



Can ten weeks intervention with exergames contribute to better subjective vitality and physical health?

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Abstract

Purpose The purpose of the study was to investigate the effect of exergames «Wii Nintendo Sports» on psychological and physiological parameters of young adults.

Methods In the present study, twenty ($N=20$) students of the School of Physical Education and Sport Sciences of Democritus University of Thrace aged from 20 to 25 years old volunteered. The participants were randomly divided into two groups, the experimental ($N=10$) and control group ($N=10$). The experimental group used as a training method the exergames «Wii Nintendo Sports», while the control group did not participate in any training program. The experimental group participated in a 10 weeks pilot study of Nintendo's Wii sports, with three 30 min sessions a week. Subjective vitality, body weight, body mass index, maximum oxygen uptake and maximum heart rate of the participants were examined, before and after the intervention program.

Results Results of the present study revealed that exergames did not affect the participants' body weight, body mass index, maximum oxygen uptake and maximum heart rate. On the contrary, it was found that only the experimental group achieved a significantly better subjective vitality, between the pre- and post-test.

Conclusions In conclusion, exergames are effective tools for achieving a better subjective vitality in young adults.

Keywords Exergames · Subjective vitality · Maximum heart rate · Maximum oxygen uptake

Introduction

Lack of physical activity is a major cause of obesity and various chronic diseases in all age categories [1]. When Kraus and Raab [2] described the inactivity as a disease, the interest of research was focused on the study of the value of physical activity for the promotion of health. It has been reported that people who follow a sedentary lifestyle are at greater risk of being sick compared to those who participate in regular physical activity and follow an active lifestyle [3]. Moreover, the participation in physical activity is beneficial for both physical and mental health of the individual [4]. Specifically, it improves cardiovascular capacity, muscle strength, body agility, bone density, lipid profile and it also regulates insulin levels and immune function [5]. Furthermore, the participation in exercise programs contributes to

reduction of depression and anxiety rates with obvious benefits in both healthy and clinical populations, and having a positive effect on the mental health and quality of life [6, 7]. For adults, exercise guidelines recommend participation in 30 min of moderate intensity physical activity five times per week or 20 min of vigorous intensity physical activity three times per week [8]. However, despite the positive effects of physical activity on health, majority of individuals do not participate in regular physical activity to take advantage of the benefits of exercise [9].

In Greece, the participation in regular physical activity is generally low, in comparison with the other European countries in terms of recommended exercise levels. According to Pitsavos, Panagiotakos, Lentzas, and Stefanadis [10], 47% of Greek men and 52% of Greek women aged from 20 to 89 refer that they do not participate in any type of physical activity. More specifically, according to Tzormpatzakis and Sleaf [11], most of the Greek population states a minimum participation in physical activity or no participation in any form of exercise (66%), while almost the half of the students in Greek universities (50%) refer that they do not participate

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in any kind of physical activity and do not follow an active lifestyle.

Lately, the increased technological development has penetrated all the areas of human activity [12–18]. A new, alternative and at the same time entertaining kind of physical activity that has evolved rapidly is the digital interactive exercise games, also known as exergames. Exergames have incorporated exercise, constituting an alternate way to increase physical activity, while reducing sedentary behavior. Previous studies have reported that the heart rate and energy consumption noted that while playing exergames, a light to moderate intensity exercise was indicated and often met the minimal requirements of physical activity levels and as a result improves individuals' body weight, body mass index, maximum oxygen uptake and maximum heart rate [16, 18]. Until today, many researchers have studied the benefits of exergames arguing that these games are beneficial for both mental and physical health of the individual [12–18]. Exergames are primarily designed to increase the level of physical activity, which in turn leads to energy consumption, increase heartbeats and improve anaerobic and aerobic capacity. It has been reported that this form of exercise enhances self-esteem, attention, social interaction and motivation [17]. In a relative research, Peng, Lin, & Crouse [18] argued that exergaming is a useful tool for engaging and encouraging individuals to increase their physical activity levels, because the connection of physical exercise with electronic games makes the exercise entertaining. What is more, engagement with exergames, it is likely to result in increased motivation for participating in physical activity in a realistic environment [17]. Given that exergames are a more pleasant way of training, this study sought to determine whether this form of physical activity, could improve the participants' subjective vitality, body weight, body mass index, maximum oxygen uptake and maximum heart rate. It was hypothesized that a 10 weeks program of Nintendo's Wii sports, with three 30 min sessions a week would result in a significant improvement in all measures.

Methods

Participants

In total, twenty healthy undergraduates, students of School of Physical Education and Sport Sciences of Democritus University of Thrace, between 20 and 25 years of age participated in this experiment, and were randomly divided into two groups, the experimental ($N=10$; three males, seven females) and the control group ($N=10$; four males, six females). The participants were recruited via a university announcement and promotions in several academic courses. Before their participation, subjects were informed about the

aim and the design of the study and they signed a written informed consent. Only subjects who did not report any injuries in the 12 months prior to the study were recruited. Sample's characteristics are analytically presented in Table 1.

Measures

Participant's height and weight were measured with clothes and without shoes. Body mass index (BMI) was calculated using the Center for Disease Control's (CDC) formula, weight in pounds (lb.) divided by squared height in inches (in) and then multiplied by the conversion factor of 703.

For the Test of Maximum Oxygen Uptake a portable gas analyzer of VIASYS was used (SensorMedics VmaxST, pulmonary gas exchange system, Yorba Linda), along with a heart rate monitor (Polar Electro, Oy, Finland) and a treadmill. The inclination of the treadmill was set to 0 degrees and the speed 8 km/h. Every 2 min, the speed was increased by 1 km/h. Also, the recording of the heart rate was performed telemetrically with Polar RS400 (Polar Electro, Finland). The protocol was terminated upon exhaustion.

For the assessment of participants' subjective vitality, the Subjective Vitality Scale was used. This scale has been developed by Ryan & Frederick [19] and evaluates whether someone feels alive and is surrounded by energy in his life on a 7-point scale (ranging from 1 = not at all true to 7 = very true, e.g., I feel alive and vital). The internal consistency of this scale in Ryan & Frederick research has been reported to be 96%, and has also been adapted in Greek population with high internal consistency [20].

Procedure

All measurements were performed at the Physical Performance Laboratory of the School of Physical Education and Sport Sciences of the Democritus University of Thrace. Medical history was completed by participants at baseline to collect information about the individual and family medical history. The subjects were randomly assigned into two groups of 10 individuals (experimental group and control group). Pre- and post-tests of body weight, body mass index (BMI), maximum oxygen uptake (Vo_2 max), maximum heart rate (HR_{max}) and subjective vitality (SV) were carried out for both experimental and control groups. Measurements

Table 1 Characteristics of the sample (mean \pm SD)

	Experimental group	Control group
Age (year)	22.00 \pm 1.63	22.10 \pm 1.10
Height (cm)	1.67 \pm 0.06	1.69 \pm 0.08
Weight (kg)	67.90 \pm 12.24	61.17 \pm 8.94
BMI (kg/m^2)	24.10 \pm 3.13	21.17 \pm 2.21

were made mainly in the morning, and the duration of each subject's test ranged from 40 to 50 min. The program lasted a total of 10 weeks. Prior to training program with exergames, the experimental team received an introductory tutorial on how to use the Wii Nintendo Sports exergames and its peripheral devices. Frequency of attendance was 3 times a week, while exercise was 30 min. In particular, in all the training sessions, the participants were able to choose two out of five exercise games like baseball, golf, boxing, tennis and bowling, which each of them lasting 15 min. Sessions occurred during the afternoon and early evening at School of Physical Education and Sport Sciences.

Statistical analysis

The SPSS 20.0 (Statistical Package for the Social Sciences) for Windows was used to perform analyses of the study's data. All data are presented as the mean \pm standard deviation (SD). Comparisons between the groups were performed with the use of two-way repeated-measures analysis of variance, followed by Bonferroni test. As our sample was rather small, our data were tested for normal distribution with Shapiro–Wilk test. The findings suggest that our data were normally distributed ($p > 0.05$). However, regarding the variable VO_2 max, the analysis of the results, which was based on the Shapiro–Wilk test, did not show a normal distribution. For this reason, the non-parametric Wilcoxon test was used. For the calculation of the effect size was used the Partial Eta Squared (η^2).

Results

The results of the present study revealed that, regardless of whether it was experimental or control group, no significant differences were found between pre- and post-tests in body weight, body mass index (BMI), maximum oxygen uptake (VO_2 max) and maximum heart rate (HR_{max}). On the contrary, regarding the parameter subjective vitality, the experimental group reported a better subjective vitality (mean = 6.01) than the control group (mean = 2.17) after the

intervention program with $F_{(1,18)} = 4.750$, $p = 0.043 < 0.05$, $\eta^2 = 0.20$ (Table 2).

Discussion

The purpose of the present study was to investigate the effect of Wii Nintendo Sports on the physiological and psychological parameters in young adults. In particularly, pre- and post-tests of body weight (BW), body mass index (BMI), maximum oxygen uptake (VO_2 max), maximum heart rate (HR_{max}) and subjective vitality (SV) were performed for both experimental and control group.

Regarding BW and BMI of the participants, there was no statistically significant difference between the experimental and the control group in pre- and post-tests. Similarly, previous studies suggest that engaging in exergames does not lead to reduction of individual's BW and BMI [21–23]. Moreover, Wagener et al. [21] who studied the impact of a 10 week exergaming program with a frequency of three times a week and a 75 min duration per training session concluded that no significant reduction was found in participants' BMI. In addition, Adamo et al. [22] and Goldfield et al. [23] reported that exergames did not contribute to the reduction of BW and BMI at the end of the experimental procedure, which lasted 10 weeks, with twice weekly participation in exercise and duration of 60 min at a time. What is more, the analysis of the results showed that there was no significant improvement in VO_2 max and HR_{max} for both experimental and control group. Similar to these results, Maddison et al. also concluded [24], arguing that exergames is not an effective form of exercise for improving the person's cardiovascular capacity.

However, opposite results were reached by Unnithan, Houser, & Fernhall [25], who argued that exergames were mainly designed to increase levels of physical activity, which in turn leads to energy consumption, increases cardiac pulse, and as a result improves cardiorespiratory capacity [17]. Also, in a meta-analysis conducted by Peng, Lin and Crouse [18], the results have shown that engaging people with digital interactive exercise games brings about a significant increase in heart rate, oxygen uptake and energy

Table 2 Pre- and post-tests in all parameters of both groups (mean \pm SD)

	Experimental group		Control group	
	Mean score (SD) pre	Mean score (SD) post	Mean score (SD) pre	Mean score (SD) post
VO_2 max	40.9 (6.49)	43.33 (7.80)	40.73 (9.38)	44.49 (9.76)
Weight	67.9 (12.24)	66.37 (12.04)	61.17 (8.94)	61.13 (8.99)
BMI	24.1 (3.13)	23.63 (3.26)	21.40 (2.21)	21.34 (2.26)
HR_{max}	33.4 (8.36)	32.45 (8.18)	28.24 (9.38)	27.23 (9.63)
SV	3.41 (0.44)	6.01 (1.05)	4.19 (0.71)	2.17 (0.24)*

* $p < 0.05$

consumption, with a similarity being seen in intensity of light to moderate traditional exercise. Based on the above studies, it is concluded that the results are dissimilar, which is probably due to the characteristics of the individual population group, the characteristics of exergames, and the characteristics of the exercise program, such as the duration of the experimental process, the frequency of participation and the duration of participation per training session. Regarding the overall subjective vitality of the participants, the results of this research revealed that there was a statistically significant improvement between pre- and post-tests only for the experimental group. Previous studies have found that exergaming is a kind of physical activity that increases life satisfaction [26], enthusiasm, fun, and positive emotions, and as a result it leads to greater engagement in exercise [13, 27]. Regarding the factor subjective vitality, a small number of studies have been conducted, which argued that exergames cannot improve participants' subjective vitality rates. However, it is important to point that these surveys evaluated the acute effect of exergames on subjective vitality, in contrast to the present study, in which a 10 week intervention exercise program took place. More specifically, Mackintosh et al. [28], who investigated the acute effect of exergames on the subjective vitality in young adults, concluded that there was no significant improvement at the end of the exercise session. The researcher Lin who ends up with similar findings [29], also explored the acute effect of exergames on the subjective vitality of the participants, using games that required dancing movements. Nevertheless, it is important to mention that subjective vitality is also directly affected by sociopsychological factors, which can affect the degree of energy and liveliness experienced by the individual [30], so it is difficult to draw final conclusions.

Limitations and conclusions

It is necessary to note the lack of control of dietary habits, and the increased academic commitments of the participants, as the sample was students of School of Physical Education and Sport Sciences and the possibility of them being involved in other motor activities during the intervention program, as well as the small number of our sample, could be limitations of the present study. Based on the findings, there was no statistically significant improvement in physical parameters after the intervention program with exergames for both experimental and control group. The only significant effect was the improvement of the participants' subjective vitality between initial and final measurements in the experimental group. To sum up, more research is needed that will be able to compare the impact of exergames on both physical and psychological

parameters, while increasing possibly the duration of the intervention program, the frequency of participation, and duration per training session.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed were in accordance with the ethical standards of the institutional and the Helsinki Declaration.

Informed consent All of the subjects sign the consent form.

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