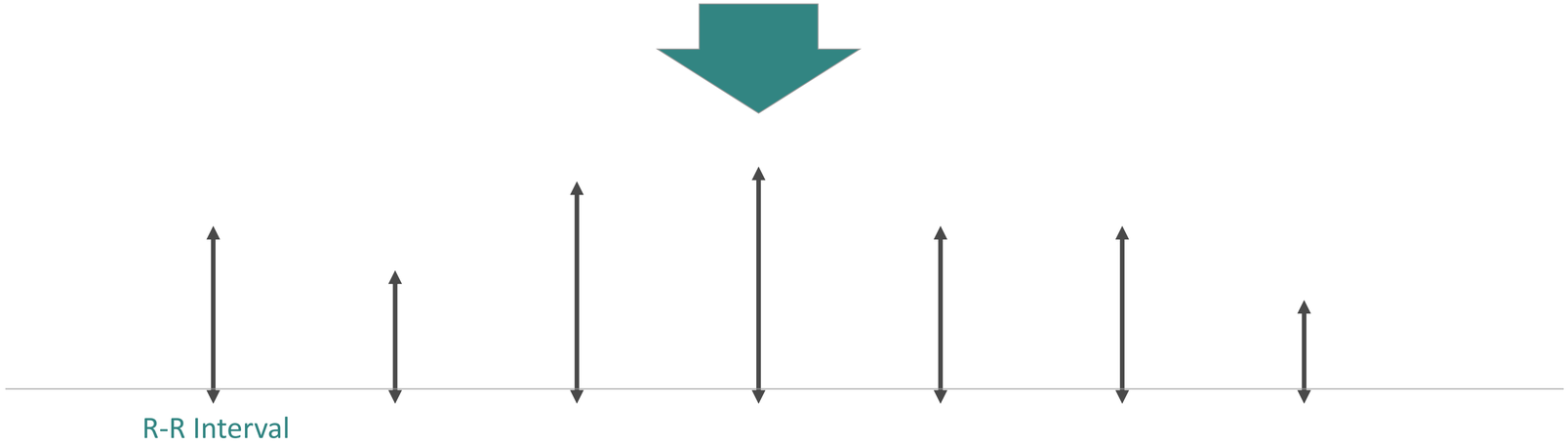
- **Main Function**: Maintaining the Homeostasis as a control system of our internal organs
- **Branch**: SNS (Sympathetic Nervous System) & PNS (Parasympathetic Nervous System)
- **Acts**: Heart rate control including hormonal, enzymatic, respiratory, pulmonary, urinary and uterine neural control
- **Diseases related to ANS dysfunction**:
Diabetes, Hypertension, Irritable Bowel Syndrome, Headache, Sudden Death after MI, Depression, Anxiety, Sleep disorder

HRV Reflects Your Autonomic Nervous System

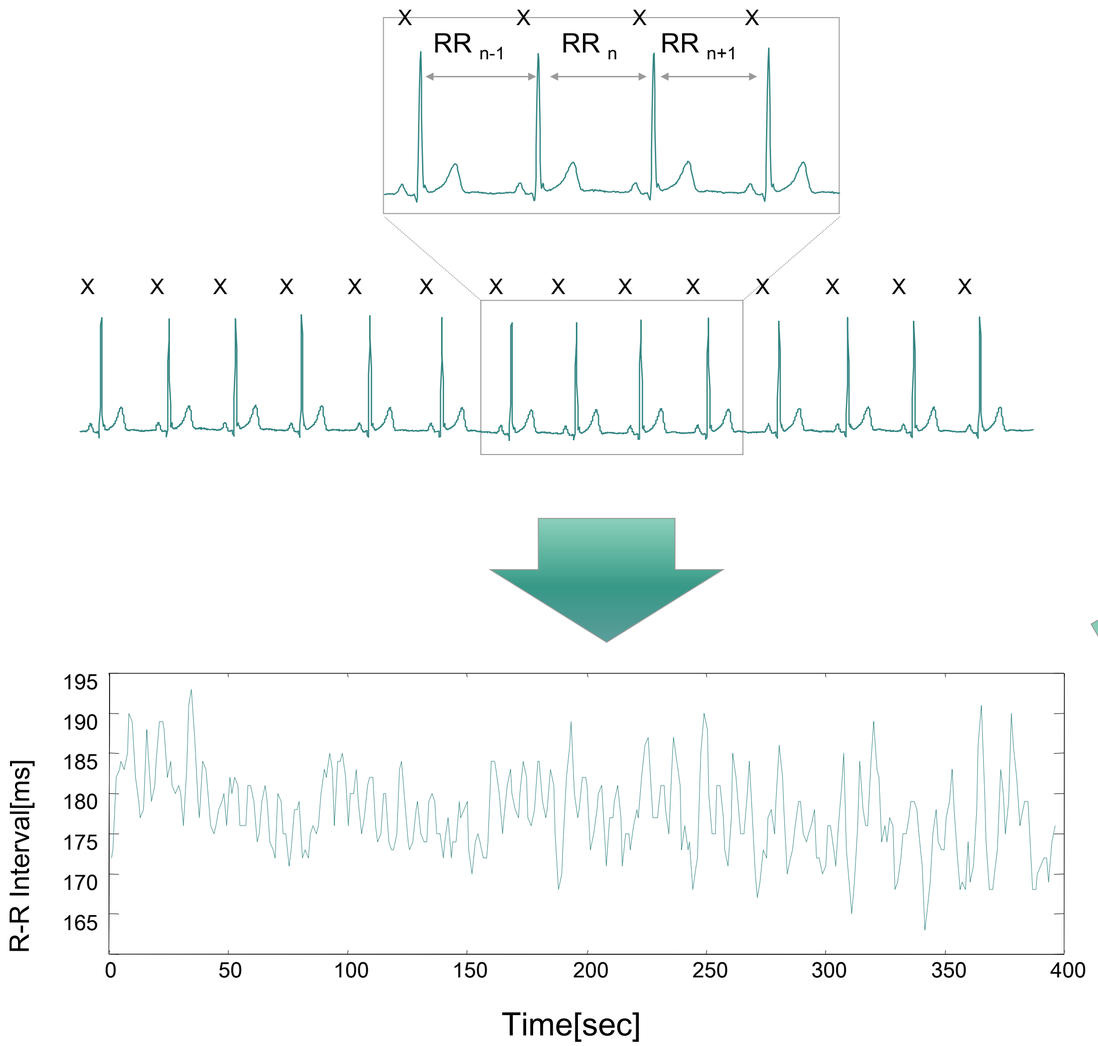


Heart Rate Fast = R-R Interval is Shorter → SNS [Fight]

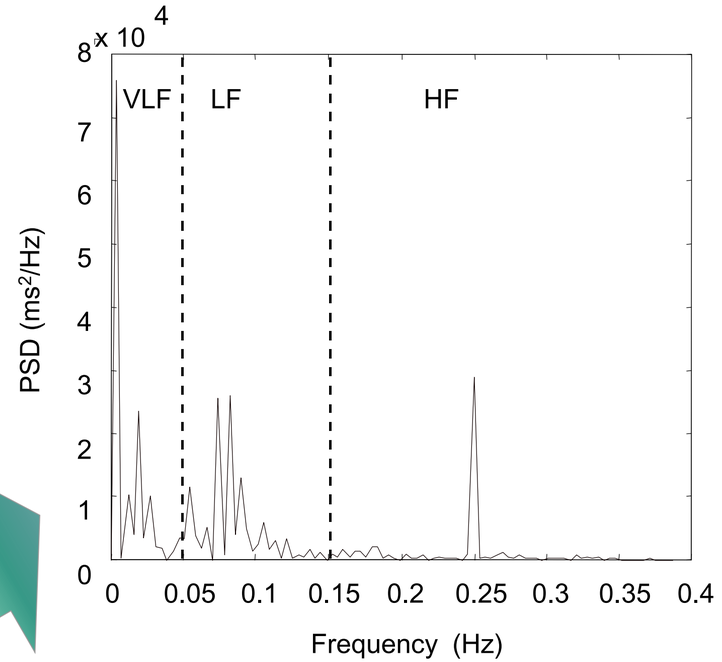
Heart Rate Slow = R-R Interval is Longer → PNS [Rest]



HRV Analysis Method



[Time Domain]



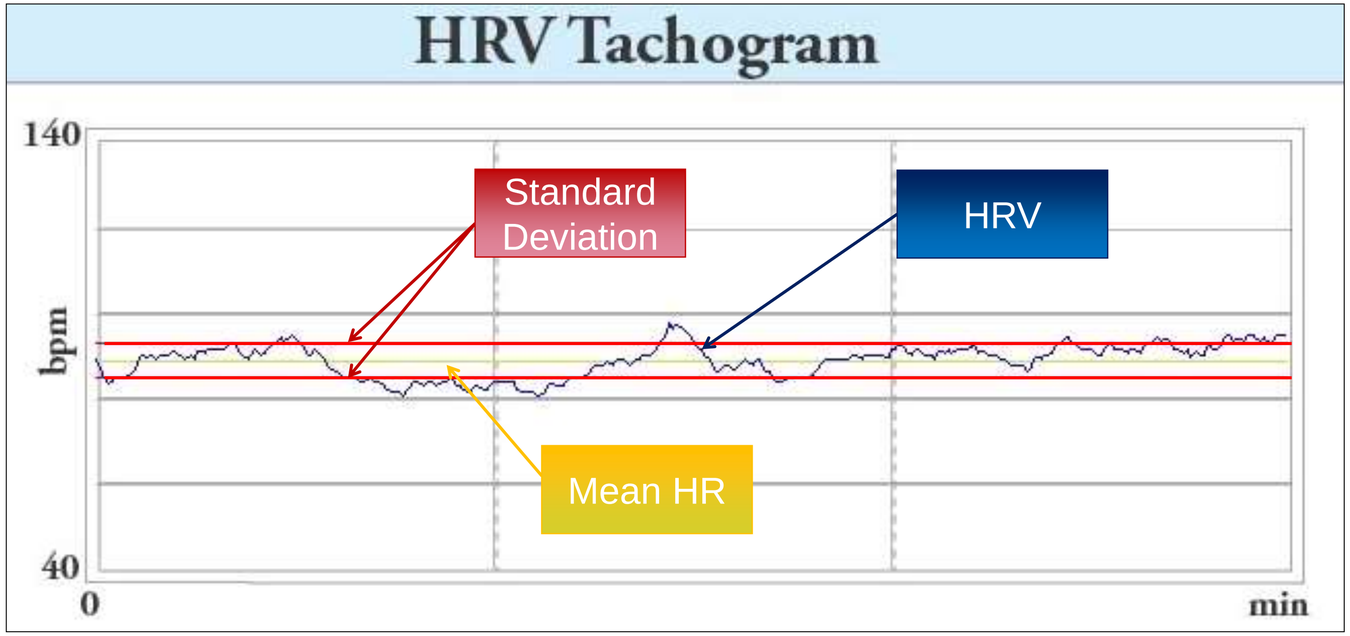
[Frequency Domain]

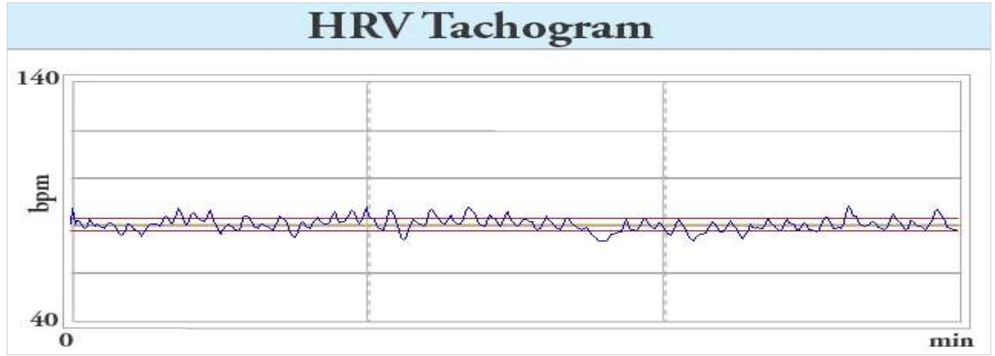
HRV Parameters

Time Domain Analysis	Frequency Domain Analysis
Mean HR	**TP**
SDNN	**VLF**
RMSSD	**LF**
PSI	**HF**
ApEn	**LF norm**
SRD	**HF norm**
	LF/HF ratio

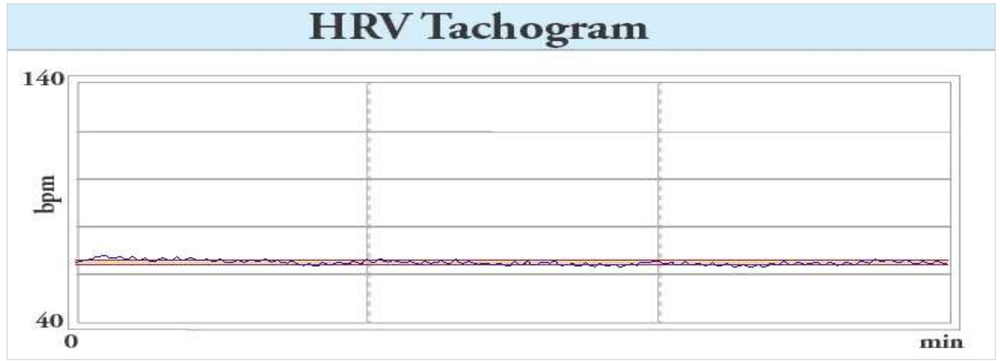
HRV Parameters [Time Domain Analysis]

- **SDNN** (Standard Deviation Normal to Normal)
  - Standard deviation of total N-N intervals
  - Reflects the Variation of Heart Rate
  - **Indicative of Autonomic Nervous System Function**
  - **Indicative of the overall health condition & immunity**





Healthy



Unhealthy

HRV Parameters [Time Domain Analysis]

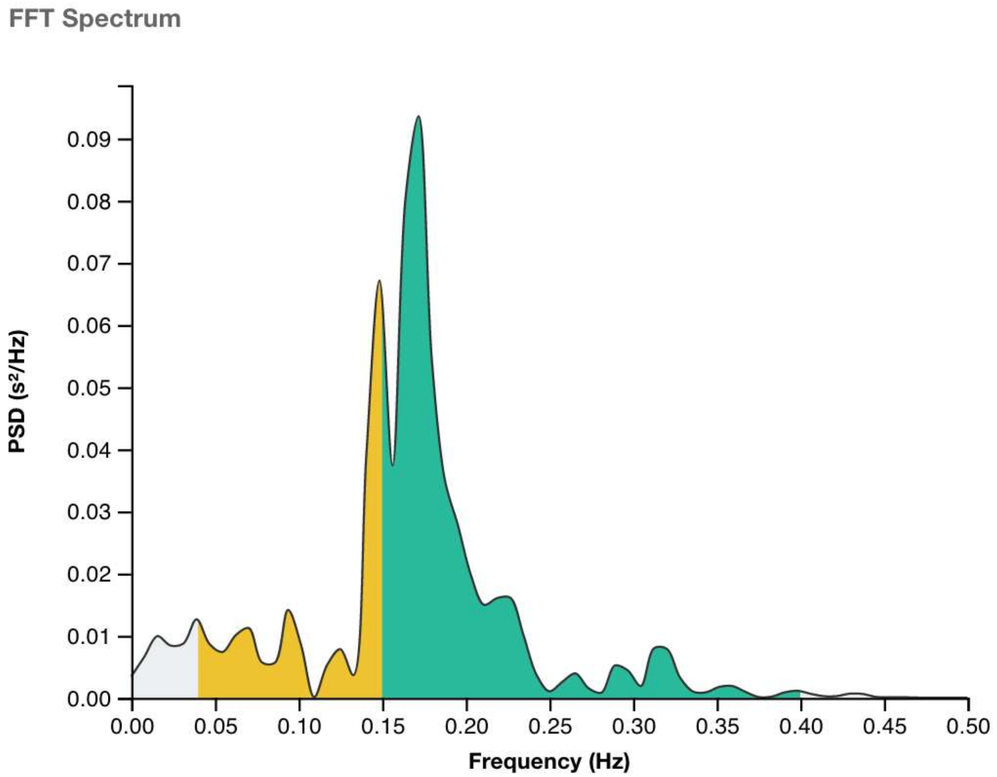
- **RMSSD**

  - **Represents the strength of your Parasympathetic Nervous System**
  - Before coming the heart dysfunction or disorder symptom, RMSSD shows lower value.
  - SDNN & RMSSD decrease → Increases the risk of heart disease

- **PSI (Physical Stress Index)**

  - The pressure loaded on our body regulation system, drawn from the time domain parameters such as HR, the distribution of HRV & RR interval

HRV Parameters [Frequency Domain Analysis]



Frequency Domain Analysis is a complex analysis technique that shows how much of a signal lies within one or more frequency bands (ranges).

With regards to Heart Rate Variability, research has identified certain frequency bands that tend to correlate with certain physiological phenomenon, such as SNS & PNS activity.

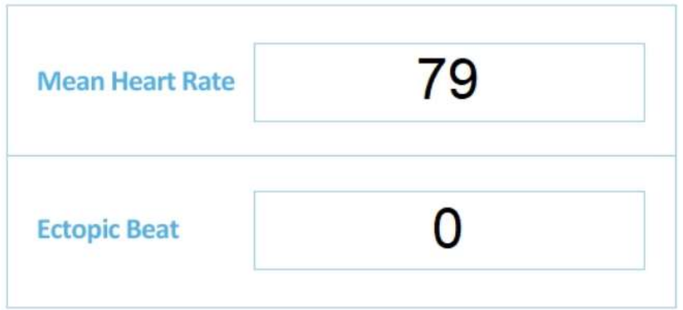
- **LF (low frequency)**
  - 0.04-0.15Hz. (Yellow in the left chart)
  - **Indicative of Sympathetic Nervous System Activity**

- **HF (High frequency)**
  - 0.15-0.4Hz (Green in the left chart)
  - **Indicative of Parasympathetic Nervous System Activity**

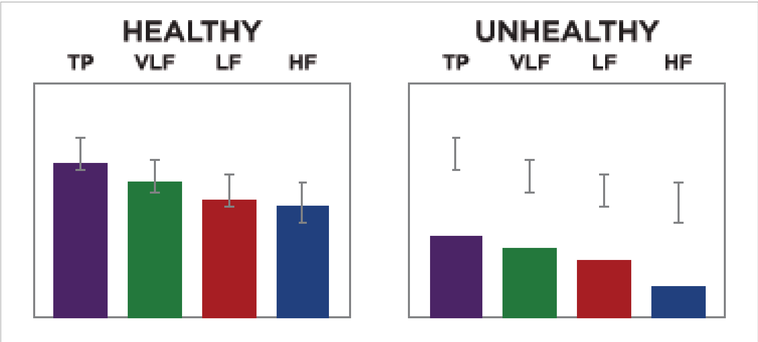
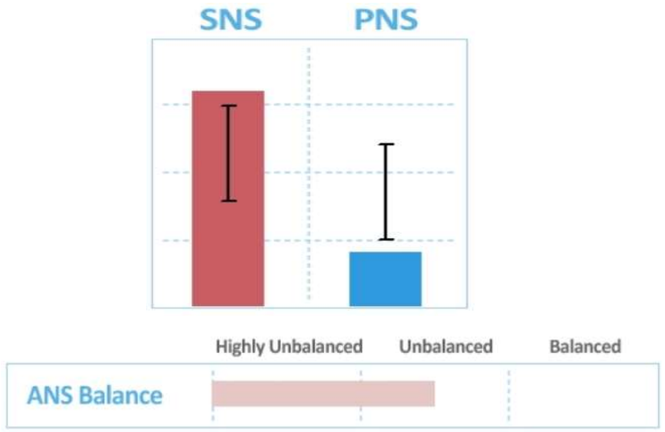
- **LF/HF Ratio**
  - A ratio of Low Frequency to High Frequency
  - **Indicative of Sympathetic to Parasympathetic Autonomic Balance**

- **LF norm, HF norm**
  - LF norm = LF / LF + HF (reflects SNS)
  - HF norm = HF / Lf + HF (reflects PNS)
  - **Reflects the regulation & balance degree of Autonomic Nervous System**

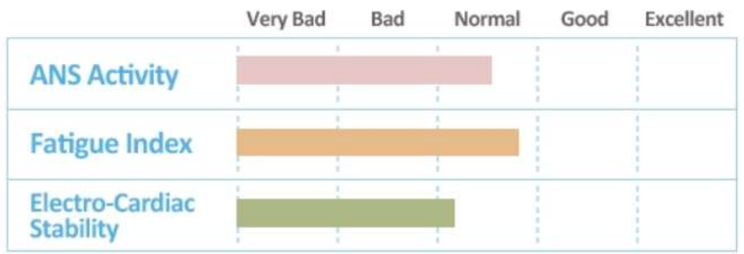
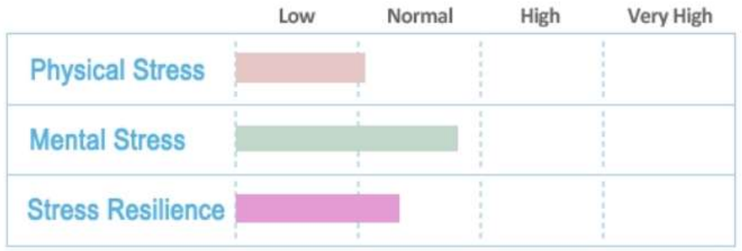
HRV Parameters in Max Pulse

Max Pulse Parameter	HRV Parameter	Description
	**HR**	**Mean Heart Rate:** This is your average heart rate measured during the test. It is typically between 60 and 90 beats per minute. But in someone such as athletes, it may be lower. **Ectopic beat:** This means the heart rhythms deviated from the normal range and it may also appear when you move or talk much during the test. If it occurs over 5 times, the measurement must be repeated. If it still remains high, you may have an irregular heart beat(Arrhythmia).
	**HRV**	**HEART RATE VARIABILITY (HRV):** Measures the degree of fluctuation in the length of intervals between heart beats. For healthy people, HRV a fluctuation in heart rates, while unhealthy people have a simple and consistent heart rate. HRV measures the adaptability of the cardiovascular system and autonomic nervous system, which is composed of the sympathetic nervous system (SNS) and parasympathetic nervous system (PNS). Your SNS plays the role of the accelerator, also known as flight or fight. Your PNS functions as the brake, also known as rest and repair. A healthy person has a balanced autonomic nervous system. **More variable & complicated HRV Tachograph = Healthy Condition**

HRV Parameters in Max Pulse

Max Pulse Parameter	HRV Parameter	Description
I Zone: It indicates normal range of healthy people. 	TP	**Total Power [combination of the 3 frequencies]** **Reduction of TP**: Decreased ANS function, decrease in regulatory competence and a decrease in the ability to cope with environmental change.
	VLF	**Very Low Frequency [Provide the additional information of SNS & PNS]** **Reduction of VLF**: Decrease in the bodies ability to regulate body temperature and hormone levels.
	LF	**Low Frequency [Indicative of Sympathetic Nervous System Activity]** **Reduction of LF**: Loss of energy, fatigue, insufficient sleep and lethargy.
	HF	**High Frequency [Indicative of Parasympathetic Nervous System Activity]** **Reduction of HF**: Chronic stress, aging, reduced electrical stability of the heart.
I Zone: It indicates normal range of healthy people. 	LF Norm	**The Ratio of SNS & PNS**: It indicates the balance degree of SNS(tension) and PNS(relax). The balanced ratio [I ZONE] means that you are in healthy condition. ***Balanced**: It means that sympathetic nerve and parasympathetic nerve are properly balanced each other. In general, ratio of SNS and PNS is 6:4, 5:5, 4:6 and it means the balance of autonomic nerve system. ***SNS Dominant(Increase in LF norm)**: If sympathetic nerve is excessively high, it means that the person has anxiety, irritation, and excessive nervousness. In other words, if the person has excitation or stress severely and has sleep disorder, aggressive character, agitation and overheating on body, it is highly dominant. ***PNS Dominant(Increase in HF norm)**: If parasympathetic nerve is excessively dominant, it means that the person has depression or can't be bothering anything or loses the motivation.

HRV Parameters in Max Pulse

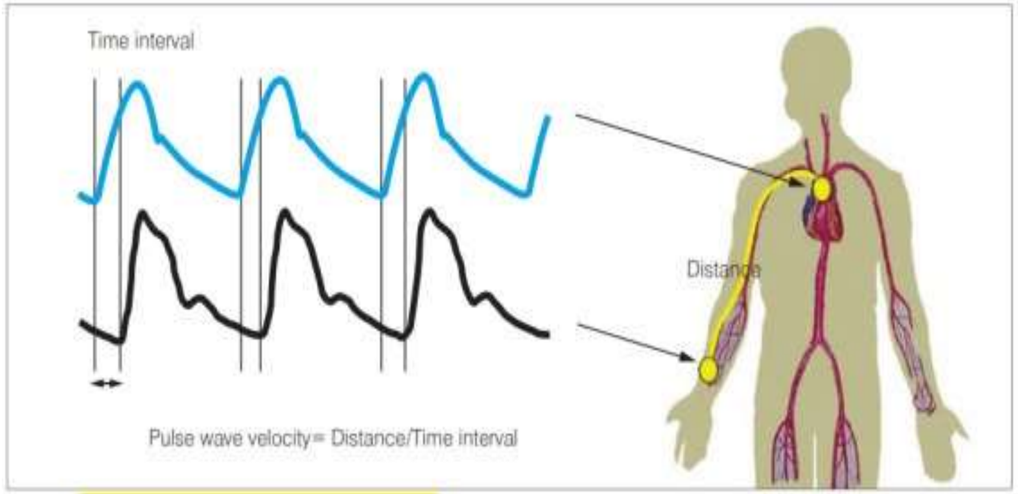
Max Pulse Parameter	HRV Parameter	Description
	**TP** [ANS Activity]	**ANS Activity**: It indicates the activity of Autonomic Nervous System function and its regulation competence.
	LF Power [Fatigue Index]	**Fatigue Index**: It indicates the state of fatigue and "loss of energy caused from stress.
	HF Power [Electro Cardiac Stability]	**Electro Cardiac Stability**: It is decreased because of chronic stress and lowered Electro Cardiac Stability may make a risk of cardiac disorder.
	**HR,SDNN,RMSSD** [PSI=Physical Stress Index]	**Physical Stress:** It indicates the degree of the pressure to our body which is suffering from fatigue or stress. **The lower value is the better.**
	LF/HF Ratio [MSI=Mental Stress Index]	**Mental Stress:** It indicates the degree of the emotional stress (Anxiety/ Worry/Anger/Tension/Lethargy) which is suffering mentally. **The lower value is the better.**
	SDNN [Stress Resilience]	**Stress Resilience:** As an indicator of how much we are adaptable to the stress, it will be greatly resistant to the stress in the healthy people under the same stress while it will be lower in resistance for the unhealthy people if they lose the resistant ability in the body or have a weak autonomic nerve system function. **The higher value is the better.** **Indicator of Autonomic Nervous System Function & Immunity**
	**SDNN,PSI,MSI** [Stress Score]	**Stress Score** is given in reference to the Physical and Mental Stress and how they relate to the ability for handling or dealing with the internal and external stress placed upon it. A score of 50 or less is ideal. The Stress Score is directly related to the autonomic nerve function and the relationship or disparity between the Physical/Mental Stress and the Stress Resilience.

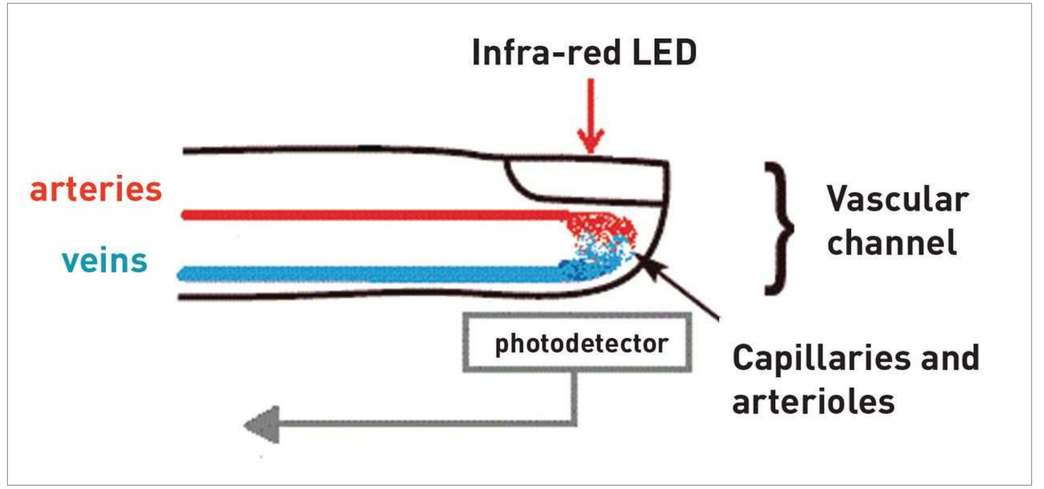
Part 4. How to Measure Vascular Condition

[APG]

Photoplethysmography [PTG]?

PTG is a non-invasive technique for measuring the amount of blood flow present or passing through, an organ or other part of the body.



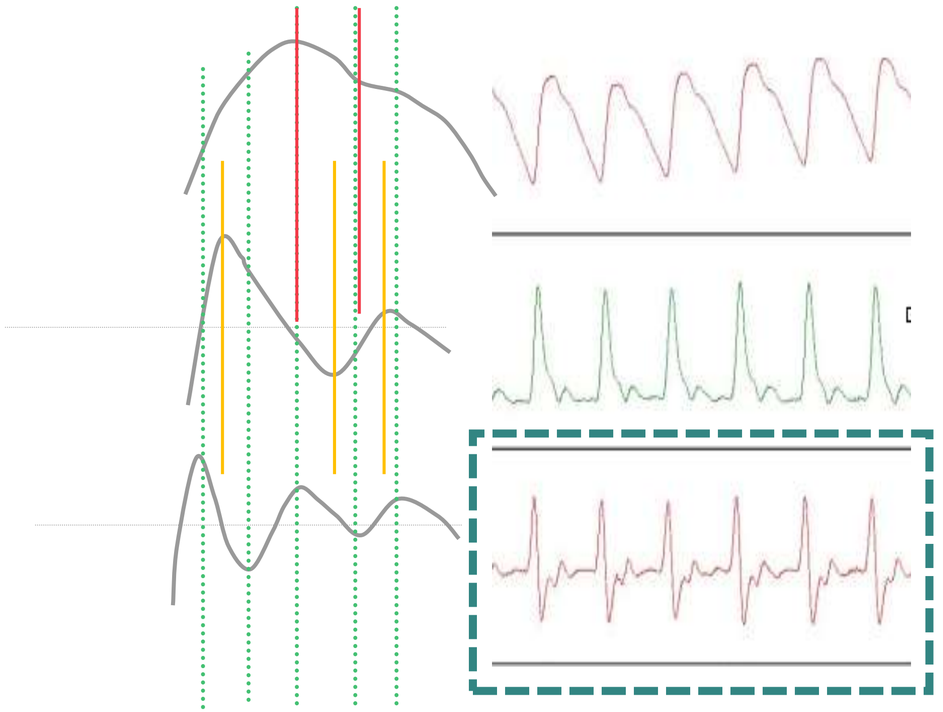


- Plethysmography is used to diagnose deep vein thrombosis & arterial occlusive disease. And, it has been around for over 25 years and are currently being used in many clinical applications.
- Using a finger clip, the blood's pulse wave is followed from the time it leaves the heart and travels through the blood vessels down to the finger.
- **The pulse wave is a snapshot into the cardiovascular system and evaluates arterial elasticity** (arterial stiffness), which is related to atherosclerosis.

Accelerated Plethysmography [APG]?

Max Pulse uses PTG and APG analysis. Specifically, **the APG application for determining Vascular health.**

Artificial processing of the Plethysmograph



Plethysmography(PTG)

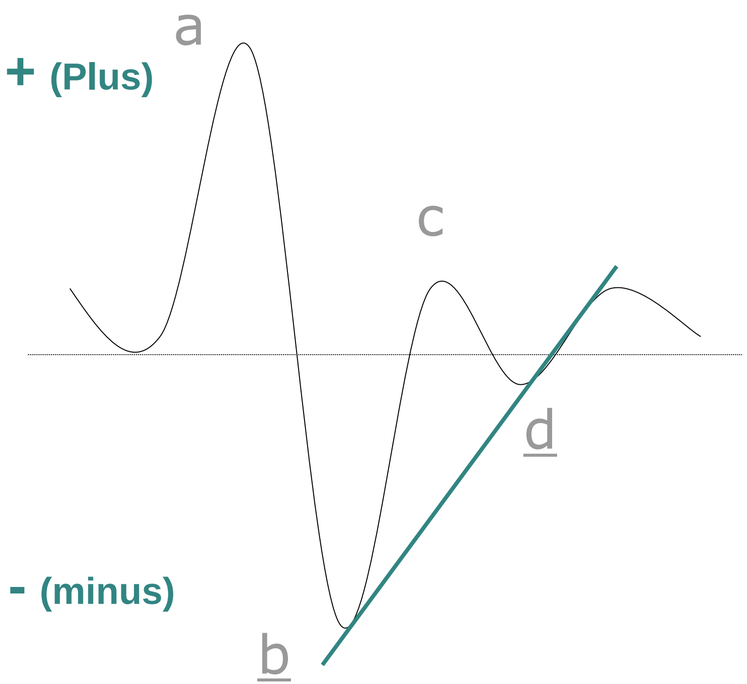
Velocity Plethysmography(VPG)

Accelerated Plethysmography(APG)

To stabilize the baseline

To make more clearly

APG Waveform Analysis



- a : Basic point to evaluate APG waveform.

- **b : Arterial Elasticity**
  - The deeper (-) value is better.
  - The b/a ratio reflects the arterial stiffness.
  - It shows the degree of the blood flow & contraction power of artery from the heart to other parts of the body.

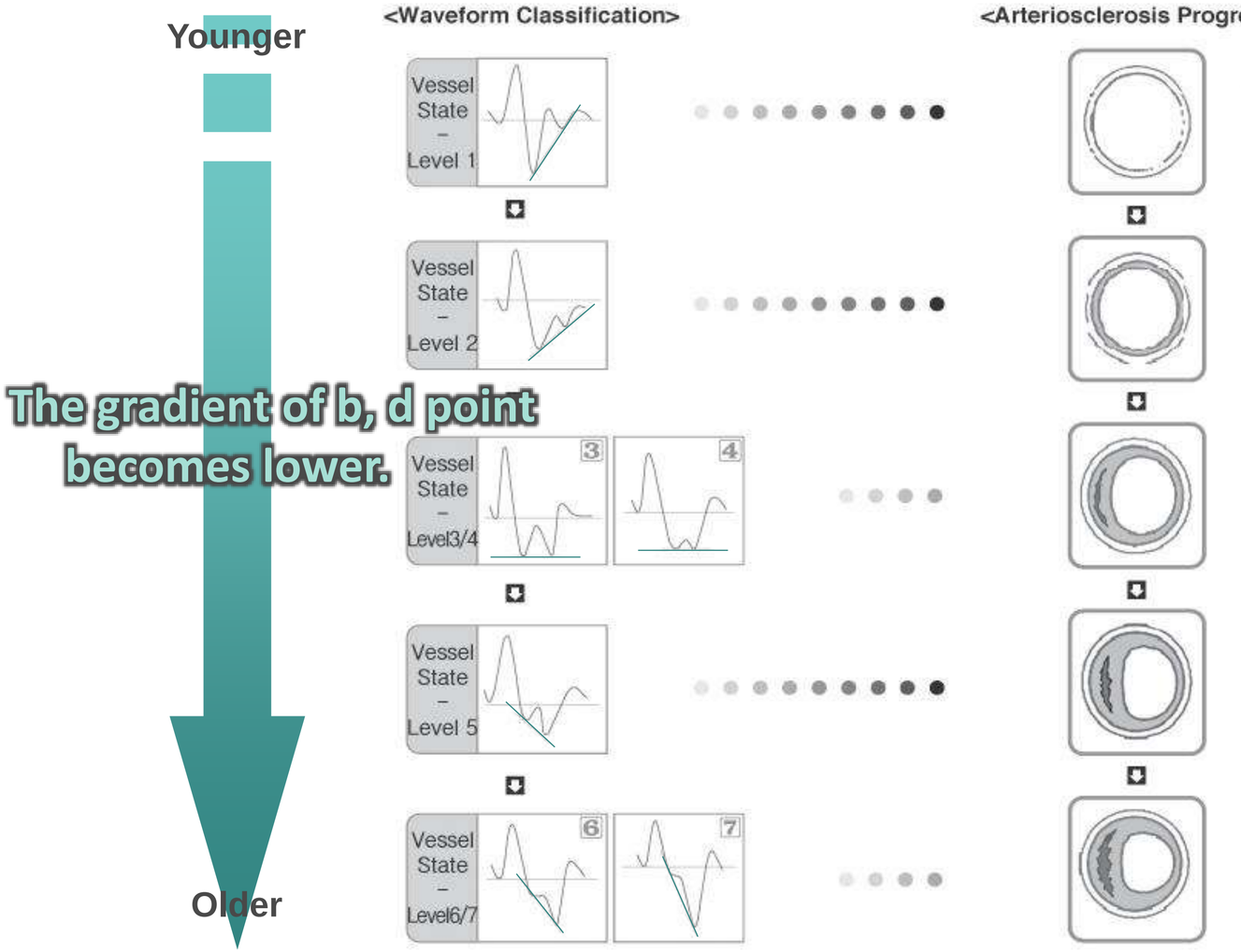
- c : Reference Value to evaluate b & d wave.

- **d : Peripheral Elasticity**
  - Higher value, smaller (-) value is better.
  - The d wave reflects the peripheral stiffness.
  - It shows the degree of the blood circulation of peripheral vessels delivering to the furthest from the heart.

- **The gradient of b, d point**
  - Indicative of the overall vascular condition and vessel aging degree
  - Used to determine the type of waveform
  - Higher gradient = Young & Healthy Blood Vessel

7 Types of APG Waveform

Classifying the wave types as aging



Type 1: Blood circulation and its vessel are Excellent

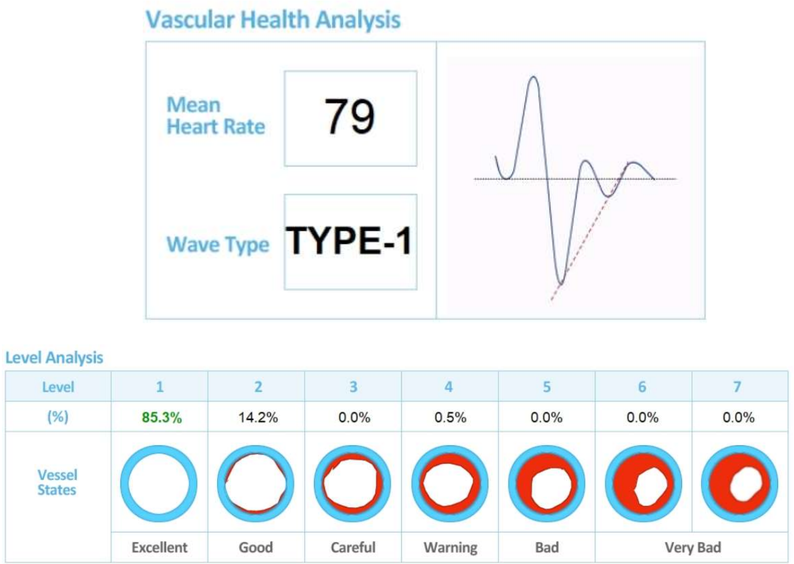
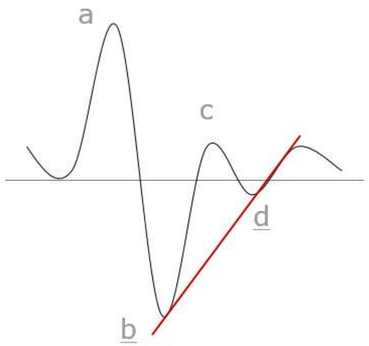
Type 2: Blood circulation and its vessel are Good

Type 3~4: Start to get aged in the vessel

Type 5: Not good at the blood circulation and aged state in the vessel

Type 6~7: Blood circulation Disorder

APG Parameters in Max Pulse

Max Pulse Parameter	APG Parameter	Description
	**b/a**	**Arterial Elasticity:** It shows the degree of the blood flow and contraction power of artery from the heart to other parts of the body. A healthy blood vessel is flexible & supple and it leads to get a higher score of Arterial Elasticity.
	d/a	**Peripheral Elasticity:** It shows the degree of the blood circulation of peripheral blood vessel delivering to the furthest from the heart. A healthy blood vessel is flexible & supple and it leads to get a higher score of Peripheral Elasticity.
	 **Wave Type**	**Type of Arterial Health:** It displays the distribution of the aging level in percentage for your blood vessel by 7 Types. (The percentages may be spread out or 100% in a given wave type) *Type 1: Blood circulation and artery state are great! *Type 2: Blood circulation and artery state are good but a slight build-up is beginning to occur. *Type 3~4: Blood circulation and artery state are becoming poor and build-up is starting. *Type 5: Blood circulation and artery state are not good and build-up is getting increased. *Type 6~7: Blood circulation and artery state are very serious and build-up is becoming serious.

Thanks for your Attention !

Get in Touch With Us

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