

Physiological Responses While Playing Games Virtually Simulated by Nintendo Wii

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1 OBJECTIVES

The aim of this study was to compare the percentage of VO_2 max and maximal heart frequency (HR max) in different games (balance and aerobic) of Nintendo Wii Fit Plus in young adults. From the results it will be possible to verify the potential of these games to incorporate cardiorespiratory training programs.

2 METHODS

This is an interventional and comparative study. Participated in the study, nine healthy male college students (20.6 ± 2.01 years, 173.6 ± 3.8 cm, 73.6 ± 8.81 kg, lean body mass 84.0 ± 5.96 %, fat body 16.00 ± 5.96 %, and VO_2 max 55.8 ± 5.46 ml/kg⁻¹/min⁻¹). None of the subjects was involved in an intense aerobic training regimen or maintain a sedentary lifestyle (minimum of 30 minutes three times per week).

Experimental Routine. The experimental procedures were performed at the Laboratory of Physical Activity in Virtual Environment (LAFAV, IFSULDEMINAS, Câmpus Muzambinho, Minas Gerais, Brazil).

The experimental routine consisted of: (a) a preliminary assessment of the anthropometric and ergoespirometric parameters (VO_2 max and HR max), and (b) characterization of physiological responses with virtual reality (VR) promoted by interaction with the Nintendo Wii console (Nintendo, Kyoto, Japan). It was performed two exercise sessions, one day apart, with the realization of different games (Balance and Aerobic categories) of the Wii Fit Plus software. All procedures were monitored individually by a researcher.

Assessment of Anthropometric and Ergoespirometric Parameters. First, it was collected the weight and

height of the subjects. The body composition (lean mass and fat body) analysis was performed by Bioelectrical Body Composition Analyzer (RJL systems, Quantum II, Clinton Township, MI, USA). The VO_2 max was assessed on a treadmill by measuring respiratory gases with the automated system VO2000 (MedGraphics, Saint Paul, MN, USA) coupled with a *Polar* heart frequency meter. Before each VO_2 max determination, the gas analyzers were calibrated according to the manufacturer's instructions. Subjects began the graded exercise test at 2.5 mph and 4% grade. Every 2 minutes, the treadmill speed was increased 1 mph and 4% grade remained constant (Kraemer Protocol). Subjects reached VO_2 max and HR max with achievement of either the primary criterion of a plateau in VO_2 with increased workload or with 2 of 3 secondary criteria: (a) attained predicted maximal HR, (b) RER= 1.1, or (c) 19 or 20 points in the 15-point Borg scale.

Environment and Virtual Training. The virtual environment was simulated by the console Nintendo Wii. The subjects performed the following games of Balance and Aerobic categories: *Soccer Heading*, *Table Tilt* and *Penguin Slide*; and *Obstacle course*, *Hulla Hoop* and *Free Run*, respectively. The games chosen are the most popular in our laboratory. Each game was performed three times continually, and the interval between one game and another of the same category lasted five minutes.

During these procedures the physiological responses (VO_2 max and HR max) were monitored breath-to-breath using the automated system VO2000 coupled with a *Polar* heart frequency meter. Before each experimental procedure the system was calibrated.

Statistical Analysis. Statistical analysis were performed using two way ANOVA followed by Bonferroni's test to indicate the localization of statistical difference. Data were expressed as mean of percentage \pm standard deviation and were

considered statistically significant those with a value of $p < 0.05$.

3 RESULTS

Figure 1 and 2 show respectively the results of percentage of VO_2 max and percentage of HR max related to practice of Wii games. It was showed in both variables that aerobic games were significantly more intense than balance games ($p < 0.05$). Moreover, also it were found differences between the aerobic games (*Obstacle Course*, *Hulla Hoop* e *Free Run*) ($p < 0.05$). It was not found differences between balance games.

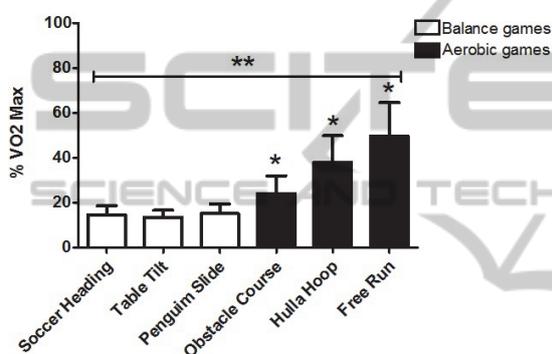


Figure 1: The values represent mean of percentage of VO_2 max (% VO_2 Max) during Wii games. ** $p < 0.05$ Aerobic vs. Balance games. * $p < 0.05$ Between the aerobic games. (n=9).

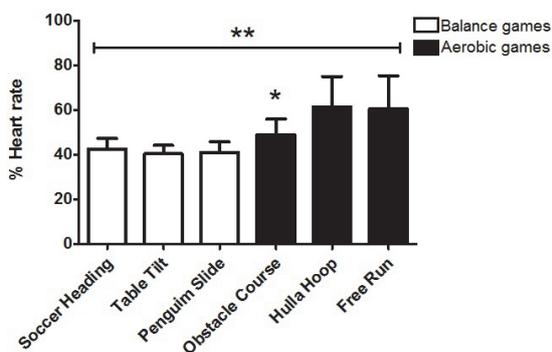


Figure 2: The values represent mean of percentage of Heart Rate max (%HR Max) during Wii games. ** $p < 0.05$ Aerobic vs. Balance games. * $p < 0.05$ Between Obstacle Course vs. other aerobic games. (n=9).

4 DISCUSSION

Recently, a new class of video games called exergames (EXG) has used VR to provide to the

user the possibility for development of sensory and motor abilities (Vagheti et al., 2010). Inserted in this context, the console Nintendo Wii, the world's most popular EXG, has been used in several studies, mainly to verify the therapeutic potential (Sposito et al., 2013) and physiological/ metabolic responses (White et al., 2011) during this technology-human interaction. Some authors have showed that Nintendo Wii significantly increase total body movement and energy expenditure compared to sedentary gaming (Maddison et al., 2007).

The main findings of the current study confirm the hypothesis that is possible to achieve intensities of stress physical compatible with health cardiovascular promotion (i.e. $>40\%$ VO_2 max and HR max). In this case, it is important to consider that only the aerobic games were sufficient. Although the balance games showed values lower than 20% of VO_2 max, it is important to consider these games to joint proprioception training.

In a similar study, (Souza et al., 2013) showed that the physical activity in a virtual environment emulated by Nintendo Wii is able to change the acute cardiovascular responses to health promotion. This possibility has also been observed in other studies related to the interpretation of physiological demand promoted by Nintendo Wii games (Miyachi et al., 2010).

In summary, the results of this study support the feasibility use of the Nintendo Wii in training programs and favor its indication more securely.

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