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FOREWORD

The Nigerian University Games Association (NUGA) Scientific Journal is a compendium of papers presented at the 2022 NUGA Scientific Conference hosted by the University of Lagos on the theme "Repositioning Institutional Sports for Excellent National and Global Impact". Institutional Sports has been identified as a propelling factor in the development of sports in all its aspects. Institutional sports is the foundation for the identification of talented athletes that would be trained and empowered to win laurels for the country and beyond.

NUGA was established in 1966 to promote institutional sports at the level of the university system in Nigeria. While its efforts to date have been commendable, several challenges continue to impede the development of institutional sports in Nigeria. The opportunity to host the 26th Edition of the NUGA Games and the accompanying Scientific Conference, however, offered a platform to lend our contribution as a University to addressing these challenges, and thus reposition institutional sports in Nigeria and beyond.

The Conference brought together seasoned experts: sport educators, administrators, researchers and practitioners to reflect on issues relevant to the theme, identify related problems and challenges and proffer solutions to these. The participants at the Conference engaged with several presentations and put forward actionable recommendations which, if adopted, will be far-reaching for policy formulation and programme interventions towards developing and tackling the challenges facing institutional sports at both the national and global levels.

The papers presented at the Conference, most of which are outputs of structured and unstructured research as well as field experience, are published in this Journal under the sub-themes of Humanities, Technology, Health and Sciences. The papers are highly insightful, reflective and informative. I therefore recommend the Journal for the use of scholars, sports administrators and all other stakeholders who are interested in charting a different trajectory for the development of institutional sports everywhere.

Prof. Oluwatoyin T. Ogundipe, *FAS*
Vice Chancellor, University of Lagos
Editor-in-Chief

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HEALTH AND SCIENCE

The Effects of Interactive Video Games (Exergame) Adherence on Physiological and Physical Parameters among Adolescents

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Abstract

This study examined the effects of interactive video games (exergame) adherence on physiological and physical parameters among adolescents in Lagos State. The pretest posttest experimental control group research design was used for the study. The population comprise 35,365 senior secondary school students in Education district IV of Lagos state. A total of sixty (60) students were selected from the three zones in Education district IV using the multi-stage sampling technique. The three zones in Education district IV are Apapa (6 senior secondary schools), Surulere (10 senior secondary schools) and Mainland (29 senior secondary schools). The following physiological and physical parameters such as blood pressure, heart rate, Body Mass Index (BMI), percent body fat and muscle mass were measured. Data was analyzed with the descriptive statistics of frequency counts, mean, standard deviation and the inferential statistics of Analysis of covariance (ANCOVA) were used to test the hypotheses at 0.05 level of significance. The result of the study indicated that there were significant differences in the pretest and posttest values of participants' heart rate, diastolic and systolic blood pressure, percent body fat and muscle mass. It is recommended that adolescents should adhere to the recommendation of physical exercise in order to get the desired benefits of it, thereby improving their quality of life.

Keywords:
Adherence,
Adolescents,
Exergame,
Overweight,
Prevalence

Introduction

Over 30 million Nigerians are between the ages of 10-19 years and nearly one third of Nigeria's total population is between the ages of 10-24 years that is about 50 million people ("Action Health Incorporated", n.d). They represent 25% of the world population and are characterized by series of physiological, psychological and social changes (Odo, Samuel, Nwagu, Nnamani & Atama, 2018). The World Health Organization (WHO) as cited by Mgbachi (2021), also agreed that adolescents and young people are persons between 10 and 24 years of age and are characterized by rapid physical growth and development as well as sexual maturation. Adolescents form a significant population group in terms of demographic parameter and are a unique population in terms of characteristics as a result of their developmental processes. Although adolescents are generally considered physically healthy, they are vulnerable to several unique health problems, which includes obesity (Lambo, 2011).

Obesity rates among children and adolescents in most countries, have increased dramatically because numerous secular changes have combined to reduce the demand for physical exercise in day-to-day life, and many barriers to physical exercise are now evident. The prevalence of childhood overweight and obesity in countries appears to be increasing, and this is a

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serious public health problem that requires urgent attention (Zhang, Wang, Wang, Du, Chang Su, Zhang, Jiang, Jia, Huang, Ouyang, Wang, & Zhang, 2018). Adeloye, Ige-Elegbede, Ezejimofor, Owolabi, Ezeigwe, Omoyele, Mpazanje, Dewan, Agogo, Gadanya, Alemu, Harhay, Auta, and Adebiyi (2021), suggested that there is a high prevalence of obesity in Nigeria. This is marked in urban Nigeria and among women, which may in part be due to widespread sedentary lifestyles and a surge in processed food outlets, largely reflective of a trend across many African settings. As a consequence, most children and adolescents do not meet the accepted public health guidelines for physical exercise. Accordingly, public health interventions are needed to increase physical exercise in adolescence. Such interventions, if successfully implemented, can be expected to improve fitness and health as well as reduce the prevalence of obesity in young people. The concern regarding the physical exercise behaviour of young people has been heightened by a remarkable increase in the prevalence of childhood obesity. It is clear that obesity rates are highest in the same nations that manifest the lowest compliance with physical exercise guidelines, and mounting evidence shows that low physical exercise is a consistent predictor of increased risk for development of overweight and obesity in young people. It seems likely that both low physical exercise and high obesity rates in children and adolescents are related to fundamental changes in societies that have had the effect of reducing the demand for physical exercise and presenting barriers that reduce physical exercise levels (Russell, Flynn & Marsha, 2016).

The World Health Organization (2011) Global strategy on diet, physical exercise and health recommends children engage in at least 60 minutes of moderate to vigorous physical exercise daily. In order to increase physical exercise, children can participate in a plethora of activities, such as exergames. Exergames also called interactive video games (IVGs) are active video games that require physical movement to participate. Children's heart rate increases when engaging in exergames, such as the Nintendo Wii Fit, Kinetic sports and Just Dance, providing users the ability to achieve a moderate to vigorous activity level (Adkins, Brown, Heelan, Ansorge & Shaw, 2013; Gao, Chen, & Stodden, 2015; George, Rohr & Byrne, 2016, as cited in Rudella, & Butz, 2018). Thus, these games may be used to encourage children/adolescents to develop a physically active lifestyle. Interactive video games (IVGs) capitalize on children's natural interest in computerized video interaction and are effective to make children/adolescents more active in a game context (Mears & Hansen, 2009).

Exergames, or interactive video games encourage physical exercise, have several documented benefits for users, including increase of daily physical exercise, and the potential for game players to reach moderate and even vigorous levels of activity. In addition to physiological impacts, interactive video games can affect social and psychosocial attributes, such as interest in exergaming, adherence, motivation, improving focus, multitasking, and working memory, (Barbara & Maloney, 2013). Some interactive video games are targeted specifically for health benefits, while others are more focused on entertainment with possible physical benefits as an added bonus. Exergames often have a personal assessment system in place to keep track of performance improvements. Keeping track of progress helps to maintain a high level of motivation through the promotion of goal setting and encouragement to proceed (Lieberman, 1998) as cited in interactive video games (Trout & Christie, 2007). Exercise training is an integral component in the management of many chronic, lifestyles - related diseases. Therapeutic exercise training is an accepted adjunct to medical therapy for two of the four leading causes of death - cardiovascular disease and chronic obstructive pulmonary disease (COPD) - and it is considered one of the three cornerstones of treatment for diabetes mellitus. For each of these chronic conditions, the scientific literature clearly demonstrates that exercise is both beneficial and safe when applicable guidelines are followed (Paraskevi & Aymara, 2013). According to the United State Department of Health and Human Services (2002), there is also abundant evidence supporting the health benefits of physical exercise, including reduced risk for stroke, some cancers, osteoporosis, hypertension, high cholesterol, obesity, osteoarthritis, and all-cause mortality. Physical exercise is also associated with improved psychological health and functional status, as well as reduced health care expenditures (Paraskevi & Aymara, 2013).

Research suggests that inadequate adherence to exercise during the intervention period might attenuate the effectiveness of intervention. There are many categories of factors related to non-adherence to physical exercise, *e.g.* demographic, health-related and biological, cognitive and psychological, behavioral, programme-related and environmental. Social factors that have been studied as correlates of physical exercise include exercise group cohesion, physician influence, and social support. Group cohesion has shown a modest positive correlation with adherence in some studies (Sallis & Owen, 1999) as cited in Adherence and physical exercise (Paraskevi & Aymara, 2013). Adherence to Physical Exercise (PE) leads to improvements in physical function and quality of life. The adherence is one of the most important factors in order to get the desired benefits of PE. There are many different ways that have been used to increase the adherence level to PE and the home exercise programmes are an effective motivational way (Fukuoka, Vittinghoff, Jong, & Haskell, 2010).

There has been a steady rise in the prevalence of overweight and obese children in all regions of the world. In very extreme cases, researchers are reporting prevalence rates for overweight/obesity in the range of 10 – 40% in developed nations. In actual numbers, 50 million girls and 74 million boys were obese in 2016. In 2013, UNICEF, WHO, and World Bank estimated an increase of the global prevalence of childhood overweight from 5 to 7 percent in a 12-years period from 2000 to 2012. According to the Global Nutrition Report 2015, Nigeria was reported as being "on course" of achieving "good progress" in terms of overweight. National overweight prevalence was 1.2 percent and has not changed much from 2015 (1.6%) and since 2014 (1.5%). Nigeria has also an overweight prevalence below the 7 percent threshold in all states surveyed. It has been forecasted that the estimated overweight population in Nigeria by 2025 will reach 25.8 percent by 2025. The 2018 Nigerian report card which is the most recent score card shows that from 30% up to 52% of the target population of children and youth are physically active. The improvement to grade of C for the overall physical exercise may have been the consequence of a more synergetic action in the call for more engagement of children and youth in physical exercise programmes. Today, computers and social media have decreased the need and desire for children to move and play. Participation in physical exercise decreases with age, and the decline is greater in girls than boys. The challenges associated with getting children active every day should be met with age-appropriate physical activities, enthusiastic leadership, and support from family and friends.

Across the globe, the majority of adolescents are not reaching the recommended amount of physical exercise, consequently impacting their physical and mental health. Reasons for decreased physical exercise levels may be caused by various factors, including the fact that children and adolescents spend much more time sedentary in front of the screen than in the past (Benzing & Schmidt, 2018). Because of the increased sedentary screen time, exergaming (or active video gaming) might be potential for making children and adolescents more active, and thus positively affecting their health. Therefore, this study aimed primarily to examine the effects of interactive video games (exergame) adherence on physiological and physical parameters among adolescents in Lagos State.

Many technological advances and conveniences that have made life easier and less active, many personal variables, including physiological, behavioral, and psychological factors, may affect one's plans of becoming more physically active. Understanding common barriers to physical exercise and creating strategies to overcome them may help make physical exercise part of daily life. People experience a variety of personal and environmental barriers to engaging in regular physical exercise. A new generation of exercise video games (exergames) shows promise as a tool to motivate and engage users in physical exercise. However, little research has been conducted to examine whether exergames work equally well across diverse populations and contexts. Therefore, this study, examines the effects of interactive video games (exergame) adherence on physiological and physical parameters among adolescents in Lagos state.

Research questions

The following research questions were answered in the study:

1. Will there be any difference in participants' resting heart rate, systolic and diastolic blood pressure after interactive video game training?

2. Will there be any difference in participants' percent body fat after interactive video game training?
3. What will participants' Body Mass Index be, after exergame game training?
4. Will there be any difference in participants' Muscle mass after exergame game training?

Research hypotheses

The following research hypotheses were tested in the study:

1. Interactive video game training will have no significant difference on participants' resting heart rate, systolic and diastolic blood pressure.
2. There will be no significant difference in participants' percent body fat after twelve weeks interactive video game training.
3. Interactive video game training will have no significant difference on participants' Body Mass Index after twelve weeks.
4. There will be no significant difference in the pretest and posttest values of Muscle mass of participants after twelve weeks interactive video game training.

Methodology

The pretest posttest experimental and control group research design was used for the study. The population comprise 35,365 senior secondary school students in Education district IV of Lagos state. During the sampling, a total of sixty (60) students were selected from the three zones in Education district IV using the multi-stage sampling technique. The three zones in Education district IV are Apapa (6 senior secondary schools), Surulere (10 senior secondary schools) and Mainland (29 senior secondary schools).

First stage: The stratified random sampling technique was used to select ten secondary schools from the three zones of the education district. Second stage: The simple random sampling was used to select six (6) students each from ten school to the experimental and control group due to their proximity. Third Stage: Body Mass Index (BMI) test was used to assign students to the experimental (interactive video game; n = 30) and control (inactive; n = 30) group. The Instrument used in collecting data for the study were stadiometer, automatic sphygmomanometer, cardiocheck analyzer blood and cholesterol kit, and bio impedance smart scale. During the pre and posttests, the participants were meant to sit for a duration of five minutes while their resting heart rate and blood pressure were measured. They were asked to stand with bare feet together and flat on a bio impedance smart scale while their body composition such as their BMI, Percent body fat and Muscle mass were measured; their heads straight in a neutral position and hands stretched forwards holding the handles of the machine around its electrode. Their heights were measured with a stadiometer. Participants were required to exercise using the EA Sports Active 2 - PS3 interactive video gaming system that is linked with peripherals and rubber gubbins with a wireless control system powered by motion sensors. The EA Sports Active 2 - PS3 interactive video gaming system track body movements and provide feedback on performance. Programme attendance was monitored throughout the programme in order to monitor exercise adherence and maximize the positive effect of a higher volume of physical exercise, which is the mechanism for the differences in health-related physical fitness. The exercise programme lasted for 15 minutes three (3) days per week (Monday, Wednesday and Friday) for a period of 12 weeks. Attendance was recorded only for the 12 weeks of the study.

Data analysis

The data was analyzed using the descriptive statistics of frequency counts, mean, standard deviation and the inferential statistics of ANCOVA was used to test the hypotheses at 0.05 level of significance.

Results

Table 1: Analyses of respondents' demographic information

	Demographic Variables		N	Male Mean	SD	N	Female Mean	SD
Experimental	Age (in years)	PrePost	99	17.22	1,39	21	15.67	1.68
				17.22	1.39	21	15.67	1.68
	Weight (in kg)	PrePost	99	79.39	8.83	21	75.94	17.57
				77.80	8.54	21	73.86	17.30
	Height (in cm)	PrePost	99	173.00	3.63	21	160.75	7.08
				173,41	3.61	21	161.15	7.07
Control	Age (in years)	PrePost	15	16.07	1.33	15	16.50	1.15
			15	16.07	1.33	15	16.20	1.15
	Weight (in kg)	PrePost	15	66.64	11.77	15	77.93	12.23
			15	68.86	11.70	15	79.35	12.51
	Height (in cm)	PrePost	15	162.77	40.79	15	160.60	5.95
			15	174.23	7.16	15	161.05	5.96
Total	Age (in years)	PrePost	24	16.50	1.44	36	15.89	1.49
			24	16.50	1.44	36	15.89	1.49
	Weight (in kg)	PrePost	24	71.42	12.29	36	76.77	15.40
			24	72.21	11.32	36	776.15	15.53
	Height (in cm)	PrePost	24	173.93	5.99	36	160.69	6.55
			24	173.93	5.99	36	161.11	6.54

Table 1 shows the socio-demographic characteristics of the sampled participants. It shows that the mean age of male respondents was 16.50±1.44years. Their mean weights prior and after the intervention programme were 71.42±12.29kg and 72.21±11.32kg. As regards the height of the male sample, a mean height of 173.93±5.99 metres was obtained. Also, the mean age of female respondents was 15.89±1.49years. Mean weights of female participants before and after the intervention programme were 76.77±15.40kg and 76.15±15.53kg. Regarding the height of the female sample, a mean height of 161.11±6.54 metres was obtained.

Analysis of research questions

Question 1

Will there be any difference in participants' resting heart rate, systolic and diastolic blood pressure after interactive video game training?

Table 2a: Mean scores and standard deviation on participants' resting heart rate after interactive video game training

Variable	Treatment	Group	N	Male Mean	SD	N	Female Mean	SD	N	Total Mean	SD
Resting heart rate	Before	Experimental	9	71.67	18.40	21	84.14	12.02	30	80.40	15.06
		Control	15	73.33	10.48	15	85.60	11.89	30	79.47	12.66
	After	Experimental	9	69.56	11.77	21	78.71	8.88	30	75.97	10.53
		Control	15	75.13	9.20	15	85.67	11.02	30	80.40	11.32

Table 2a presents the means and standard deviation of participants' resting heart rate, systolic and diastolic blood pressure after interactive video game training. The result showed that the mean value of resting heart rate of study participants in the experimental and control were 80.40 and 79.47 respectively prior to treatment. Resting heart rate of participants in the experimental group showed a sharp decreasing tendency from a pre-training value of 80.40 to a post-training value of 75.97. The difference in the post-training and pre-training mean values of the resting heart rate of the participants in the experimental group showed a decline of 4.43. However, resting heart rate of participants in the control group showed a slight increasing tendency from a pre-training value of 79.47 to a post-training value of 80.40. The difference in the post-training and pre-training mean values of the resting heart rate of the participants in the control group represented an increase of 0.93.

Table 2b: Mean scores and standard deviation on participants' systolic blood pressure after interactive video game training

Variable	Treatment	Group	Male			Female			Total		
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Systolic blood pressure	Before	Experimental	9	132.33	16.02	21	116.76	13.69	30	121.43	15.90
		Control	15	120.60	14.79	15	115.33	8.31	30	117.97	12.09
	After	Experimental	9	113.56	19.53	21	111.19	11.35	30	111.90	13.97
		Control	15	115.87	11.04	15	117.07	7.47	30	116.47	9.28

Table 2b presents the means and standard deviation of participants' systolic blood pressure after interactive video game training. The result showed that the mean value of systolic blood pressure of participants in the experimental and control were 121.43 and 117.97 respectively prior to treatment. Systolic blood pressure of participants in the experimental group showed a sharp declining tendency from a pre-training value of 121.43 to a post-training value of 111.90. The difference in the post-training and pre-training mean values of the systolic blood pressure of the participants in the experimental group showed a decline of 9.53. However, Systolic blood pressure of participants in the control group showed a slight increasing tendency from a pre-training value of 117.97 to a post-training value of 116.47. The difference in the post-training and pre-training mean values of the systolic blood pressure of the participants in the control group represented an increase of 1.50.

Table 2c: Mean scores and standard deviation on participants' diastolic blood pressure after interactive video game training

Variable	Treatment	Group	Male			Female			Total		
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Diastolic blood pressure	Before	Experimental	9	70.56	8.28	21	71.81	6.38	30	71.43	6.88
		Control	15	68.13	7.57	15	71.13	6.57	30	69.63	7.13
	After	Experimental	9	70.11	8.19	21	68.76	6.84	30	69.17	7.15
		Control	15	70.53	10.32	15	75.07	6.54	30	72.80	8.80

Table 2c presents the means and standard deviation of participants' diastolic blood pressure after interactive video game training. The result showed that the mean value diastolic blood pressure of participants in the experimental and control were 71.43 and 69.63 respectively prior to treatment. Diastolic blood pressure of participants in the experimental group showed a sharp decreasing tendency from a pre-training value of 71.43 to a post-training value of 69.17. The difference in the post-training and pre-training mean values of the diastolic of the participants in the experimental group showed a decline of 2.26. However, diastolic blood pressure of participants in the control group showed a slight increasing tendency from a pre-training value of 69.63 to a post-training value of 72.80. The difference in the post-training and pre-training mean values of the diastolic blood pressure of the participants in the control group represented an increase of 3.17.

Question 2: Will there be any difference in participants' percent body fat after interactive video game training?

Table 3: Mean scores and standard deviation on percent body fat among adolescents in Lagos State

Variable	Treatment	Group	Male	Female	Total						
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Percent body fat	Before	Experimental	9	25.10	9.10	21	36.91	8.83	30	33.37	10.34
		Control	15	16.45	11.56	15	40.03	5.55	30	28.24	14.94
	After	Experimental	9	23.49	9.38	21	34.67	8.77	30	31.32	10.22
		Control	15	17.83	10.68	15	40.50	6.00	30	29.18	14.32

Table 3 presents the means and standard deviation of participants' percent body fat before and after interactive video game training. The result showed that the mean value of percent body fat of participants in the experimental and control were 33.37 and 28.24 respectively prior to treatment. Percent body fat of participants in the experimental group showed a sharp decreasing tendency from a pre-training value of 33.37 to a post-training value of 31.32. The difference in the post-training and pre-training mean values of the percent body fat of the participants in the experimental group showed a decline of 2.05. However, percent body fat of participants in the control group showed a slight increasing tendency from a pre-training value of 28.24 to a post-training value of 29.18. The difference in the post-training and pre-training mean values of the percent body fat of the participants in the control group represented an increase of 0.94.

Question 3: What will participants' Body Mass Index be after exergame game training?

Table 4: Mean scores and standard deviation on body mass index among adolescents in Lagos State

Variable	Treatment	Group	Male	Female	Total						
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Body mass index	Before	Experimental	9	26.60	2.95	21	29.07	6.47	30	28.33	5.71
		Control	15	22.83	3.94	15	30.17	4.49	30	26.50	5.58
	After	Experimental	9	25.88	2.62	21	28.36	6.26	30	27.61	5.50
		Control	15	22.62	3.15	15	27.91	8.26	30	25.27	6.71

Table 4 presents the means and standard deviation of participants' body mass index before and after interactive video game training. The result showed that the mean value of percent body fat of participants in the experimental and control were 28.33 and 26.50 respectively prior to treatment. Percent body fat of participants in the experimental group showed a sharp decreasing tendency from a pre-training value of 28.33 to a post-training value of 27.61. The difference in the post-training and pre-training mean values of the body mass index of the participants in the experimental group showed a slight decline of 0.72. Similarly, body mass index of participants in the control group showed a slight decreasing tendency from a pre-training value of 26.50 to a post-training value of 25.27. The difference in the post-training and pre-training mean values of the body mass index of the participants in the control group represented a decrease of 1.23.

Question 4: Will there be any difference in participants' muscle mass after exergame game training?

Table 5: Mean scores and standard deviation on muscle mass among adolescents in Lagos State

Variable	Treatment	Group	Male	Female	Total						
			N	Mean	SD	N	Mean	SD	N	Mean	SD
Muscle mass	Before	Experimental	9	35.86	6.32	21	28.51	4.46	30	30.72	6.04
		Control	15	40.48		15	27.19	2.50	30	33.83	8.50
	After	Experimental	9	36.31	6.75	21	29.61	4.41	30	31.62	5.98
		Control	15	39.75	7.14	15	26.97	2.53	30	33.36	8.36

Table 5 presents the means and standard deviation of participants' muscle mass before and after interactive video game training. The result showed that the mean value of muscle mass of participants in the experimental and control were 30.73 and 33.83 respectively prior to treatment. Muscle mass of participants in the experimental group showed a slight increasing tendency from a pre-training value of 30.72 to a post-training value of 31.62. The difference in the post-training and pre-training mean values of the muscle mass of the participants in the experimental group showed a slight increase of 0.90. Similarly, muscle mass of participants in the control group showed a slight decreasing tendency from a pre-training value of 33.83 to a post-training value of 33.36. The difference in the post-training and pre-training mean values of the muscle mass of the participants in the control group represented a decrease of 0.47.

Testing of hypotheses

Hypothesis 1

Hypothesis one postulates that "Interactive video game training will have no significant difference on participants' resting heart rate, systolic and diastolic blood pressure". The above stated hypothesis was tested using Analysis of Covariance (ANCOVA) with level of significance set at 0.05. The result is presented in Table 6(a).

Table 6a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on resting heart rate among adolescents in Lagos state

Source	SS	df	MS	F	p	Partial Eta2
Corrected Model	6138.408	4	1534.602	77.678	.000	.850
Intercept	698.862	1	698.862	35.375	.000	.391
Covariate (Pretest)	4483.000	1	4483.000	226.919	.000	.805
Sex	15.221	1	15.221	.770	.384	.014
Group	364.679	1	364.679	18.459	.000	.251
Sex * Group	7.927	1	7.927	.401	.529	.007
Error	1086.575	55	19.756			
Total	373983.000	60				
Corrected Total	7224.983	59				

p< 0.05

Table 6a result showed that computed F-value (18.459) with degrees of freedom 1 and 55 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that interactive video game training have significant difference on participants' resting heart rate. The treatment accounted for about 25.1% (Eta2 = 0.251) of the observed variance in the participants' resting heart rate. However, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' resting heart rate showed that there was no significant interaction between the effects of gender and treatment on participants' resting heart rate, $F(1, 55) = 0.401$, $p = 0.529$. Also, it was revealed that there was no statistically significant difference in l participants' resting heart rate between gender ($F=0.770$, $p = 0.384$). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Table 6b.

Table 6b: Estimated marginal means for gender and treatment on participants' resting heart rate

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	75.353	1.531	72.286	78.421
	Control	79.762	1.188	77.381	82.143
Female	Experimental	75.762	.990	73.779	77.745
	Control	81.692	1.178	79.332	84.052

Table 6b showed that male and female adolescents in control group had higher estimated marginal means than their counterparts in the experimental group. The result further showed that there was no mean difference between male and female resting heart rate when treatment was administered to them with (means for experimental: Male = 75.353, female= 75.762; means for control: Male = 79.762, female= 81.692) respectively.

Table 7a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on systolic blood pressure among adolescents in Lagos State

Source	SS	df	MS	F	p	Partial Eta2
Corrected Model	4180.186	4	1045.046	13.383	.000	.493
Intercept	995.434	1	995.434	12.748	.001	.188
Covariate (Pretest)	3821.330	1	3821.330	48.937	.000	.471
Sex	416.000	1	416.000	5.327	.025	.088
Group	867.788	1	867.788	11.113	.002	.168
Sex * Group	27.000	1	27.000	.346	.559	.006
Error	4294.797	55	78.087			
Total	790745.000	60				
Corrected Total	8474.983	59				

p< 0.05

Table 7a result showed that computed F-value (11.113) with degrees of freedom 1 and 55 was statistically significant at p<0.05 level of significance for the groups. The null hypothesis was rejected. This implies that interactive video game training have significant difference on participants' systolic blood pressure. The treatment accounted for about 16.8% (Eta2 = 0.168) of the observed variance in the participants' systolic blood pressure. However, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' systolic blood pressure showed that there was no significant interaction between the effects of gender and treatment on participants' systolic blood pressure, F(1, 55) = 0.346, p = 0.559. However, it was revealed that there was statistically significant difference in participants' systolic blood pressure between gender (F=5.327, *p* = 0.025). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Table 7b.

Table 7b: Estimated Marginal Means for Gender and Treatment on participants' systolic blood pressure

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	105.679	3.153	99.359	111.999
	Control	115.306	2.283	110.730	119.881
Female	Experimental	113.022	1.946	109.122	116.922
	Control	119.789	2.315	115.151	124.428

Table 7b showed that male and female adolescents in control group had higher estimated marginal means than their counterparts in the experimental group. The result further showed that there was no mean difference between male and female systolic blood pressure when treatment was administered to them with (means for experimental: Male = 105.679, female= 113.022; means for control: Male = 115.306, female= 119.789) respectively.

Table 8a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on diastolic blood pressure among adolescents in Lagos State

Source	SS	df	MS	F	p.	Partial Eta2
Corrected Model	1828.941	4	457.235	11.986	.000	.466
Intercept	218.942	1	218.942	5.740	.020	.094
Covariate (Pretest)	1465.323	1	1465.323	38.413	.000	.411
Sex	.027	1	.027	.001	.979	.000
Group	272.925	1	272.925	7.155	.010	.115
Sex * Group	72.566	1	72.566	1.902	.173	.033
Error	2098.042	55	38.146			
Total	306245.000	60				
Corrected Total	3926.983	59				

p< 0.05

Table 8a result showed that computed F-value (7.155) with degrees of freedom 1 and 55 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that interactive video game training have significant difference on participants' diastolic blood pressure. The treatment accounted for about 11.5% (Eta2 = 0.115) of the observed variance in the participants' diastolic blood pressure. However, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' diastolic blood pressure showed that there was no significant interaction between the effects of gender and treatment on participants' diastolic blood pressure, $F(1, 55) = 1.902$, $p = 0.173$. Similarly, it was revealed that there was no statistically significant difference in participants' diastolic blood pressure between gender ($F=0.001$, $p = 0.979$). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Table 8b.

Table 8b: Estimated Marginal Means for Gender and Treatment on participants' diastolic blood pressure

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	70.095	2.059	65.969	74.221
	Control	72.279	1.619	69.034	75.525
Female	Experimental	67.834	1.356	65.116	70.551
	Control	74.630	1.596	71.431	77.829

Table 8b showed that male and female adolescents in control group had higher estimated marginal means than their counterparts in the experimental group. The result further showed that there was no mean difference between male and female diastolic blood pressure when treatment was administered to them with (means for experimental: Male = 70.095, Female= 67.834; means for control: Male = 72.279, Female= 74.630) respectively.

Hypothesis 2

Hypothesis two postulates that "There will be no significant difference in participants' percent body fat after twelve weeks interactive video game training". The above stated hypothesis was tested using Analysis of Covariance (ANCOVA) with level of significance set at 0.05. The result is presented in Table 9a.

Table 9a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on percent body fat among adolescents in Lagos state

Source	SS	df	MS	F	p	Partial Eta2
Corrected Model	8719.729	4	2179.932	367.059	.000	.964
Intercept	7.052	1	7.052	1.187	.281	.021
Covariate (Pretest)	4016.689	1	4016.689	676.334	.000	.925
Sex	.415	1	.415	.070	.792	.001
Group	98.041	1	98.041	16.508	.000	.231
Sex * Group	.448	1	.448	.075	.785	.001
Error	326.640	55	5.939			
Total	63938.020	60				
Corrected Total	9046.369	59				

p< 0.05

Table 9a result showed that computed F-value (16.508) with degrees of freedom 1 and 55 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that there is significant difference in participants' percent body fat after twelve weeks interactive video game training. The treatment accounted for about 23.1% (Eta2 = 0.231) of the observed variance in the participants' percent body fat. However, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' percent body fat showed that there was no significant interaction between the effects of gender and treatment on participants' percent body fat, $F(1, 55) = 0.075$, $p = 0.785$. The result revealed that there was no statistically significant difference in participants' percent body fat between gender ($F=0.070$, $p = 0.792$). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Tables 9b.

Table 9b: Estimated Marginal Means for Gender and Treatment on participants' percent body fat

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	28.862a	.838	27.182	30.541
	Control	31.378a	.816	29.742	33.014
Female	Experimental	28.915a	.576	27.760	30.069
	Control	31.811a	.712	30.383	33.239

Table 9b showed that male and female adolescents in control group had higher estimated marginal means than their counterparts in the experimental group. The result further showed that there was no mean difference between male and female percent body fat when treatment was administered to them with (means for experimental: Male = 28.862, Female= 28.915; means for control: Male = 31.378, Female= 31.811) respectively.

Hypothesis 3

Hypothesis three postulates that "Interactive video game training will have no significant difference on participants' Body Mass Index after twelve weeks". The above stated hypothesis was tested using Analysis of Covariance (ANCOVA) with level of significance at 0.05. The result is presented in Table 10a.

Table 10a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on Body Mass Index among adolescents in Lagos state

Source	SS	df	MS	F	p	Partial Eta2
Corrected Model	1654.013a	4	413.503	37.269	.000	.730
Intercept	.043	1	.043	.004	.951	.000
Covariate (Pretest)	1322.537	1	1322.537	119.200	.000	.684
Sex	8.433	1	8.433	.760	.387	.014
Group	4.189	1	4.189	.378	.541	.007
Sex * Group	11.910	1	11.910	1.073	.305	.019
Error	610.231	55	11.095			
Total	44208.660	60				
Corrected Total	2264.244	59				

p> 0.05

Table 10a result showed that computed F-value (0.378) with degrees of freedom 1 and 55 was not statistically significant at p>0.05 level of significance for the groups. The null hypothesis was not rejected. This implies that interactive video game training have no significant difference on participants' body mass index after twelve weeks. The treatment accounted for about 23.1% (Eta2 = 0.231) of the observed variance in the participants' percent body fat. Similarly, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' body mass index showed that there was no significant interaction between the effects of gender and treatment on participants' body mass index, F(1, 55) = 1.073, p = 0.305. The result also revealed that there was no statistically significant difference in participants' percent body mass index between gender (F=0.760, *p* = 0.387). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Table 10b.

Table 10b: Estimated Marginal Means for Gender and Treatment on participants' Body Mass Index

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	26.666	1.113	24.437	28.896
	Control	27.068	.952	25.161	28.975
Female	Experimental	26.754	.742	25.268	28.240
	Control	25.237	.894	23.445	27.029

Table 10b showed that there was no mean difference between male and female body mass index when treatment was administered to them with (means for experimental: Male = 26.666, Female= 26.754; means for control: Male = 27.068, Female= 25.237) respectively.

Hypothesis 4

Hypothesis four postulates that "There will be no significant difference in the pretest and posttest values of Muscle mass of participants after twelve weeks interactive video game training". The above stated hypothesis was tested using Analysis of Covariance (ANCOVA) with level of significance set at 0.05. The result is presented in Table 11a.

Table 11a: Result of (ANCOVA) showing the effect of interactive video games (exergame) adherence on muscle mass among adolescents in Lagos state

Source	SS	df	MS	F	P	Partial Eta2
Corrected Model	2981.128	4	745.282	322.025	.000	.959
Intercept	.912	1	.912	.394	.533	.007
Covariate (Pretest)	1428.212	1	1428.212	617.109	.000	.918
Sex	.939	1	.939	.406	.527	.007
Group	19.697	1	19.697	8.511	.005	.134
Sex * Group	.202	1	.202	.087	.769	.002
Error	127.290	55	2.314			
Total	66457.420	60				
Corrected Total	3108.417	59				

p< 0.05

Table 11a result showed that computed F-value (8.511) with degrees of freedom 1 and 55 was statistically significant at $p<0.05$ level of significance for the groups. The null hypothesis was rejected. This implies that there is significant difference in the pre-test and post-test values of muscle mass of participants after twelve weeks interactive video game training. The treatment accounted for about 13.4% (Eta2 = 0.134) of the observed variance in the participants' muscle mass. However, the result of two-way ANCOVA performed to examine the effect of gender and treatment on participants' muscle mass showed that there was no significant interaction between the effects of gender and treatment on participants' muscle mass, $F(1, 55) = 0.087$, $p = 0.769$. The result revealed that there was no statistically significant difference in participants' muscle mass between gender ($F=0.406$, $p = 0.527$). The mean difference among the estimated marginal means descriptive statistics of the groups, after correcting for the other effects in the model is presented in Table 11b.

Table 11b: Estimated Marginal Means for Gender and Treatment on participants' muscle mass

Sex	Group	Mean	Std. Error	95% Confidence Interval	
				Lower Bound	Upper Bound
Male	Experimental	32.804	.526	31.749	33.859
	Control	31.716	.509	30.696	32.736
Female	Experimental	33.298	.364	32.570	34.027
	Control	31.958	.441	31.074	32.842

Table 11b showed that male and female adolescents in experimental group had higher estimated marginal means than their counterparts in the control group. The result further showed that there was no mean difference between male and female muscle mass when treatment was administered to them with (means for experimental: Male = 32.804, Female= 33.298; means for control: Male = 31.716, Female= 31.958) respectively.

Discussion

Hypothesis 1 states that Interactive video game training will have no significant difference on participants' resting heart rate, systolic and diastolic blood pressure. The findings of research hypothesis 1 indicate that interactive video game training have significant difference on participants' resting heart rate, systolic blood pressure and diastolic blood pressure. Findings were in line with the study conducted by Carbonera, Vendrusculo, and Donadi (2016) indicating a positive change in physiological responses of the use of video games as exercise in the heart rate of participants.

Hypothesis 2 states that there will be no significant difference in participants' Percent body fat after twelve weeks interactive video game training. The findings revealed that there is significant difference in participants' percent body fat after twelve weeks interactive video game training. The study is in line with the findings of Amorim, de Oliveira, Soares, Borges, Dermargos, and Hatanaka (2017) which observed that total serum cholesterol, triglycerides, and LDL were reduced by 64, 29, and 12%, respectively in participants after exagame. They concluded that exergaming was useful in reducing body fat, serum adipokine levels, and lipid profiles, thus reducing cardiovascular risks. The result of this study is corroborated by Kristi, Adamo, Rutherford and Goldfield (2010) which supported that the exercise modalities for exergame is adequate to reduced body fat percentage and total cholesterol.

Hypothesis 3 states that interactive video game training will have no significant difference on participants' Body Mass Index after twelve weeks. The findings revealed that interactive video game training have no significant difference on participants' body mass index after twelve weeks. This is in line with the findings of Goldfield, Cameron and Chaput (2014) which reviews on studies that interactive video game, have no effect on BMI.

Hypothesis 4 states that there will be no significant difference in the pretest and posttest values of Muscle mass of participants after twelve weeks interactive video game training. The findings indicated that there was a significant difference in the pretest and posttest values of Muscle mass of participants after twelve weeks interactive video game training. The finding was in line with the study conducted by Lee (2013) who investigated the effects of training using video games played on the Xbox Kinect on the muscle strength, muscle tone, and activities of daily living of post-stroke patients. The result showed significant difference in pre and posttest muscle strength of the upper extremities.

Conclusion

Based on the findings of the study, the following conclusions were made. The customized interactive video game (exergame) exercise training improved heart rate, blood pressure, body fat and increases Muscle mass, but have no significant effect on the Body Mass Index of participants.

Recommendations

Based on the findings of this study, the following recommendations are made.

1. Technology in sports and fitness should be used as a means to reduce injury due to over exertion and rounds of fitness class by trainers.
2. Interactive video game (exergaming) should be considered a highly relevant strategic tool for the adoption of an active and healthy lifestyle and may be useful in the fight against childhood obesity.
3. Interactive video game should be used as an alternative for traditional play and physical activity.
4. There should be more research work done on exergame.

References

Adeloye, D., Ige-Elegbede, J.O., Ezejimofor, M., Owolabi, E.O., Ezeigwe, N., Omoyele, C., Adebiyi, A.O. (2021). Estimating the prevalence of overweight and obesity in Nigeria in 2020: a systematic review and meta-analysis, *Annals of Medicine*, 53:1, 495-507, DOI: 10.1080/07853890.2021.1897665

Amorim, M.G.S., de Oliveira, M.D., Soares, D.S., Borges, L., Dermargos,A & Hatanaka, E. (2017). Effects of exergaming on cardiovascular risk factors and adipokine levels in women. The Journal of Physiological Sciences; 68, (671–678). https://doi.org/10.1007/s12576-017-0581-5

Barbara, C. & Maloney, A. (2013). Active video game: Impacts and research. The oxford handbook of media psychology. Retrieved April 9, 2022 from *https://www.oxfordhand books.com /view/10.1093/oxfordhb/9780195398809.001.0001/oxfordhb-9780195398809*

Benzing, V., &_Schmidt, M. (2018). Exergaming for children and adolescents: strengths, weaknesses, opportunities and threats. University of Tennessee at Knoxville. *Journal of Clinical Medicine*. 7(11): 422. *doi: 10.3390/jcm7110422*.

Carbonera, R.P., Vendrusculo, F.M., & Donadi, M.V. (2016). Physiological responses during exercise with video games in patients with cystic fibrosis: A systematic review. DOI:https://doi.org/10.1016/j.rmed.2016.08.011

Fukuoka, Y., Vittinghoff, E., Jong, S.S., & Haskell, W. (2010). Innovation to motivation-pilot study of a mobile phone intervention to increase physical activity among sedentary women. *Preventive Medicine: An international Journal devoted to practice and theory.* 51.(3-4).287-289. *https://doi.org/10.1016/j.ypmed.2010.06.006*

Goldfield, G.S., Cameron, J.D. & Chaput, J. (2014). Is exergaming a viable tool in the fight against childhood obesity? Available on: https://www.hindawi.com/journals/jobe/2014/304521/

Kristi, B., Adamo, K.B., Rutherford, J.A., & Goldfield, G.S (2010). Effects of interactive video game cycling on overweight and obese adolescent health. Applied physiology, nutrition and metabolism. 35(6):805-15. doi: 10.1139/H10-078.

Lambo, E. (2011). National Strategic Framework on the Health & Development of Adolescents & Young People in Nigeria (2007 – 2011). Available on: https://www.prb.org/wp-content/uploads/2018/05/National-Strategic-Framework-on-the-Health-and-Develop me nt-of-Adolescents-and-Young-People-in-Nigeria-2007-2011.pdf

Lee, G. (2013). Effects of training using video games on the muscle strength, muscle tone, and activities of daily living of chronic stroke patients. Journal of physical therapy science, 25(5), 595–597. https://doi.org/10.1589/jpts.25.595

Lieberman, D.A. (1998). Health education video games for children and adolescents: theory, design, and research findings. *International Communication Association*; 49 (150). Retrieved on 7th March, 2022 from*: https://files.eric.ed.gov/fulltext/ED422312.pdf*

Mears, D., & Hansen, L. (2009). Active gaming: definitions, options and implementation. Strategies. Available on:
file:///C:/Users/user%20me/Downloads/GaoChenPascoPope-2015-10.1111-obr.12 287.pdf

Mgbachi, I. (2021). HIV / AIDS and the Nigerian Adolescent. Health Think Analytics. Retrieved on 5th April, 2022 from: https://healththink.org/hiv-aids-in-adolescents-and-young-people-in-nigeria/

Odo, A.N., Samuel, E.S., Nwagu, E.N., Nnamani, P.O., & Atama, C.S. (2018). Sexual and reproductive health services (SRHS) for adolescents in Enugu state, Nigeria: a mixed methods approach. *BioMed Central Health Service Research* 18, 92. https://doi.org/10.1 186/s12913-017-2779-x

Paraskevi, T., & Aymara, R. S. (2013). Adherence and physical exercise. *Health Psychology Research Journal.* 1(1). *doi: 10.4081/hpr.2013.e6*

Rudella, J.L, & Butz, J.V. (2018). Using interactive video games to enhance physical exercise among children. *Journal of Physical exercise and Health Promotion in the Early Years* pp 93-112 Retrieved April 9, 2022 from *https://link.springer.com/chapter/10. 1007/97 8-3-319-76006-3_6*

Russell, R. P., Flynn, J., & Marsha, D. (2016). Policies for promotion of physical exercise and prevention of obesity in adolescence. Retrieved April 9, 2022 from
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5801719/

Trout, J. & Christie, B. (2007). Interactive video games in physical education. Retrieved from: *https://www.researchgate.net/publication/233502338_Interactive_Video_Games_in_Physical_Education*

U.S. Department of Health and Human Services (2002). Physical exercise fundamental to preventing disease. Washington DC: Available on: *https://www.ncbi.nlm.nih.gov/pmc/ articles /PMC4768608/*

World Health Organization (2011). Global recommendations on physical activity for health. Available on: *https://www.who.int/dietphysicalactivity/physical-activity-recommendation s-5-17years.pdf*

World Health Organization (2016). Physical activity in adolescents Retrieved on 6th April, 2022 from: https://www.euro.who.int/__data/assets/pdf_file/0018/303480/HBSC-No.7_ factsheet _Physical.pdf

Zhang, J., Wang, H., Wang, Z., Du, W., Chang Su, Zhang, J.………………... Zhang, B. (2018). Prevalence and stabilizing trends in overweight and obesity among children and adolescents in China, 2011-2015. *BMC Public Health.* 18 (571). *https://doi.org/10.11 86/s12889-018-5483-9*