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Effect of Selected Physical Therapy Program on Heart Rate Variability and Cervical Angle in Violent Video Game Addict Children

Rowayda R. Rashad*, Naglaa Ahmed Zaky, Mohamed Ismail Attia Elassal
Department of Physical Therapy for Pediatrics, Faculty of Physical Therapy, Cairo University, Egypt
***Corresponding author:** Rowayda R. Rashad, **Mobile:** (+20) 01010042242, **E-mail:** roudywhite9@hotmail.com

ABSTRACT

Background: Playing violent games puts the body in a state of stress because of the situation you face. Children neglect the body reaction, which is severe and, in some cases may leads to death, due to the impairment that happens in vagal nerve activity, leading to dysregulation of inflammatory processes and cardiovascular disease, also addicting playing violent video games can affect children's musculoskeletal health especially at the cervical region due to staying in a fixed position for long times focusing on the screen.

Objective: To determine the effect of selected physical therapy program on heart rate variability and cervical angle in violent video game addicted children.

Subjects and Methods: Forty children from both sexes were selected randomly from Cairo schools and were classified into two equal groups: group A (control group) consisted of 20 school aged children who were also addicted to play violent video games and group B (study group) consisted of 20 school aged children who were addicted to play violent video games, and they received selected physical therapy program.

Results: This study found a significant increase in heart rate variability (HRV) of group A compared with that of group B post treatment ($p = 0.001$), there was no significant difference in flexion angle between groups pretreatment ($p = 0.59$), there was a significant increase in extension angle of group A compared with that of group B post treatment ($p = 0.003$).

Conclusion: Selected physical therapy program in the form of aerobic exercise combined with relaxation technique improved the cardiac rhythm and improved neck extension range of motion (ROM).

Keywords: Physical exercise, Aerobic exercise, Diaphragmatic breathing, Heart rate variability, Violent video games, Cervical spine angle.

INTRODUCTION

Video games, like any other media medium, are classified into many kinds. Around the world, many different sorts of video games are played, including action, adventure, combat, platform, racing, roleplaying, shooter, simulation, sports, and strategy[(1)]. Violent video games are defined by their main goal which usually boils down to kill or be killed[(2)].

Because digital media is becoming more and more common, people are becoming more concerned about its possible negative impacts, such as the chance that playing video games might become "addictive." [(3)]. An assessment of stress levels has been made using heart rate variability (HRV). Since the autonomic nerve system (ANS) is impacted by stress, HRV, which is regulated by the ANS, is frequently used as a stress indicator [(4)].

There have been reports of possible concerns for musculoskeletal issues associated with the increased usage of smart gadgets. The majority of actions on smart gadgets demand the user to extend their arms out in front of them or to look down sharply, which forces the head to go forward. Chronic musculoskeletal discomfort has been linked to incorrect head and neck posture. Addiction to smart gadget use might result in neck disability[(5)].

Maintaining physical fitness can be achieved through aerobic exercise. Physical activity is well recognised as being vital to children's growth and development. Children's physical, mental, and social wellbeing can all benefit from regular physical activity [(6)].

Breathing has a crucial role in the regulation of many bodily processes. Breathing techniques through targeted exercises can help avoid cardiac events, manage anxiety, stress, depression, and post-traumatic stress disorder, as well as treat asthma [(2)]. When certain workout approaches are used, HRV and vagal activity improve state-specifically and can eventually result in persistent increases in HRV[(7)].

This study aimed to determine the effect of selected physical therapy program on HRV and cervical angle in violent video game addicted children.

SUBJECTS AND METHODS

Study design:

A prospective randomized controlled trial was undertaken at Cairo University Hospitals for three successive months from August to October in 2022.

Sampling procedure and recruitment:

Inclusion and exclusions:

Initially, a sample of forty-two children from both sexes were selected randomly from Cairo schools who were addict to play violent video games. An independent person randomly selected numbers from a sealed envelope to divide the 42 participants into two groups: group A (control group), which consisted of 20 school aged children who were classified as addict to violent video games playing, they did not receive any therapeutic intervention, and group B (study group), which consisted of 22 school aged children who were addict to play violent video games, participants in this

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group received a selected physical therapy program. Two children were excluded from group B (study group) as they dropped out their sessions.

All subjects included in this study were aged from 8 to 12 years old and had normal body mass index (BMI); from 15.69 kg/m^2 to < 22.11 kg/m^2 [8], they were all selected according to game addiction scale[9].

All children had been assessed through EMG biofeedback and neurofeedback system to measure their HRV[10] and had measured their cervical spine angle in flexion and extension by using universal goniometer before and after they received the intervention plan.

While all children were evaluated and a recording data sheet was used to record the history of each child, they were all of the same characteristics of physical activities and the same daily routine and style of diet intake. Children with any cardiovascular disease (CVD) or pulmonary disease, children with any mental problems or any musculoskeletal deformity were excluded from the study.

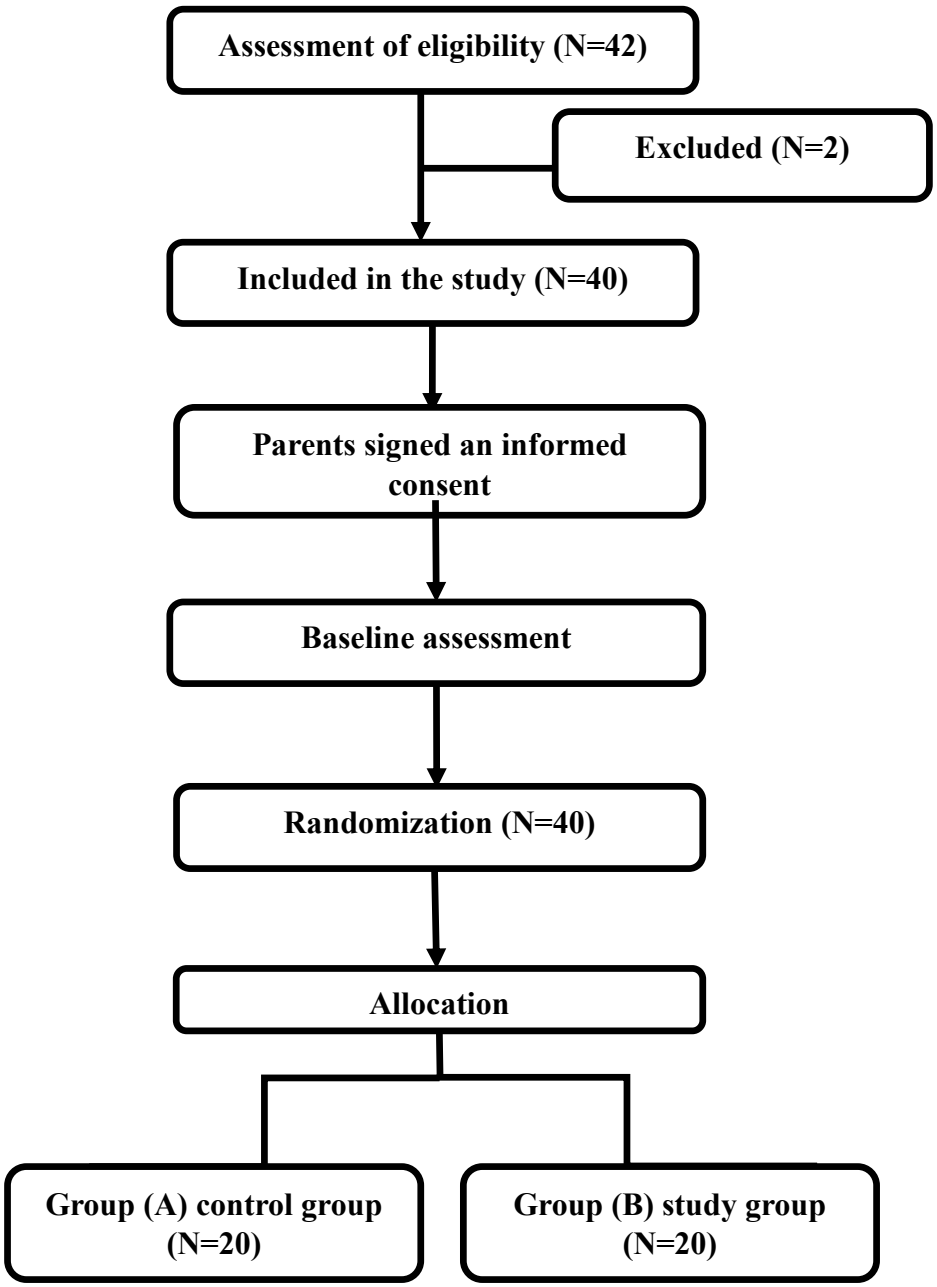

Figure (1): Flow chart of the study.

I. Materials:

A. For selection:

Body mass index (BMI): Each participant in the two groups had their weight and height measurement [8].

Game addiction scale (GAS): A well stablished questionnaire that consists of 7 main criteria was used [11].

B. For assessment:

The following measurements were done at the beginning and at the end of the treatment procedure for both groups A and B.

Biofeedback and neurofeedback system: It was used to evaluate the HRV, which was measured through (electro dermal activity; sweat gland activity) for each child in both group A and B, before and after treatment program[12].

Universal goniometer: It was used to evaluate cervical spine angle for each child in both group A and B before and after the treatment program[13].

C. For treatment:

1. **Treadmill:** It was used for therapeutic intervention as a form of aerobic exercise training, in everyday clinical practice, the treadmill is one of several valid and effective methodologies for evaluating aerobic fitness, treadmill was chosen because almost all children can be checked correctly on a treadmill in which it doesn't need any special development of any muscle, so all children undergone equal level of exercise difficulty[14].

2. **Spirometer:** It was used as a therapeutic intervention in the form of breathing exercise for relaxation. Primary care physicians and pediatricians used spirometers to treat children with respiratory illnesses. Spirometry may be effective for asthma, cystic fibrosis, congenital or acquired airway abnormalities, and a variety of other respiratory ailments in children [15].

II. Procedures:

A. For Selection:

1. **Body mass index (BMI):** The assessment was carried out by the same researcher. Each participant's height and weight were measured. These measurements were taken for kids who were without wearing shoes. The formula was used to compute BMI:

   BMI = Weight (Kg) / Height (m^2) with an accuracy of ± 100 g using the medical scale RADWAG WPT 60/150 (RADWAG, Radom, Poland). With a precision of ± 0.1 centimeter, the children's height was measured using a stadiometer fastened to the scales. All subjects were asked to stand straight on the scale while the weight was measured in kilograms and height in centimeters. Participants who had normal BMI ranges from 15.69 kg/m^2 to < 22.11 kg/m^2 were selected[8].

2. **Game addiction scale (GAS):**

   A valid scale used to select children who were addicted to play violent video games to be included in the study. It has 21 measures that measure the following seven fundamental criteria: difficulties, withdrawal, relapse, conflict, salience, tolerance, and mood modification. A score of 1 indicates never, 2 means seldom, 3 means sometimes, 4 means often, and 5 means very often on this quiz. The assessment of the existence of gaming addiction may be done in two ways: either in a polythetic format, where at least half of the things score three or higher, or in a monothetic style, where all of the items score three or higher [11].

B. For assessment:

1. **Heart rate variability:**

   All participants were evaluated before the HRV recordings began, while they were sat straight and their backs were placed against the chair's back. The children were evaluated in the same chair. The participant's left index finger was fitted with the finger sensor electrode. After the HRV device was positioned correctly, participants rested for two minutes. The subjects were seated and given some rest in a quiet environment before the HRV measurements. Throughout the whole testing period, the room's temperature was maintained. This was regarded as the baseline for pre-intervention, then after 3 months of regular sessions at the end of last session, as a cumulative effect for post intervention training data[16].

2. **Cervical spine angle measurement:**

   Cervical spine angle was measured to all participants before and after the intervention for both groups (A) and (B), at the initial 5 minutes in the first session before starting the intervention therapy; this was regarded as the baseline for pre-intervention (pre-baseline data) and then after 3 months of regular sessions at the end of last session, as a cumulative effect for post intervention, to calculate the cervical angle. The youngster was instructed to sit upright in a chair with the goniometer's axis above the external auditory meatus, arms hanging down by their sides, and feet flat on the ground. The child's thoracic spine was to be positioned against the chair's back. The moving arm was oriented to the base of the nose and the stationary arm was either vertically or perpendicularly to the floor[17].

C. For treatment:

Participants in the control group (group A) didn't receive any kind of intervention and were asked not to perform any kind of exercise and to maintain their current levels of physical activity over the research period.

All participants of the study group (group B) performed the following protocol:

1. **The treadmill:** The aerobic training program was performed by using treadmill. Each session lasted 40 minutes and included 5 minutes of warm-up, 30 minutes of aerobic training, and 5 minutes of cool-down**,** the child stood erect holding the treadmill rails by both hands, head was looking forward, started with foot on the stable sides of the treadmill, then after pressing the start button they started to walk slowly then the speed increased gradually to a medium speed of walking[18].

2. **Spirometer:** It was used to do breathing exercise program with duration of 15 minutes through the following steps[19]**:**
   a) Posture correction by stretching exercises of the accessory breathing muscles to adjust the position of the head, shoulders, and dorsal spine.
   b) Spirometer training for diaphragmatic or belly breathing, as well as strong intake and/or exhalation through the spirometer to "ventilate" the lungs.
   c) Establishing breathing cycles in which the child started to breathe, filling the diaphragmatic, lower abdominal, and middle intercostal or thoracic areas with air first, and then the upper or subclavicular area; the exhalation followed the opposite path twice the inspiration time (6 breaths/minute).
   d) Holding the breath for brief intervals of time (about six seconds) when the lungs were full of air.

Ethical approval:

Cairo University Ethics Committee of the Faculty of Physical Therapy gave its approval to this study [No: P.T.REC/012/004332]. Before taking part in this trial, all participants and their parents were given a thorough description of the evaluation and therapy methods, and each subject's parent signed an informed consent form. The Helsinki Declaration was followed throughout the study's conduct.

Statistical analysis

The statistical software SPSS version 25 for Windows was used to do the statistical analysis. The mean and standard deviation were used to present the quantitative data. For the comparison within the same group, the paired T-test was employed. The comparison between the groups was performed using an unpaired T-test. A chi squared test was used to compare the distribution of sexes. The data were tested for normal distribution using the Shapiro-Wilk test. To evaluate the homogeneity between groups, Levene's test for homogeneity of variances was used. When the p-value was equal to or less than 0.05, it was deemed significant.

RESULTS

Subject characteristics:

Age, weight, height, and sex distribution did not significantly differ across the groups (Table 1).

Table (1): Comparison between group A and B regarding age, BMI, GAS and sex:

	Group A (N=20)	Group B (N=20)	MD	t- value	p-value
	Mean ±SD	Mean ±SD			
Age (years)	10 ± 1.58	10.15 ± 1.57	0.15	0.30	0.76
BMI (kg/m²)	18.22 ± 3.06	18.94 ± 2.22	0.72	0.85	0.40
GAS	89.65 ± 8.07	87.2 ± 9.19	-2.45	-0.89	0.37
Sex, n (%)					
Girls	8 (40%)	6 (30%)	-	(χ^2 = 0.44)	0.51
Boys	12 (60%)	14 (70%)			

SD, Standard deviation; MD, Mean difference.

Effect of treatment on HRV and cervical spine angle measurement:
Within group comparison

Table (2) shows that group A's HRV significantly decreased after 3 months in comparison to baseline value, whereas group B's post treatment HRV significantly increased in comparison to pretreatment ($p > 0.001$).

Table (2): Comparison between baseline and after 3 months of group A and B, regarding mean values of HRV.

Group		HRV (ms)	MD	% of change	t- value	p-value
		Mean ± SD				
Group (A)	Baseline	25.39 ± 4.31	1.31	5.16	2.82	<0.01
	After 3 months	24.08 ± 3.93				
Group (B)	Pre treatment	25.46 ± 4.97	-4.9	19.25	-5.34	<0.001
	Post treatment	30.36 ± 7.09				

SD, Standard deviation; MD, Mean difference

Effect of selected P.T program on cervical spine angle measurement:
Table (3) shows that in comparison with the pretreatment, group A's flexion angle increased significantly and its extension angle decreased significantly. In contrast, group B's flexion and extension angles increased significantly after treatment.

Table (3): Comparison between baseline and after 3 months of group A and B, regarding cervical spine angle measurement:

	Cervical spine angle (degrees)	Baseline	After 3 months	MD	% of change	t- value	p-value
		Mean ± SD	Mean ± SD				
Group (A)	**Flexion**	**46.6 ± 4.31**	**47.45 ± 4.37**	**-0.85**	**1.82**	**-2.6**	**0.01**
	Extension	**55 ± 3.4**	**54.2 ± 3.57**	**0.8**	**1.45**	**2.43**	**0.02**
Group (B)	**Cervical spine angle (degrees)**	**Pretreatment**	**Post treatment**	**MD**	**% of change**	**t- value**	**p-value**
		Mean ± SD	**Mean ± SD**				
	Flexion	45.95 ± 4.21	48.25 ± 4.94	-2.3	5.01	-2.36	0.02
	Extension	56.8 ± 4.87	58.5 ± 4.75	-1.7	3	-4.98	0.001

SD, Standard deviation; MD, Mean difference.

Effect of P.T program on HRV and cervical spine angle between groups comparison:
Prior to therapy, there was no discernible difference between the groups. After the therapy, a comparison between the groups showed that group B had a significantly higher HRV and extension angle than group A, but there was no significant difference in the extension angle between the groups (Tables 4-5).

Table (4): Baseline and after 3 months mean of HRV of group A and B:

	HRV (ms)				
	Group A	Group B			
	Mean ±SD	Mean ±SD	MD	t-value	p value
Baseline	25.39 ± 4.31	25.46 ± 4.97	0.07	0.04	0.96
After 3 months	24.08 ± 3.93	30.36 ± 7.09	6.28	3.46	0.001
MD	1.31	-4.9			
% of change	5.16	19.25			
t-value	2.82	-5.34			
p value	**0.01**	**0.001**			

SD, Standard deviation; MD, Mean difference.

Table (5): Mean flexion and extension angle pre and post treatment of group A and B:

Cervical spine angle (degrees)	Group A	Group B			
	Mean ±SD	Mean ±SD	MD	t-value	p value
Flexion					
Baseline	46.6 ± 4.31	45.95 ± 4.21	-0.65	-0.48	0.63
After 3 months	47.45 ± 4.37	48.25 ± 4.94	0.8	0.54	0.59
MD	-0.85	-2.3			
% of change	1.82	5.01			
t-value	**-2.6**	-2.36			
p value	**0.01**	**0.02**			
Extension					
Baseline	**55 ± 3.4**	56.8 ± 4.87	1.8	1.35	0.18
After 3 months	**54.2 ± 3.57**	58.5 ± 4.75	4.3	3.23	0.003
MD	**0.8**	-1.7			
% of change	**1.45**	3			
t-value	**2.43**	-4.98			
p value	**0.02**	**0.001**			

SD, Standard deviation; MD, Mean difference.

DISCUSSION

The effects of playing video games have drawn more attention. The primary goal of violent video games is to harm other game characters. One example of this is the first-person shooter Call of Duty: Modern Warfare, which made over $600 million in its first three days of release. As a result, playing violent video games encourages aggression by rewarding in-game violence, which then permeates the player's daily behaviour [(20)].

Video games have become much more than just a recreational activity; they may also have negative consequences. These repercussions include stress, anxiety, sadness, loneliness, and gaming disorder[(21)]. The aim of this study was to determine the effect of selected physical therapy program influence on HRV and cervical angle in violent video game addicted children.

Findings of our study revealed that:

HRV rose in group B (study group) after therapy, with a mean SD value of 25.46± 4.97 ms before treatment and 30.36±7.09 ms after treatment. The average difference was -4.9 ms, with a percentage change of 19.25%. Group A's HRV increased significantly after therapy compared to before treatment (p = 0.001). Whereas it was discovered that the mean SD value of HRV after treatment of both groups (A and B) was 30.36±7.09 ms and that of group B was 24.08± 3.93 ms. The mean difference between groups was 6.28 ms. After therapy, group A's HRV increased much more than group B's (p = 0.001).

Our results were in line with those of **Souza *et al.*** [(22)] who reported that physical activity, particularly aerobic exercise, has been demonstrated to be helpful in raising HRV in these people, mostly by enhancing the vagal autonomic response. They discovered that consistent physical activity can enhance cardiovascular fitness and facilitate advantageous cardiac autonomic changes. Regular physical activity, particularly aerobic exercise, can improve cardiovascular fitness and is a valuable therapeutic strategy for producing favourable changes in cardiac autonomic regulation. These modifications are typified by an increase in vagal modulatory impact or a decrease in sympathetic modulatory influence on the heart.

Furthermore, even in the absence of additional risk factors, a lower degree of cardiovascular fitness is linked to a higher risk of morbidity and death. The notion that HRV analysis can be used to aid in the prognosis of stress and cardiovascular conditioning in athletes, as well as directing the prescription of physical training, is supported by the fact that people with moderate to high cardiovascular fitness as a result of regular physical exercise, especially aerobic exercise, have a low risk of mortality from chronic degenerative diseases, especially cardiovascular and metabolic diseases. **Dias *et al.*** [(23)] also supported this idea by mentioning that exposure to exercise appears to influence HRV in children and adolescents.

In terms of cervical spine flexion angle pretreatment, group A's mean SD value was 48.25±4.94 degrees, whereas group B's was 47.45±4.37 degrees. The average group difference was 0.8 degrees. After therapy, there was no significant difference in flexion angle between groups (p = 0.59). In extension angle, group A's mean±SD value of extension angle pretreatment was 58.5±4.75 degrees, whereas group B's was 54.2±3.57 degrees. The average difference in temperature across the groups was 4.3 degrees. The extension angle of group A increased significantly more than that of group B after treatment (p = 0.003).

Batistão *et al.* [(24)] conducted research on 303 primary school students to investigate the effects of a muscle workout programme on postural mobility. The control group received no intervention. For eight weeks, the intervention group engaged in an activity programme during physical education sessions. The

training programme was held twice a week for 50 minutes each time. The pattern of the workout session was a warm-up, followed by strengthening, and lastly stretching, as advised in the literature. **Batistão *et al.* [24]** agreed with our study results in neck extension in which he found that there was no difference between the groups (P = 0.52) and in which he found a statistical difference between pre-and post-exercise (P < 0.01) in both flexion and extension which is contra versed with our results of flexion.

In another study by **Liao *et al.* [25]**, they set an explorative study on total of 208 adult participants who were included in the study. Their exercise program was done through many interventions by a variety of mind–body exercise (includes breathing exercise). They concluded that the exercises have a significant effect (p <0.01) on cervical flexion, which is inconsistent with our result, while they discovered a substantial influence (p< 0.01) on cervical extension, which coincided with our findings.

CONCLUSION

Our data show that aerobic exercise has a positive effect on HRV and cervical extension but doesn't influence cervical flexion.

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Conflict of Interest: Nil.

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