The Effects of Cycling with and without Mechanical Vibration on Oxygen Uptake and Heart Rate

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This is a summary of a preliminary study carried out at the Centre for Sports Science & Human Performance, University of Greenwich, UK

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Introduction:

Whole body vibration (WBV) is used in different sporting, fitness and rehabilitation contexts (Rittweger et al., 2000). It is also widely recognized as an alternative method to traditional training (Nordlund et al., 2007; Sands et al., 2008). The Power Plate Rev™ represents a mechanical training ergometer specifically designed to apply vibration training (VT) to enhance human performance. A patented mechanism placed in the crank enables the bike to generate vibration that is transmitted to the pedals during cycling. The focus of this study was to evaluate the cardio-vascular and pulmonary responses during a submaximal incremental cycling exercise, with or without vibration.

Method:

Eight participants volunteered to participate in this study (height 1.79 + 0.04m, mass 74 + 9 kg). The cycling protocol was approved by the University's Research Ethics Committee and participants gave their written consent. Each participant performed two sub-maximal tests in random order (with or without vibration). The incremental increase of the vibrations was cadence-related, equivalent to 20, 23.3, 26.7 and 30 Hz respectively at each stage. The subjects cycled at a fixed resistance for three min at each cadence: 60, 70, 80 and 90 rpm.

Respiratory Gases [Oxygen uptake (VO2), Carbon Dioxide production (VCO2)], Respratory Exchange Ratio (RER) and Minute Ventilation (VE) were continuously measured using a "Vacu Med, mini CPX, USA" gas analyser. Heart rate was monitored usin a Heart Rate Monitor (Polar, Finland). Rate of Perceived Exertion was recorded at the end of each stage using the BORG scale (6 to 20)

Results:

Oxygen Consumption (VO2) during vibration ans non-vibration conditions is shown in Figure 1. A significant increase in the VO2 was observed during the vibration trial when compared to cycling without vibration P<0.05). Heart rate (HR) values were significantly higher (P<0.05) in all stages of the vibration trial compared to the non-vibration (Fig. 2) and similarly for the subjects' perceived exertion (RPE)

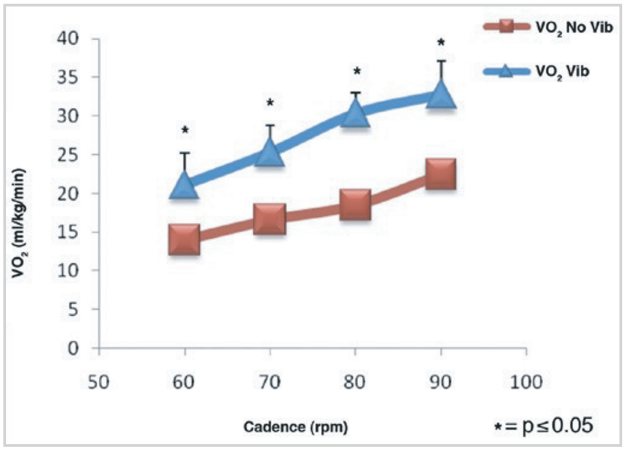

Fig 1: Oxygen consumption during cycling with and without vibration

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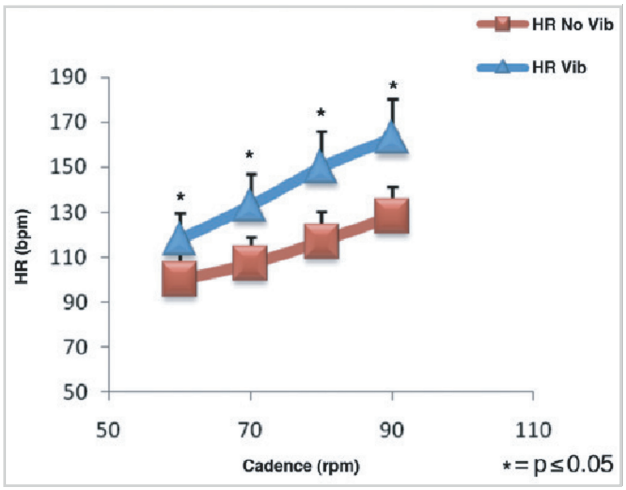

Fig 2: Heart rate during cycling with and without vibration

Conclusion:

The preliminary data show that the addition of mechanical vibration during cycling produces significant increases in the physiological demands (oxygen consumption and heart rate) confirmed by an increased exertion perceived by the subjects. Cycling at the same cadence with vibration seems to allow higher energy expenditure. An increased neuromuscular recruitment has been confirmed with other studies using electromyography (EMG).

The mechanism providing the mechanical vibration is responsible for the increase in power output in the same way as increasing the resistance. Testing showed that, when cycling at the same cadence, level 1 with vibration was the same as cycling at level 5 without vibration.