ACTIVATION: CENTRAL NERVOUS SYSTEM RESPONSE DURING FITWALL EXERCISE

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1. INTRODUCTION

Exercise is an ever increasing area of interest in the medical and health fields. Each year more research is conducted to evaluate new modes of exercise and ways exercise can be structured to optimize benefits. The purpose of this article is to review existing research on the activation of the Central Nervous System (CNS) as well as my own research evaluating CNS activation on a new mode of exercise called Fitwall. The studies were performed in the Welltec Human Performance Lab in Albuquerque, NM, using a Polar rs800CX and R-R recorder to conduct time domain heart rate variability (HRV) analysis on each subject.

2. OVERVIEW OF CNS

Activation of the CNS occurs when the body is subjected to any type of stress, emotional or physical. The CNS is divided into 2 systems: sympathetic and parasympathetic.

Sympathetic: The sympathetic nervous system stimulates most organs' functions. For instance, an increase in sympathetic stimulation causes increases in HR, stroke volume, and systemic vasoconstriction. Figure 1: Sympathetic, Parasympathetic NS

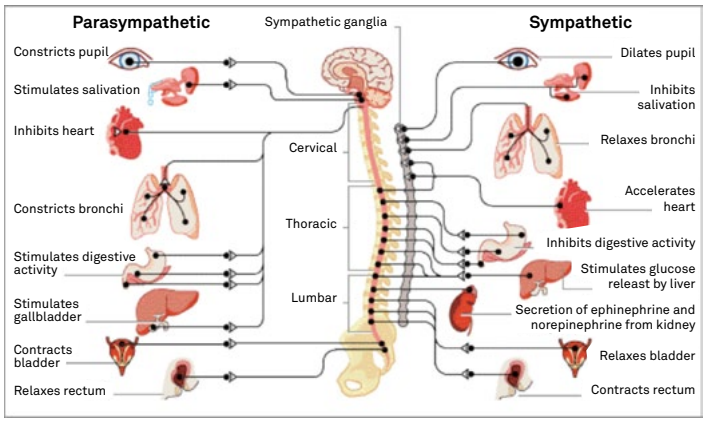


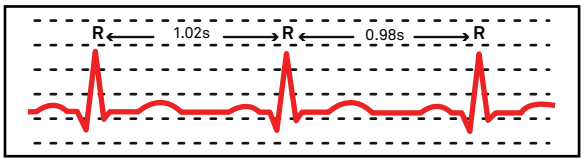
Figure 1: Sympathetic, Parasympathetic NS

Parasympathetic: In contrast, the parasympathetic nervous system inhibits the functions of these organs. An increase in parasympathetic stimulation causes decreases in HR, stroke volume, and systemic vasodilation. The heart's response to parasympathetic stimulation is almost instantaneous.

3. MEASURING SYMPATHETIC, PARASYMPATHETIC ACTIVITY

A non-invasive and accurate method of measuring sympathetic-parasympathetic activation is the measurement of Heart Rate Variability (HRV).2 HRV indicates the fluctuations of heart rate around an average heart rate. For example, if one's average heart rate at a given time is 60 beats per minute (bpm), this does not mean that the time between successive heartbeats would be exactly 1.0 sec. In fact, the times can fluctuate/vary between 0.5 sec and 2.0 sec. This study uses the time domain SD1 real time method (RLX). 2

Figure 2: HRV diagram, Polar Electro OY 2012



4. METHODS

It has been discussed that one of the unique properties of Fitwall is the ability to stimulate the sympathetic nervous system without an increase in physical stress. The reason for this response can be attributed to a fear of falling while grasping the wall with both one's hands and feet. 6 It is well-documented that fear of falling (FoF) influences the anticipatory postural control (APA) of medio-lateral stability4 when in postural threat, as in all Fitwall movements. In previous research, APA was measured using maximal velocity of muscle contraction and HRV2, but with the intention of measuring the entire CNS response to FoF, rather than solely the sympathetic response.

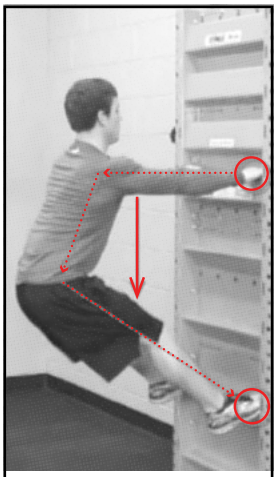


Figure 3

As shown in Figure 3, the subject's toes are engaged since the step on the Fitwall cannot accommodate the entire foot (postural threat). This leverage causes a line of force from the feet to the hands in a vertical plane, or diagonal plane if one hand or foot is removed from the wall during a specific exercise.

Figure 4: Subject in Welltec Human Performance Lab

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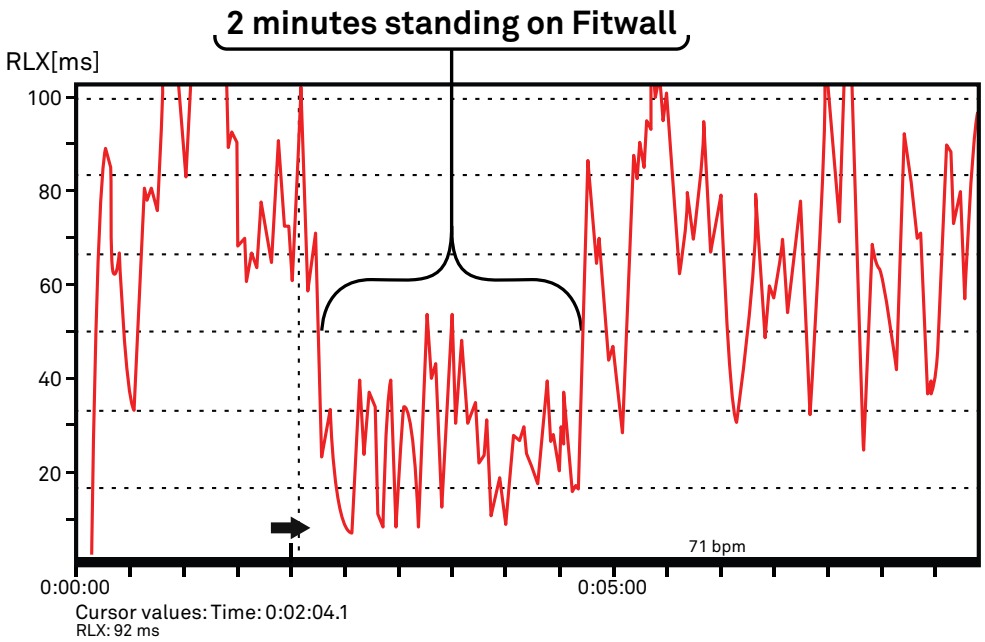

Figure 5: HRV Response

5. RESULTS

Figure 5 shows a sample of an HRV curve during 2 minutes of standing on flat ground, 2 minutes of standing on the wall, and 4 minutes recovering standing on flat ground.

As shown in Figure 5, the HRV (or sympathetic nervous system response) was strongest while on the Fitwall. The bracket indicates the RLX response. The lower the RLX, the more sympathetic the response (depressed parasympathetic).

This high sympathetic response occurs when under postural threat. This indicates that there is a mechanism that is activating the sympathetic nervous system, causing a higher response than would be found with traditional exercise positions.

6. CONCLUSION

Exercise activates the central nervous system (CNS), stimulating metabolism, balance, stability and many other neuromuscular responses. This study found that a four point position (both hands and feet) on a Fitwall caused a strong sympathetic nervous system response as measured by heart rate variability (HRV). This is the same CNS response as would be expected with exercise; however this was during a static non-exercise position. This increase in HRV indicates a strong CNS response to the vertical 4-point position on a Fitwall.

A fear of falling has been shown to be a factor in anticipatory postural control (APA) of medio-lateral stability in previous research4. Using HRV, this research suggests the CNS stress response to FoF does in fact happen when in postural threat on a Fitwall.

This sympathetic response may explain the high levels of metabolic consumption and increased motor unit recruitment for balance and stability both during and after a Fitwall exercise session.

7. REFERENCES

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