NSCA®
NATIONAL STRENGTH AND CONDITIONING ASSOCIATION

# 2022 NSCA TACTICAL ANNUAL TRAINING

#NSCATactical22

# *CONFLICT OF INTEREST STATEMENT*

I currently have, or I have had in the past 2 years an affiliation or financial interest with [company name(s)] around this presentation, including:

- Consulting
- Employment
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- Scholarship
- Other(s)

# *CONFLICT OF INTEREST STATEMENT*

I have no actual or potential conflict of interest in relation to this presentation.

# What Can Heart Rate Variability Teach Us About Readiness?

Jan Redmond, PhD, CSCS D*, NSCA-CPT D*
Research Physiologist

# Learn ➡ Understand ➡ Apply

1. Understand Heart Rate Variability as a physiological measure

2. What can we learn from Heart Rate Variability?

3. Can Heart Rate Variability be applied in the Tactical Environment to Evaluate Readiness?

# Is this Readiness?

Military training and operations = High Physical and Mental Demands

# Readiness Defined

- U.S. Department of Defense (DoD):

  **"Readiness is the ability of the military to fight and meet the demands of assigned missions"**

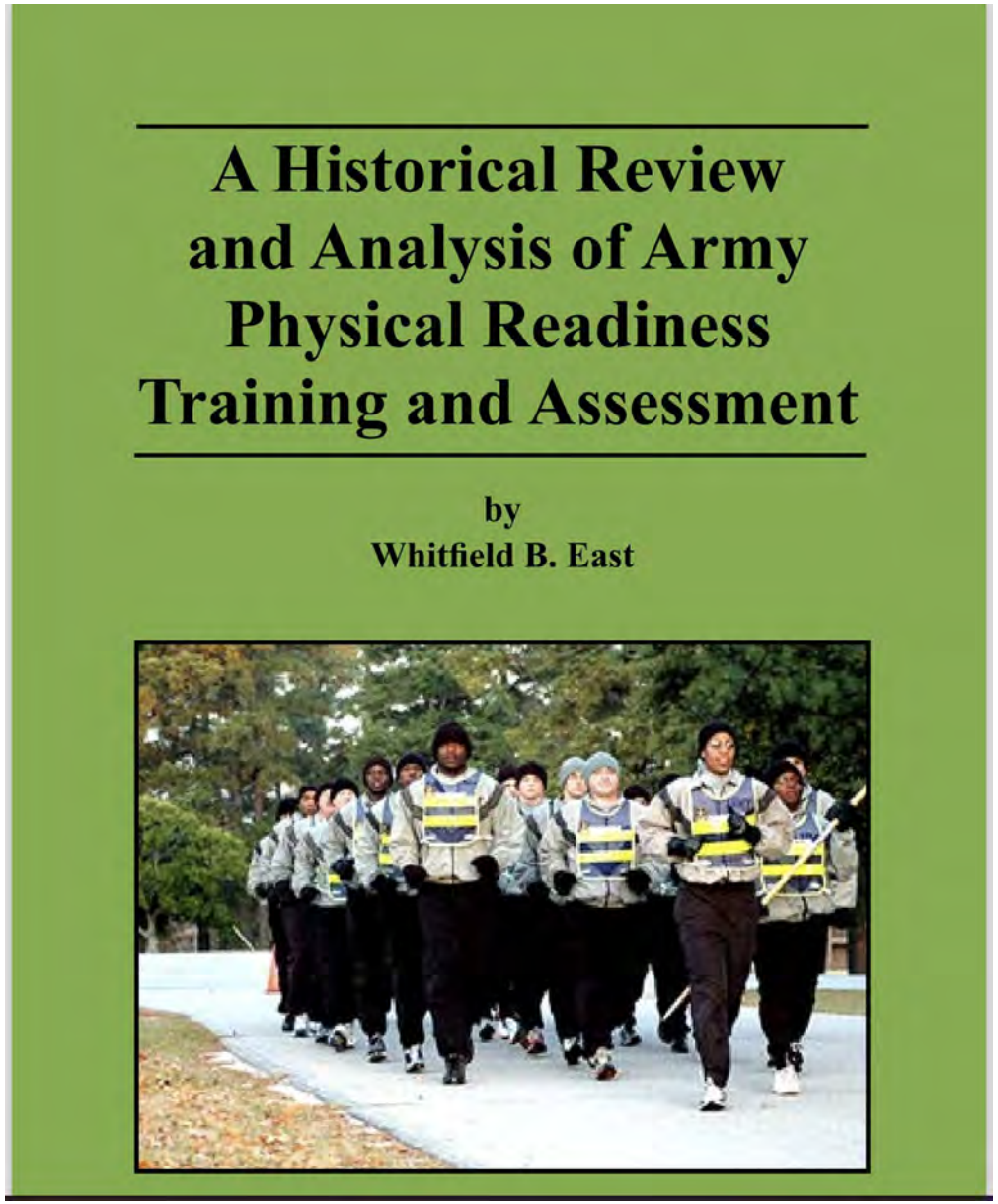
  ➢ **Principal focus on the warfighter and includes the following:**
  - **Building Readiness:** Initial training, testing, and proper resourcing
  - **Increasing Readiness:** Advanced individual and unit training and testing and proper resourcing
  - **Sustaining Readiness:** Continual training and resourcing of units

Congressional Research Service, https://crsreports.congress.gov, R46559

"Here are four basic research questions that demonstrate the depth of our lack of understanding:

**(1) What are the baseline physical attributes that constitute combat readiness?**
**(2) What are the frequency, duration, and intensity of training required to illicit these physical attributes?**
**(3) What fitness measures best assess these physical attributes?**
**(4) What resources (trainers, facilities, and equipment) are required to facilitate acquisition of these physical attributes in a timely manner while mitigating organic failures?**

We currently cannot answer even these basic questions to any degree of scientific acceptability." *Dr. Chip East, Research Physiologist, TRADOC-CIMT*



# Holistic Health and Readiness System

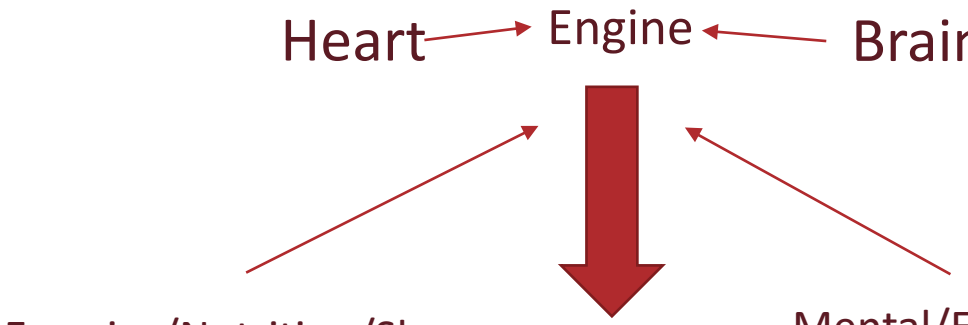
Optimal Physical Performance + Optimal Mental Performance =

Movement Lethality/Readiness


Field Manual 7-22, October 2020

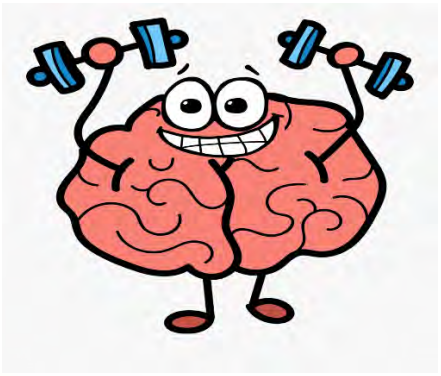
# How Do We Build Readiness?

Optimal Physical Performance + Optimal Mental Performance




Exercise/Nutrition/Sleep

Mental/Emotional/Spiritual



# Building Resilience/Readiness

- **Physical Resilience/Readiness:** physical flexibility, endurance, strength, power and agility (Sleep and Nutrition)
- **Mental Resilience/Readiness:** focus, attention, mental flexibility, and ability to integrate information and different points of view
- **Emotional Resilience/Readiness:** self-regulation, emotional flexibility, positive outlook and supportive relationships
- **Spiritual Resilience/Readiness:** commitment to core values, intuition and tolerance for others and their beliefs

**McCraty, R** (2015). Science of the Heart: Exploring the Role of the Heart in Human Performance, Vol II. Heart Math Institute
**East, W** (2013). A Historical Review and Analysis of Army Physical Readiness Training and Assessment. Combat Studies Institute Press

Circulation

AHA SCIENTIFIC STATEMENT

# Psychological Health, Well-Being, and the Mind-Heart-Body Connection

## A Scientific Statement From the American Heart Association

**ABSTRACT:** As clinicians delivering health care, we are very good at treating disease but often not as good at treating the person. The focus of our attention has been on the specific physical condition rather than the patient as a whole. Less attention has been given to psychological health and how that can contribute to physical health and disease. However, there is now an increasing appreciation of how psychological health can contribute not only in a negative way to cardiovascular disease (CVD) but also in a positive way to better cardiovascular health and reduced cardiovascular risk. This American Heart Association scientific statement was commissioned to evaluate, synthesize, and summarize for the health care community knowledge to date on the relationship between psychological health and cardiovascular health and disease and to suggest simple steps to screen for, and ultimately improve, the psychological health of patients with and at risk for CVD. Based on current study data, the following statements can be made: There are good data showing clear associations between psychological health and CVD and risk; there is increasing evidence that psychological health may be causally linked to biological processes and behaviors that contribute to and cause CVD; the preponderance of data suggest that interventions to improve psychological health can have a beneficial impact on cardiovascular health; simple screening measures can be used by health care providers for patients with or at risk for CVD to assess psychological health status; and consideration of psychological health is advisable in the evaluation and management of patients with or at risk for CVD.

**Glenn N. Levine, MD, FAHA, Chair**
**Beth E. Cohen, MD, MAS**
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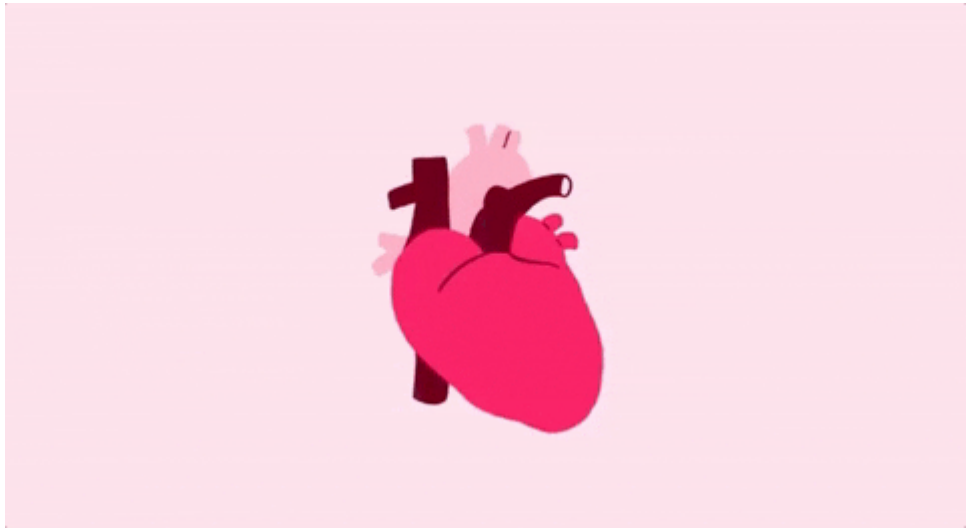
**Erin D. Michos, MD, MHS**
**Erica S. Spatz, MD, MHS**
**Laura D. Kubzansky, PhD, MPH**
**On behalf of the American Heart Association Council on Clinical Cardiology; Council on Arteriosclerosis, Thrombosis and Vascular Biology; Council on Cardiovascular and Stroke Nursing; and Council on Lifestyle and Cardiometabolic Health**

Downloaded from http://ahajournals.org by on June

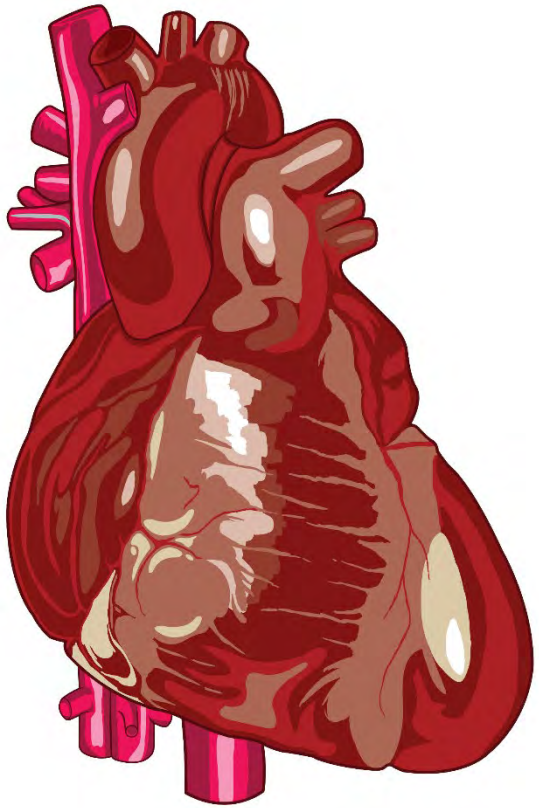
# Heart = Wisdom



"Truth is what stands the test of experience"
Einstein, The Laws of Science and The Laws of Ethics

**"The heart is the most important organ of the body."**
Aristotle viewed the heart as the seat of our intelligence, emotions, and consciousness, while describing it as the center of vitality

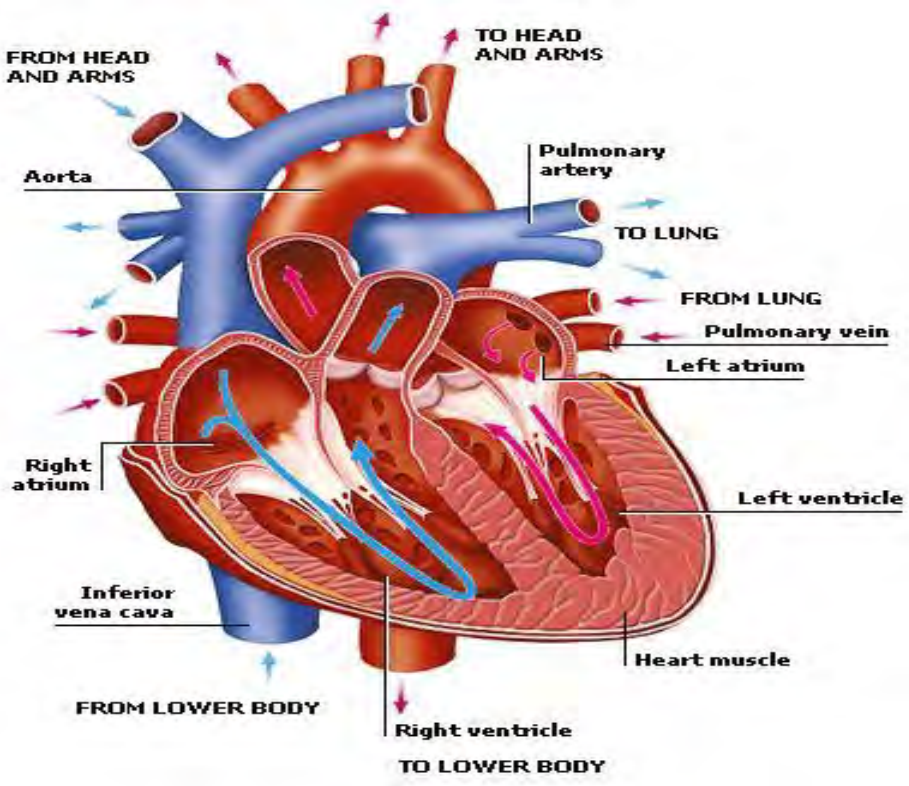
**Can the heart provide us with information about our physical and psychological experiences and wellbeing?**



# The Heart

- The heart is the first organ to develop form and become functional
- Originates about day 18 or 19 in the developing infant
  - **Emphasizes the importance of transporting material to and from the developing infant**
- Heart begins beating and pumping blood about day 21 or 22 of development
- Research indicates that the heart is more than a "simple efficient pump"
  - "The heart is highly complex and serves as an information-processing center with its own functional brain"
  - "The hearts influence on brain function and other major organs within the body, play an important role in mental and emotional experiences and the quality of our lives"

# Heart Structure = The Pump

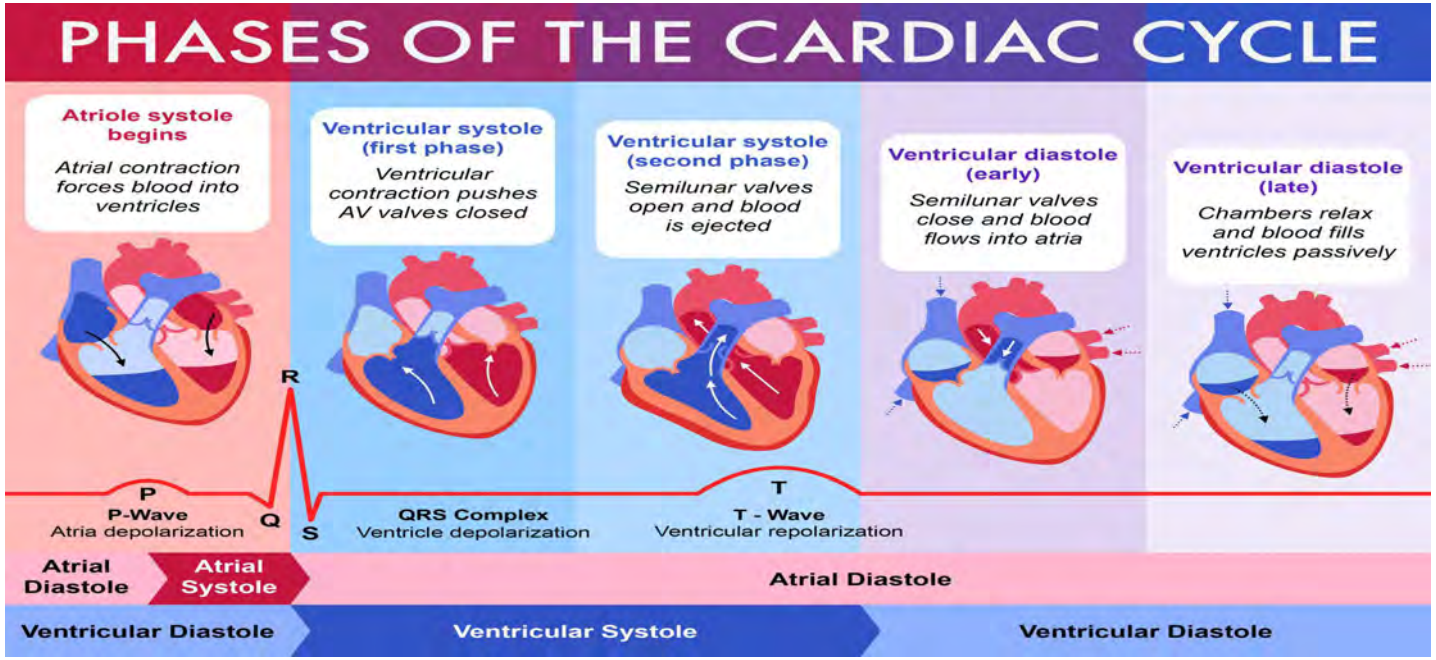



- Composed of 4 chambers and 2 distinct sides
- **Right side** receives blood from the peripheral circulation and pumps blood to the pulmonary circulation
- **Left side** receives blood from the pulmonary circulation and pumps blood to the peripheral circulation
- Each of the 4 chambers of the heart has a specific function during the cardiac cycle
- Cardiac muscle is capable of contraction and force generation
  - A sequential series of contractions (systole) and relaxations (diastole) of the cardiac chambers enable the heart to function as a pump
- The cardiac cycle is repeated with each beat of the heart

# The Effortless Cardiac Cycle

## Intrinsic Control:

- Specialized nervous tissue within the heart that control the contraction sequence of the atria and ventricles
- Blood moves in a specific direction through the heart into the pulmonary and peripheral circulation




Sinoatrial (SA) Node
Pacemaker

↓

Atrioventricular (AV) Node
Delays Impulse to Contract 1/10$^{th}$ of a second

↓

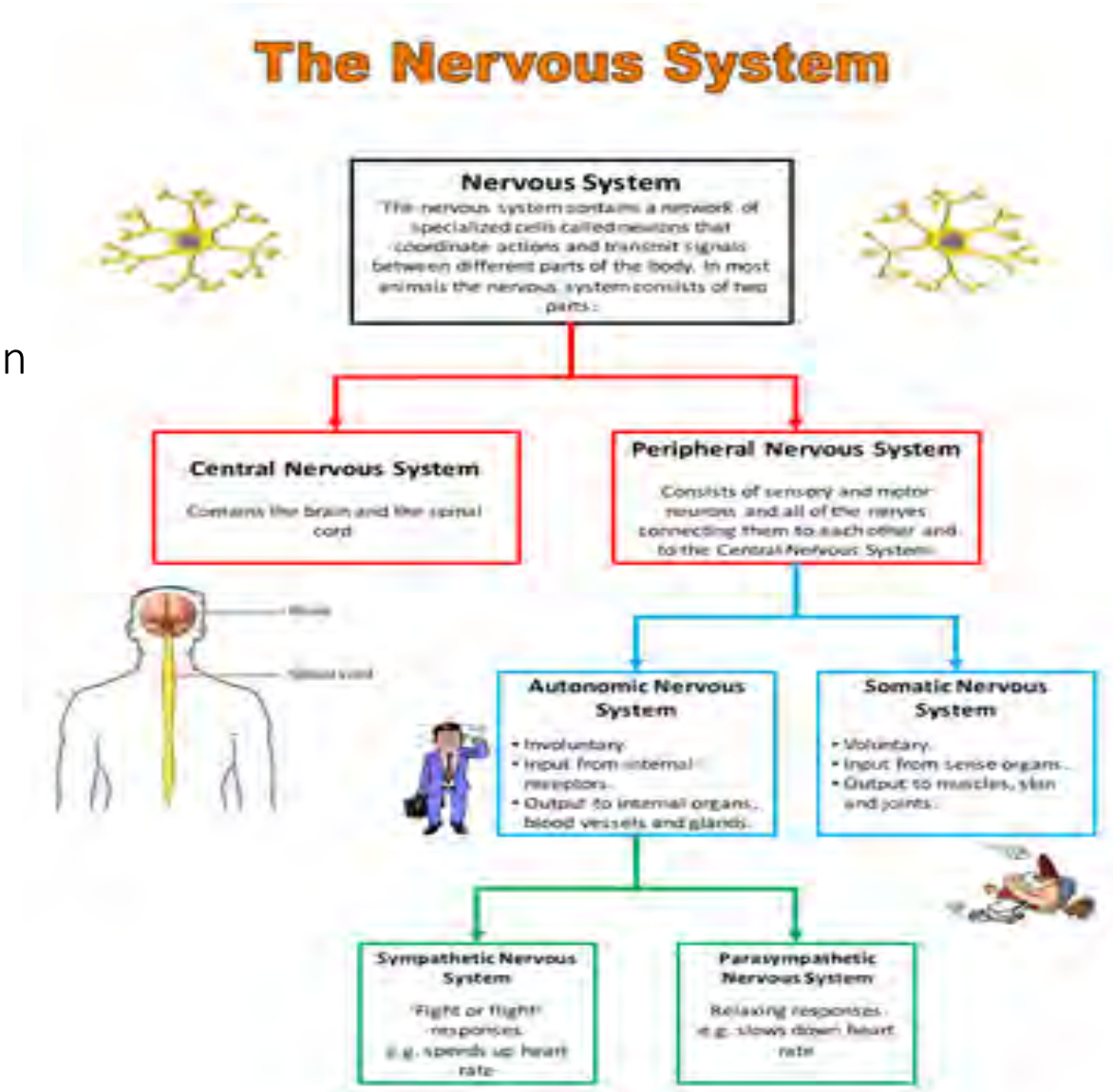
Atrioventricular Bundle
Left and Right Bundle Branches

↓

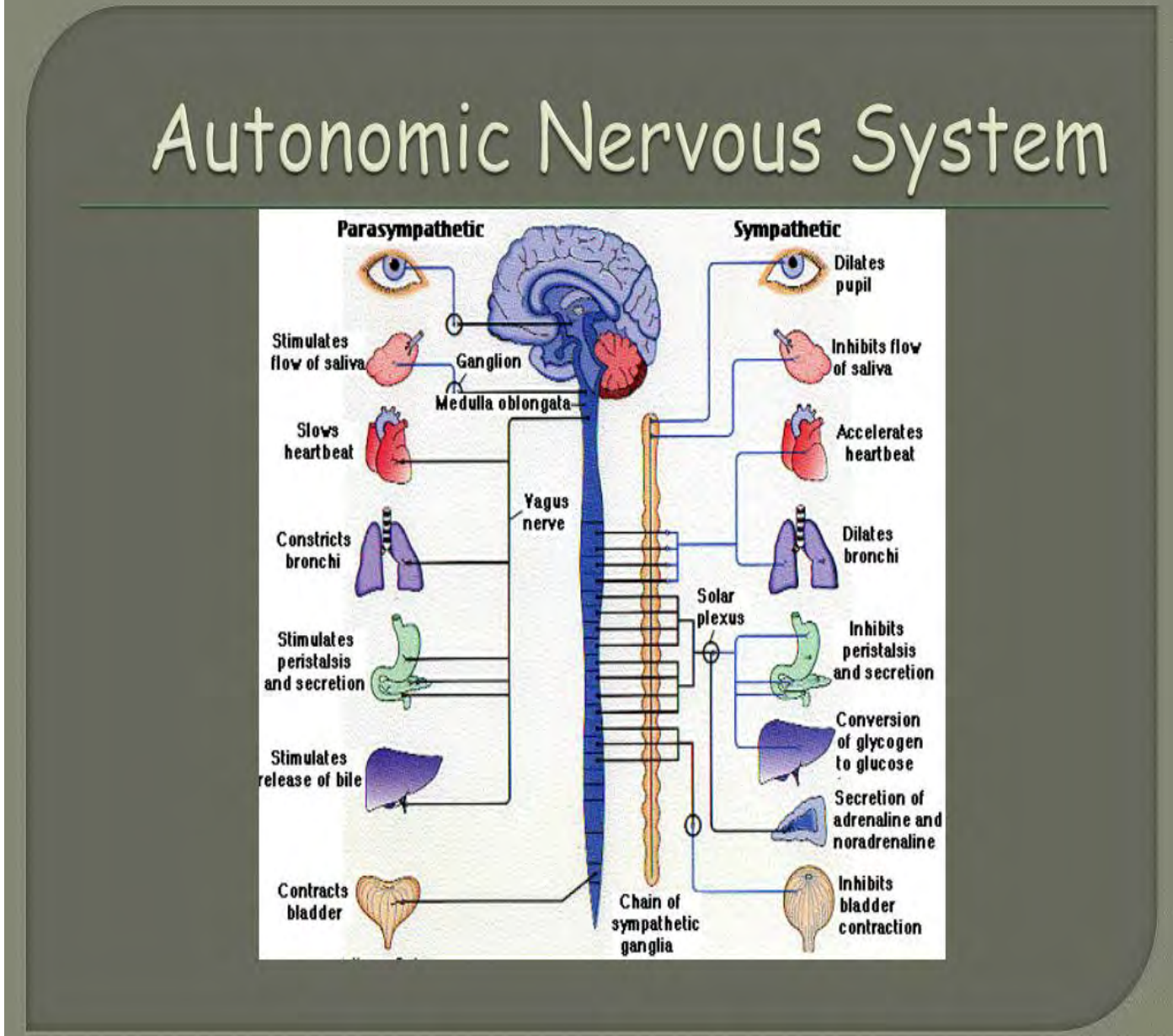
Purkinje Fibers

## Extrinsic Control:

- Occurs through branches of the Autonomic Nervous System (ANS)
- The ANS controls cardiac function through its innervation of the SA Node and AV Node via the vagus nerve
- The ANS controls physiological functions that are unconscious in nature through its subcomponents – **sympathetic nervous system (SNS)/parasympathetic nervous system (PNS)**
  - **Heart Rate, Cardiac Timing, Contractility, Blood Pressure, Breathing, Digestion**
  - **Serves as a "check engine" light for making adjustments on a moment-to-moment basis**



- Research has shown the rhythm of a healthy heart to be variable even under resting conditions
- This variability is due to the synergistic action of SNS and PNS
- The SNS and PNS are continuously interacting to maintain CV activity in an optimal range and permit appropriate responses to internal and external conditions
- **Fight, flight or freeze is not the only option. Self regulation is possible by inhibiting sympathetic outflow (gas) and initiation of the PNS (brake).**



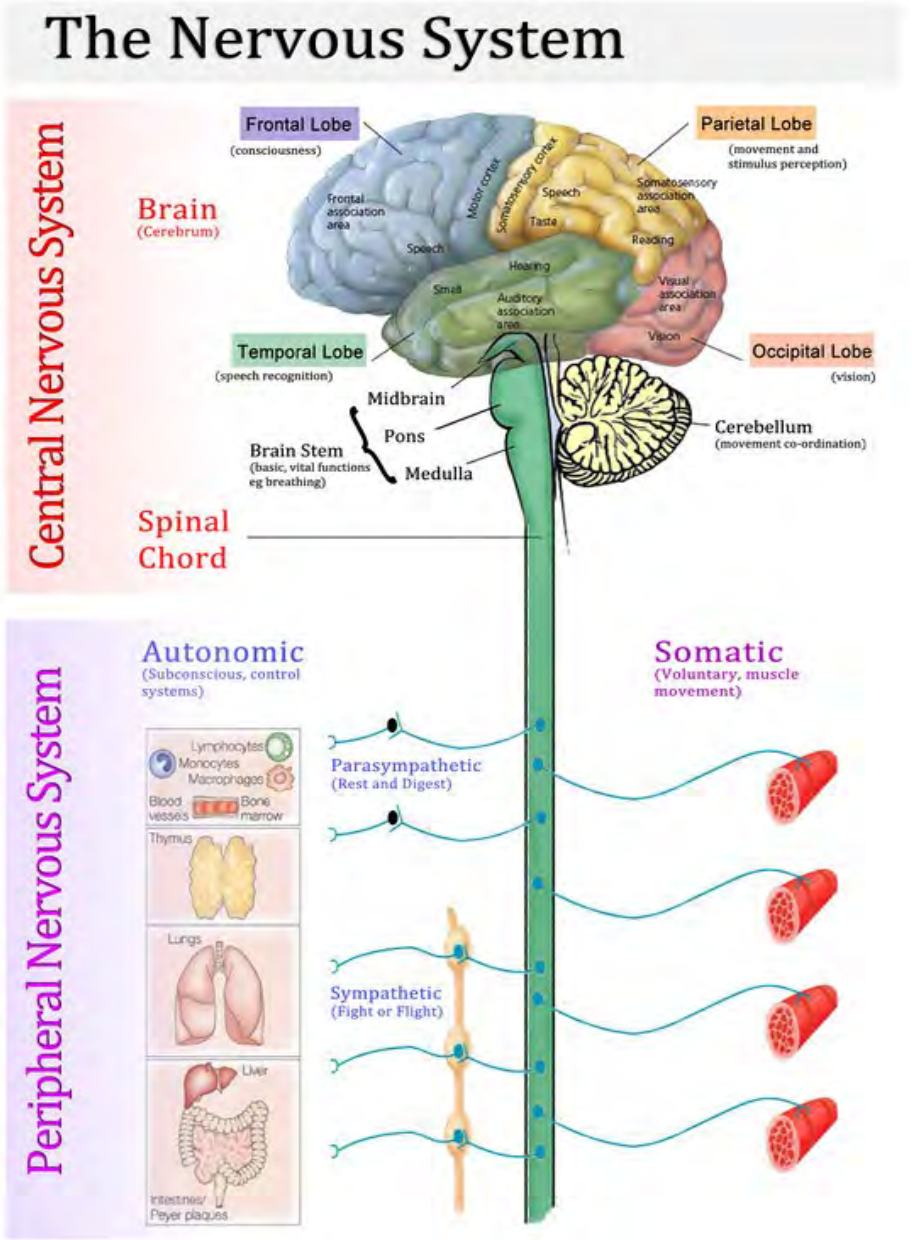


**Ernst G** (2017) Heart-Rate Variability—More than Heart Beats? Front. Public Health 5:240. doi: 10.3389/fpubh.2017.00240

**Stephenson, M.D. et al**. Applying Heart Rate Variability to Monitor Health and Performance in Tactical Personnel: A Narrative Review. Int. J. Environ. Res. Public Health 2021, 18, 8143. https://doi.org/10.3390/ijerph18158

**Tomes C, Schram B and Orr R** (2020) Relationships Between Heart Rate Variability, Occupational Performance, and Fitness for Tactical Personnel: A Systematic Review. Front. Public Health 8:583336. doi: 10.3389/fpubh.2020.583336

- **The traditional scientific view is the heart responds to brains commands**
  - The ANS influences the cardiovascular system through a complex system of brain centers (limbic, hypothalamus and medulla) and neural pathways (brainstem and spinal cord)
- **Research shows a dynamic two-way dialogue exists between the heart and brain with each organ continuously influencing the other.**
  - **Heart communicates with the brain and body in 4 ways:**
    - Neurological communication (nervous system)
    - Biochemical communication (hormones)
    - Biophysical communication (pulse wave)
    - Energetic communication (electromagnetic fields)




**McCraty, R** (2015). Science of the Heart: Exploring the Role of the Heart in Human Performance, Vol II. Heart Math Institute

# The Heart Brain

- Research has shown the heart has a complex neural network that is extensive and characterized as a brain on the heart and includes a network of ganglia, neurotransmitters, proteins and support cells
- The heart is processing information from the internal and external environment and appropriately responding with signals to the SA Node and other tissues in the heart
- Messages from the cardiac nervous system travel to the brain via ascending pathways in both the spinal column and vagus nerve and on to the medulla, hypothalamus, thalamus, amygdala and cerebral cortex
- Under normal physiologic conditions the heart's intrinsic nervous system is vital for maintenance of CV stability and efficiency

**McCraty, R** (2015). Science of the Heart: Exploring the Role of the Heart in Human Performance, Vol II. Heart Math Institute

# Emotions and Stress

- Research has shown when the heart is pushed by constant emotional inputs and excessive physical exertion without appropriate rest, it suffers through disordered function and vulnerability to disease
- The psychophysiological response to stress is through emotions and includes feelings of anxiety, irritation, lack of control and at times hopelessness
- The ANS is intimately connected to other physiological and psychological systems in the body, understanding it responsiveness may provide information about occupational performance capacity
- This is important in tactical populations who often operate in unpredictable and extreme environments with high physical demands while under stress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# Can We Measure “Readiness”?

**MILITARY MEDICINE,** 174, 5:491, 2009

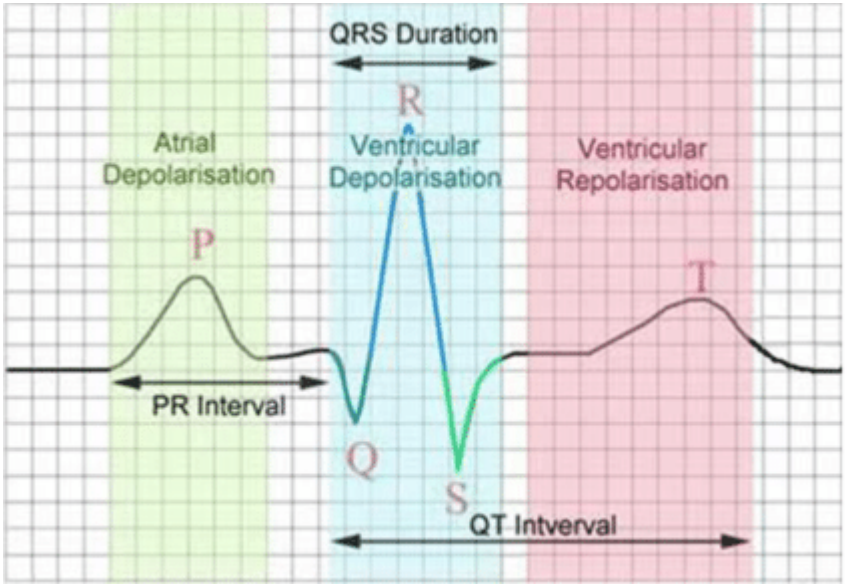
# Heart Rate Variability to Assess Combat Readiness

*Donovan L. Fogt, PhD*; Paige J. Cooper, MS*; Christine N. Freeman, MS†; John E. Kalns, PhD‡; William H. Cooke, PhD†*

**ABSTRACT** Chronic fatigue/physical exhaustion (FPE) impacts combat readiness but is difficult to identify. We tested the hypothesis that resting heart rate variability (HRV), including both time- and frequency-domain assessments, would correlate with hydration status and aerobic capacity in military recruit-age men and women with varying fitness levels. Cardiac interbeat intervals were recorded using a heart R-R monitor during 20 minutes of quiet, supine rest with paced breathing (0.25 Hz). HRV metrics included average R-R interval ($RRI_{avg}$), R-R interval standard deviation (RRISD), the percentage of adjacent R-R intervals varying by ≥50 ms (pNN50), and integrated areas of R-R interval spectral power at the high (0.15–0.4 Hz) (RRIHF) and low (0.04–0.15 Hz) (RRILF) frequencies. Treadmill maximal oxygen uptake ($VO_2$ max), segmental bioimpedance estimates of total body water (TBW), and urine specific gravity (USG) were also assessed. All dependent variables of interest were within expected ranges, although absolute ranges of individual values were considerable. RRI correlated with $VO_2$ max ($r = 0.49$; $p < 0.001$), with TBW ($r = 0.38$; $p < 0.001$), and inversely with USG ($r = -0.23$; $p = 0.02$). RRISD correlated with $VO_2$ max ($r = 0.21$; $p = 0.03$), but not with TBW or USG. pNN50 correlated inversely with USG ($r = -0.21$; $p = 0.03$) but not with $VO_2$ max or TBW. R-R interval spectral power at the high and low frequencies did not correlate with $VO_2$ max, TBW, or USG. We have demonstrated that fitness level and hydration status may affect cardiac function via changes in autonomic tone, highlighting the potential of field-based assessment of heart rate variability metrics to identify FPE and other aspects of combat readiness.

# What is Heart Rate Variability (HRV)?

- **Heart rate variability (HRV) is the fluctuation in the time intervals between adjacent heartbeats**
- **HRV is a measure of the normally occurring beat to beat changes in heart rate or the duration of the R-R interval/inter-beat-intervals (IBI)**
- HRV assesses neurocardiac function and is generated by heart-brain interactions and dynamic non-linear ANS processes
- Psychological and physical arousal initiates sympathetic activation and parasympathetic (vagal) withdrawal causing the IBI to become shorter, more rapid, and less varied
- Research has shown HRV is an important indicator of health and fitness
- Optimal levels of HRV within an organism reflects healthy function and a inherent self-regulatory capacity, adaptability, and resilience

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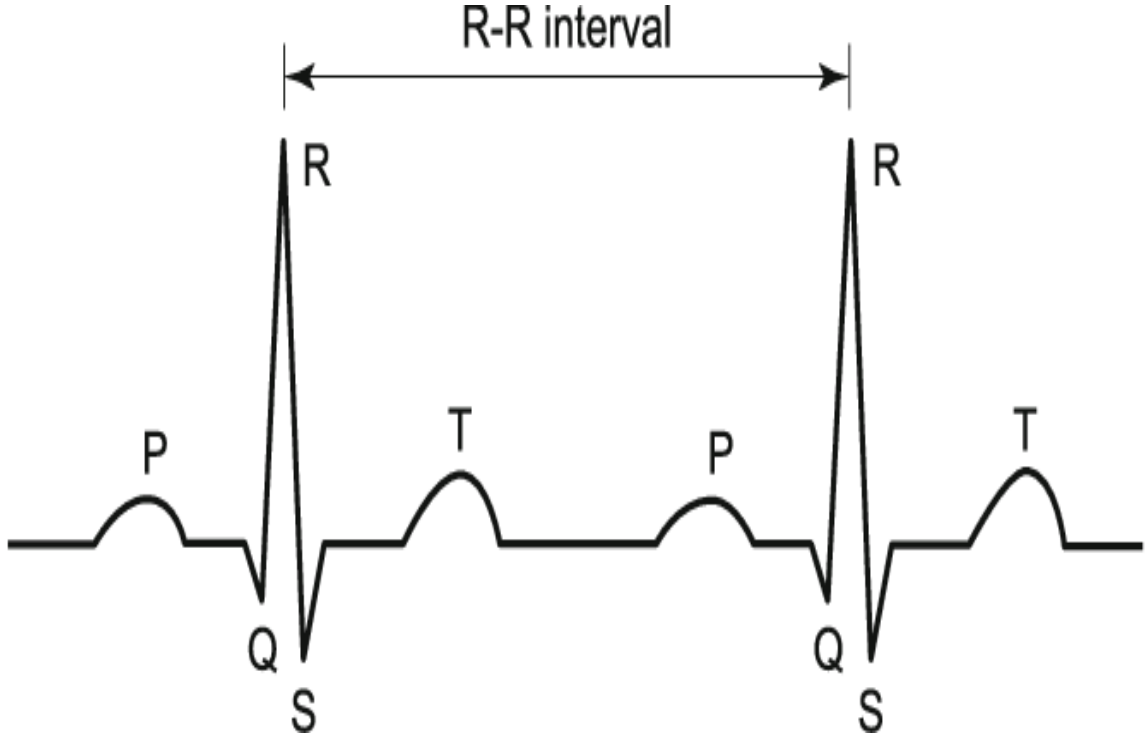
# HRV

- The IBI/R-R intervals are typically measured with electrocardiography signal using sampling frequencies from 250-1000Hz
- Field based HRV monitoring is available, user friendly, objective, affordable and a practical/somewhat reliable tool
- Chest straps, clothing garments, and wrist/finger worn devices are unobtrusive. The fit of the device is critical for valid and reliable measures.
- Chest straps have been shown to be most effective (accurate and reliable) for HRV assessments

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# Very Brief Overview of HRV Metrics

- Measuring and understanding IBI variations over time via HRV parameters can provide psychophysiological insight regarding a Tactical Professional's capacity to handle challenging environmental conditions

**Commonly used HRV parameters:**

These HRV parameters provide different ways to view over time measures of central tendency (mean, median, mode), variability and distribution (standard deviation)

➢ **Time-Domain**

- HRV time-domain indices quantify the amount of HRV observed during monitoring periods of < 1 min to > 24 hours

➢ **Frequency-Domain**

- Frequency-domain measurements estimate the distribution of absolute or relative power into 4 frequency bands as designated by the Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology (1996)

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# What Effects Heart Rate Variability

| Training Factors | Lifestyle Factors | Biological Factors |
|---|---|---|
| Frequency | Diet/Nutrition | Age |
| Volume | Alcohol | Gender |
| Intensity | Sleep | Genetics |
| New/Unfamiliar Tasks | Stress | Chronic Health Conditions |


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# HRV in Tactical Populations

## Who Serves in the U.S. Army?

U.S. Army Demographics 2020:

- Active component (AC) Soldier population was 474,000
- 81% of AC end strength was enlisted personnel
- 77% were under 35
- 15% were female
- **49% of Soldiers experienced a new injury**
- **70% cumulative overuse musculoskeletal injuries (MSKIs)**
- **18% of Soldiers were classified as obese**
- **17% had a diagnosed chronic disease**
- **15% of Soldiers were diagnosed with 1 or more behavioral health disorders**
- **9% of Soldiers had a sleep disorder**

2021 Health of the Force Report, APHC, 2021-hof-web.pdf (army.mil)

# The Performance Triad?

- Sleep, Activity, Nutrition (SAN)
  - Annual Survey per Reg 350.53
  - Pillars of optimal physical, behavioral, and emotional health
  - Based on CDC and USDA recommendations/targets
  - Neglect in any single domain = suboptimal performance

Increased Injury Risk

2021 Health of the Force Report, APHC, 2021-hof-web.pdf (army.mil)

# Summary

**Percent of AC Soldiers Meeting SAN Targets, 2020**

## Sleep

- 38% obtained 7 or more hours of sleep on weeknights/duty nights.
- 69% obtained 7 or more hours of sleep on weekends/non-duty nights.

## Activity

- 81% engaged in resistance training 2 or more days per week.
- 89% achieved adequate moderate and/or vigorous aerobic activity targets.

## Nutrition

- 30% ate 2 or more servings of fruits per day.
- 40% ate 2 or more servings of vegetables per day.


2021 Health of the Force Report, APHC, 2021-hof-web.pdf (army.mil)

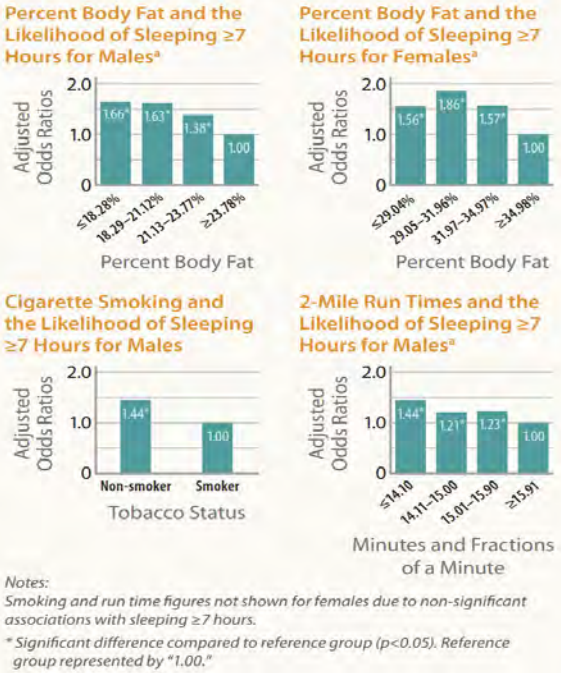
# Physical and Behavioral Characteristics of Soldiers who Obtain Recommended Sleep

**Just over one-third of U.S. Army Soldiers meet the NSF's recommended guidelines of 7 or more hours of sleep per night (APHC 2021a). Insufficient sleep is associated with negative health impacts such as increased injury risk; impaired decision making and reaction time; decreased cognitive, metabolic, and immune functions; increased fatigue and tiredness; decreased anaerobic and endurance performance; and increased prevalence of cigarette smoking (Fullagar et al. 2015, Bruce et al. 2017, Vitale et al. 2019, Grier et al. 2020). Therefore, identifying those who do not achieve optimal sleep duration and intervening to promote increases in sleep have the potential to positively impact many aspects of Soldier well-being.**

In a recent investigation by the APHC, male and female Soldiers with a lower body fat percentage were more likely to meet sleep recommendation guidelines than those with higher body fat percentages. Soldiers who were categorized as obese were less likely to meet sleep recommendation guidelines compared to those who were categorized as normal weight. Male Soldiers who were non-smokers and/or had greater aerobic endurance (as indicated by APFT 2-mile run times) were more likely to meet the guidelines compared to smokers and Soldiers with lower aerobic endurance (see figure). These results are consistent with previous research that has reported better sleep health among those with healthy body compositions, positive health behaviors, and greater fitness (Krueger and Friedman 2009, Phillips and Danner 1995, Jaehne et al. 2009, Costa and Esteves 2018).

Results from the APHC study as well as previous studies can inform how Soldiers may improve their sleep. Sleep impacts associated with tobacco use can reverse after cessation (Jaehne et al. 2009, Zhang et al. 2006). Likewise, Soldiers may be more likely to have healthier sleeping habits if they regularly eat breakfast, maintain their aerobic and strength training, and pass their APFT in the top quartile (Lentino et al. 2013). Maintaining a healthy body weight, being a non-smoker, and having higher aerobic endurance are associated with meeting sleep recommendation guidelines and may ultimately improve Soldier performance and reduce injury risk.

**Physical and Behavioral Characteristics and Likelihood of Sleeping ≥7 Hours, 2018–2019**




*Notes:*
*Smoking and run time figures not shown for females due to non-significant associations with sleeping ≥7 hours.*
** Significant difference compared to reference group ($p<0.05$). Reference group represented by "1.00."*

# HRV and Physical (Occupational) Performance

- Research on the effects of physical activity on HRV have been designed to assess overtraining or non-functional overreaching, which can impact performance and increase injury risk
- Overtraining and NF overreaching are associated with increased SNS activity
- HRV values that persist as abnormally high or low may reflect a state of overtraining and indicate a need to evaluate training volume and for training to be adjusted
- Research shows the association between HRV metrics and aerobic fitness and general fitness levels, but individual characteristics along with training intensity and volume must be considered

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# HRV and Physical (Occupational) Performance

- HRV mainly assesses and reflects neurocardiac ANS function. Its relationship to neuromuscular performance (maximal strength and power) is not clear with more research needed
- HRV may be an effective tool for monitoring program design by accounting for training volumes and implementing appropriate recovery
- HRV provides a non-invasive and practical method for assessing internal load responses and adaptability to external demands (occupational)
- **HRV provides an opportunity for the Tactical Professional to learn to self-monitor and develop personal psychophysiological awareness via real-time biofeedback**

**Stephenson, M.D. et al**. Applying Heart Rate Variability to Monitor Health and Performance in Tactical Personnel: A Narrative Review. Int. J. Environ. Res. Public Health 2021, 18, 8143. https://doi.org/10.3390/ijerph18158
**Tomes C, Schram B and Orr R** (2020) Relationships Between Heart Rate Variability, Occupational Performance, and Fitness for Tactical Personnel: A Systematic Review. Front. Public Health 8:583336. doi: 10.3389/fpubh.2020.583336

# HRV and Nutrition

- HRV serves as a measure of general body homeostasis due to its link with lifestyle factors and association with morbidity and mortality. HRV is pathologically decreased in individuals with cardiovascular disease
- Research has shown co-morbidities, dietary habits, physical activity, genetic factors and emotional stress all influence HRV
- *Glucose levels and Insulin resistance:*
  - High fasting plasma glucose levels are significantly correlated with PNS modulation resulting in reduced heart rate recovery after cardiopulmonary exercise testing
- *Body Fat:*
  - PNS modulation is inversely related to body fat percentage, high body mass and waist circumference
- *Exercise Training in Individuals with Obesity*:
  - Weight reduction through exercise training in obese individuals has been shown to improve HRV by modulating PNS (vagal) activity
  - Research has shown that improved cardiorespiratory fitness is a stronger and independent determinant of HRV than weight loss

**Struven et al**., Obesity, Nutrition and HRV*, Int. J. Mol. Sci.* 2021, 22, 4215. https://doi.org/10.3390/ijms22084215
**Stephenson, M.D.** et al.Applying Heart Rate Variability to Monitor Health and Performance in Tactical Personnel: A Narrative Review. *Int. J. Environ. Res. Public Health* 2021, 18, 8143. https://doi.org/10.3390/ijerph18158
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# HRV and Sleep

- In the long-term, poor sleep hygiene increases sleep problems co-morbid with physiological and psychological issues including:
  - Cardiovascular disease, substance abuse, post-traumatic stress disorder (PTSD), and mood disorders
  - Sleep disruption is often conditioned by trauma and specifically when an individual is deployed  an environment that is threatening
- Research shows that sleep has important benefits for health and well-being and is often disrupted in tactical populations
- HRV values below a determined normative rolling baseline may indicate incomplete recovery, onset of illness, chronic stress and poor sleep
- HRV has been shown be useful in predicting mental (stress, depression) and physical disorders (insomnia, fatigue) through an observable increase in SNS output that creates an imbalance in ANS function and greater allostatic load (cumulative effect of chronic stress and life events)

**Corrigan et al.** Monitoring stress and allostatic load in first responders and tactical operators using heart rate variability: a systematic review, BMC Public Health (2021) 21:1701 https://doi.org/10.1186/s12889-021-11595-x

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# HRV and Stress

- Tactical Professionals experience stress through physical training, deployments, environmental conditions, vigilance, emotions, cognitive strain and illness
- Acute and chronic stress generally initiates a withdrawal of the PNS and increased SNS activity resulting in a decrease in HRV
- A slower rate of recovery of HRV after the completion of acute occupational stressors appears to occur in response to stressors of greater magnitude.
- Baseline HRV is reduced when acute stressors cause a chronic accumulation of stress, which degrades physical and mental task performance
- In general, Tactical Professionals with high HRV values tend to demonstrate better coping skills (positive emotions, cognitive flexibility) under stressful conditions when compared to those with lower HRV values (poor self-regulatory capacity, more rigidity)

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# Heart Rate Variability-The Why?

- HRV as an assessment tool may be effective in assessing health and performance in tactical work environments
- HRV offers a method to develop awareness and implement adjustments to training specific to the needs of the tactical professional and their occupational demands.
- Monitoring HRV facilitates an opportunity to develop self-awareness about one's recovery, lifestyle habits, and the effect of these variables on their psychophysiology (wellbeing)
- HRV provides psychophysiological feedback that may be useful in addressing the tactical professional's current capabilities to handle occupational tasks while in the selection process and when returning to duty following a musculoskeletal injury or illness.


**Ernst G** (2017) Heart-Rate Variability—More than Heart Beats? Front. Public Health 5:240. doi: 10.3389/fpubh.2017.00240

**Corrigan et al.** Monitoring stress and allostatic load in first responders and tactical operators using heart rate variability: a systematic review, BMC Public Health (2021) 21:1701 https://doi.org/10.1186/s12889-021-11595-x

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# Heart Rate Variability-The Why?

*" The phrase "popular science" has in itself a touch of absurdity. The knowledge which is popular isn't scientific."*

"*Study as if you were going to live forever; live as if you were going to die tomorrow."*

*Maria Mitchell, American Astronomer,* First woman elected Fellow of the American Academy of Arts and Sciences and the American Association for the Advancement of Science

# Heart Rate Variability-The How?


- Ernst G (2017) Heart-Rate Variability—More than Heart Beats? Front. Public Health 5:240. doi: 10.3389/fpubh.2017.00240
- Shaffer F and Ginsberg JP (2017) An Overview of Heart Rate Variability Metrics and Norms. Front. Public Health 5:258. doi: 10.3389/fpubh.2017.00258
- Hinde, K.; White, G.; Armstrong, N. Wearable Devices Suitable for Monitoring Twenty-Four Hour Heart Rate Variability in Military Populations. Sensors 2021, 21, 1061. https://doi.org/10.3390/ s21041061
- Stephenson, M.D. et al. Applying Heart Rate Variability to Monitor Health and Performance in Tactical Personnel: A Narrative Review. *Int. J. Environ. Res. Public Health* 2021, 18, 8143. https://doi.org/10.3390/ijerph18158
- Tomes C, Schram B and Orr R (2020) Relationships Between Heart Rate Variability, Occupational Performance, and Fitness for Tactical Personnel: A Systematic Review. *Front. Public Health* 8:583336. doi: 10.3389/fpubh.2020.583336
- **Corrigan et al.** Monitoring stress and allostatic load in first responders and tactical operators using heart rate variability: a systematic review, BMC Public Health (2021) 21:1701 https://doi.org/10.1186/s12889-021-11595-x

# Thoughts and Questions?

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