Electronic Gaming versus Physical Activity: Effect on Heart

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Conflict of Interest: None declared

This article has been peer reviewed.

Article Submitted on: 11th January 2011

Article Accepted on: 27th February 2011

Funding sources: None Declared

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Cite this article: Sobani ZA, Pervaiz A, Yakub M, Khawaja A, Khan R. Electronic gaming versus physical activity: effect on heart. J Pak Med Sci. 2011; 1 (1): 3-6

ABSTRACT

BACKGROUND: Little attention has been given to the relationship of electronic gaming with energy expenditure and cardiovascular responses in young adults. To investigate the effect of electronic gaming on heart rate in adolescents, a cross-sectional study was conducted at the Aga Khan University, Karachi.

METHODS: Thirty male participants between the ages of 17 to 25 years were recruited for the study. A basal heart rate (HR0) was recorded. They were then asked to play the first race of Burnout Paradise developed by Criterion games on a Micrososft Xbox 360 Premium. All participants played the same course at same difficulty using a standard wireless Xbox 360 controller. Heart rate was recorded after sixty seconds (HR1), one hundred five seconds (HR2) and one hundred fifty seconds (HR3). After resting for five minutes, subjects were put on bicycle ergometry to a moderate speed (5km/hour) for three minutes, thereafter another heart rate (HR4) was recorded.

RESULTS: Heart rate increased significantly after playing for 150 seconds (HR3) compared to basal heart rate (HR0); (86.60 ± 16.04 /min vs 81.80 ± 15.15 /min; p=0.01). Furthermore, the direction of change was similar to what was observed between HR4 and HR0 (87.60 ± 16.79 /min vs 81.80 ± 15.15 /min; p=0.001).

CONCLUSION: Playing electronic games for one hundred fifty seconds exerts similar effect on heart rate as observed after three minutes of bicycle ergometry. The increase in heart rate observed with electronic gaming raises the question on the implications of increased heart rate in the absence of physical activity. Further work in a larger sample size may elaborate this relationship.

Key Words: Electronic Gaming, Physical Activity, Heart Rate

INTRODUCTION

Electronic gaming has taken the world by storm since its induction. It is common to observe that not only children but a large percentage of adolescents play electronic games regularly. The addictive properties of electronic games have been well-demonstrated, [1] and are based on the trial and reward mechanism. Electronic games are also known to cause aggressive behavior [2] as well as anti-social behavior [3]. Online gamers show decreased interpersonal relationships and have increased social anxiety [4].

In the last few decades, leisure activities among the youth have changed from healthy physical activities to a more sedentary pattern involving television, internet surfing, and electronic gaming. Increasing prevalence of such leisure activities, particularly during the late hours of the night, leads to a deficiency of sleep which in turn has been shown increase obesity risk [5, 6].

METHODS

This is a descriptive cross-sectional study conducted in aduration of 3 weeks in July 2010 at the Aga Khan University Medical College, Karachi. Due to a lack of local literature, sample size could not be calculated and owing to the time consuming sampling technique, a non-purposive convenience based sample of 30 participants was included in the study.

The inclusion criterion included male gender and age between 17 and 25 years. Study participants were recruited from the Aga Khan Medical College and provided informed consent for this

study. A basal heart rate (HR0) was recorded at rest prior to the electronic gaming session. The electronic gaming session comprised of the first race of Burnout Paradise developed by Criterion games on a Microsoft Xbox 360 Premium. The subjects played the same course at same difficulty and cars using a standard wireless Xbox 360 controller. The effect of electronic gaming on the heart rate was measured from a limb lead electrocardiogram (EKG) at 60 seconds (HR1), 105 seconds (HR2) and 150 seconds (HR3) after during the electronic gaming session. Subjects were categorized as experienced or in-experienced based on their self-reported experience with the platform, the game itself and similar games available in the genre. Limb lead EKGs were taken using AdInstruments PowerLab and data was recorded using Chart 5 software allowing the investigators to keep a dynamic scale for analysis. The sound effects and music of the game were turned off in order to prevent confounding effect of music and synchronization of heart rate to the beat. Participants played the course seated at comfortable postures in an environment free from distractions and external stimuli. After a wash-out period of 5 minutes, subjects exercised on bicycle ergometry to a moderate speed for 3 minutes at the end of which another heart rate (HR4) was recorded. The recorded readings were compared to notice the trend of the change in heart rate. SPSS 15.0 was used for data entry and analysis. The variables were further categorized as discrete and continuous. Chi-square test was used for discrete while student's t-test was applied to continuous variables. P-value of less than 0.05 was considered significant.

RESULTS

We enrolled 30 males with ages between 17 and 25 years (weight 71 ± 14 kg, height 69 ± 2 in, and Body Mass Index (BMI) 22.81 ± 4.36) (Table 2). Analysis of our data revealed a significant change in heart rate of the study participants from basal rates (81.80 ± 15.153/min) to rates after 60 seconds of gaming (85.00 ± 14.276/min, P-value 0.077), rates after 105 seconds of gaming (84.40 ± 15.830/min, P-value 0.267) and those after 150 seconds of gaming (86.60 ± 16.044/min, P-value 0.012) (Table 1). The direction of change in heart rate was comparable to the change noticed in the participants after 3 minutes of bicycle ergometry (87.60 ± 16.794 /min, P-value 0.001). On further grouped analysis of participants with self-reported high experience against those with little or no experience of electronic gaming, we noted that the change in heart rate was significantly higher in the inexperienced group from basal rates (81.91 ± 15.730/min) to rates after 60 seconds of gaming (86.61 ± 15.117/min, P-value 0.025), rates after 105 seconds of gaming (87.13 ± 16.369/min, P-value 0.016) and those after 150 seconds of gaming (88.43 ± 17.560/min, P-value 0.003).

These values were also comparable to the change noticed after bicycle ergometry (88.70 ± 16.772 /min, P-value 0.002). However, a statistically

Table 1: Heart rate among the Participants

	All Participants			Inexperienced Gamers			Experienced Gamers		
	Mean	Standard Deviation	P-Value*	Mean	Standard Deviation	P-Value*	Mean	Standard Deviation	P-Value*
Basal Heart Rate	81.80	15.153		81.91	15.730		81.43	14.223	
Gaming Heart Rate 1	85.00	14.276	0.077	86.61	15.117	0.025	79.71	10.226	0.631
Gaming Heart Rate 2	84.40	15.830	0.267	87.13	16.369	0.016	75.43	10.309	0.403
Gaming Heart Rate 3	86.60	16.044	0.012	88.43	17.560	0.003	80.57	7.635	0.818
Cycling Heart Rate	87.60	16.794	0.001	88.70	16.772	0.002	84.00	17.664	0.356

*when compared to basal rate

non-significant decrease in heart rate was noted in experienced gamers from basal rates (81.43 ± 14.223/min) to rates after 60 seconds of gaming (79.71 ± 10.226/min, P-value 0.631), rates after 105 seconds of gaming (75.43 ± 10.309/min, P-value 0.403) and those after 150 seconds of gaming (80.57 ± 7.635/min, P-value 0.356), indicating that a process of desensitization, habituation and adaptation may be active. For bicycle ergometry, the experienced gamer group heart rate changed to 84.00 ± 17.66/min (P-value 0.356).

DISCUSSION

In this study, we have shown that short periods of electronic gaming in young adults are associated with increased heart rate in inexperienced gamers to the same extent as moderate exercise for the individual. An interesting fact to note in the results of our study was an inverse relationship between the level of experience of the gamer and the increase in heart rate. This phenomenon was observed to such an extent wherein experienced gamers heart rate actually declined when playing the game, contradictory to the increase observed in inexperienced gamers indicating a crude conditioning to the observed stimuli, although this did not reach statistical significance.

A study shows that the average time spent by adolescents on electronic games was 1:08h a day,[8] the same study formed a relationship between electronic game exposure and declining school performances [8]. Another study reveals that 12% of current gamers are pathologically addicted to electronic games,[9] indicating that this is an issue of significant importance.

Sedentary activities are associated with an increased risk of obesity. Sedentary entertainment leads to an increased snacking behavior and the consumed snacks are usually high in caloric and carbohydrate values. Since the advent of electronic games, more and more children forgo sports in favor of electronic gaming and thus trend may be one of the contributing factors to the current obesity epidemic. In this study, the only stimulus provided to the participants was visual. It is possible that had we provided auditory stimulation as well, the heart rate response would have been of a greater magnitude.

Recent trials on active gaming machines such as the Xavix J-Mat and the Nintendo Wii indicate that children's heart rates are equal to vigorous exercise [10].

It has been postulated that this could help them meet their recommended daily activity level,[11] and that it may result in the same health benefits as those of vigorous exercise [12].

Two studies comparing the energy expenditure of the new generation of active games and sedentary games claim highly significant differences in the energy expenditure between the sedentary and active gaming consoles; [13, 14] however, the majority of the market is dominated by sedentary consoles. Our results point out that heart rate, while playing sedentary games, is comparable to the heart rate at moderate exercise in inexperienced gamers while there is a decrease in that of experienced gamers.

The implications of this increase in heart rate in the absence of physical activity are uncertain and the utility of increased cardiac output is unclear. Moreover, the lack of heart rate response to electronic gaming in experienced users highlights the adaptation of the experienced gamers to neural stress or suppressive conditioning of the sympathetic nervous system.

CONCLUSION

This study reflects that playing electronic games for one hundred fifty seconds exerts similar effect on heart rate as observed after three minutes of bicycle ergometry. The increase in heart rate observed with electronic gaming raises the question on the implications of increased heart rate in the absence of physical activity. Moreover, the lack of heart rate response to electronic gaming in experienced users highlights the adaptation of the experienced gamers to neural stress or suppressive conditioning of the sympathetic nervous system. Further work in a larger sample size may better elaborate this relationship

Table 2: Characteristics of participants included in the study

Variable	All Participants (n =30)	Inexperienced Gamers (n =19)	Experienced Gamers (n =11)
Age	20.07 ± 2.212	20.58± 2.567	19.18 ± 0.982
Height	69.14 ± 2.023	68.99± 2.077	69.40± 1..998
Weight	70.57±13. 909	67.73±12. 778	75.47±15.0 14
BMI	22.81 ± 4.358	22.00 ± 4.072	24.20 ± 4.674

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