International Journal of Innovation and Research in Educational Sciences
Volume 7, Issue 6, ISSN (Online) : 2349–5219

Exergaming as a Strategy to Increase Physical activity Participation among Youth

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Date of publication (dd/mm/yyyy): 15/12/2020

Abstract – **In the U.S., 13.7 million children and adolescents are categorized as either overweight or obese, making this epidemic a severe public health challenge for the nation (CDC, 2019). Limited participation in physical activity has been identified as a strong contributor to excessive weight gain, especially among youth (Gerrero et al., 2017). One solution to this negative trend may lie in Exergaming (a physical form of controlling video games) which has increased among younger populations (Fulton et al., 2012). The purpose of this study was to test the efficacy of Exergame play to determine if youth's physical activity levels were significantly different between real life play and Exergame play. Results showed there were significant differences in physical activity levels between the two types of play, dependent on the activity chosen. Overall, utilizing both Exergame play and real life play provides more opportunities for youth to achieve their recommended daily amount of physical activity.**

Keywords – **Exergaming, Physical Activity, Youth, Obesity, Intervention.**

I. Introduction

Youth continue to struggle with weight management across the nation. Ogden and colleagues analyzed data from the National Health and Nutrition Examination Survey that provided information on over 40,000 children and adolescents ages 2 years to 19 years of age. Based on the Centers for Disease Control and Prevention's (CDC) BMI-for-age growth charts, researchers found that 32% of youth are overweight. Of that population, 17% were identified as obese, and 6% were identified as extremely obese (Odgen et al., 2016). Youth who are overweight are at an increased risk of health complications such as high blood pressure and high cholesterol, glucose intolerance, insulin resistance and type 2 diabetes, asthma, sleep apnea, joint problems, fatty liver disease, gallstones, and reflux (Cote et al., 2013; Lloyd et al., 2012; Bacha & Gidding, 2016; Mohanan et al., 2014; Narang & Mathew, 2012; Pollock, 2015). Psychologically, overweight or obese youth are at a higher risk for problems such as anxiety, depression, low self-esteem, and lower quality of life (Morrison et al., 2015; Shin, 2015; Halfon et al., 2013). Socially, overweight or obese youth experience more incidences of bullying and stigmatization than their healthy weight peers (Beck, 2016).

Several factors have been identified as strong contributors to overweight status and obesity. A poor diet consisting of high-calorie, low-nutrient foods and insufficient sleep have been cited as two contributing factors (United States Department of Health and Human Services and Department of Agriculture, 2015; Matricciani et al., 2012; Williams et al., 2013; Miller et al., 2015). However, lack of physical activity is one of the most significant factors linked to obesity, making it pertinent for researchers to study and determine what environmental influencers produce the best energy balance for youth (Sahoo et al., 2015). Increasing physical activity levels among youth has the ability to combat heart disease, cancer, type 2 diabetes, high blood pressure, anxiety, and obesity. Therefore, the CDC recommends adolescents ages 6 to 17 years old engage in 60 minutes or more of physical activity a day (CDC, 2019).

Ensuring that youth achieve the recommended amount of physical activity a day can be an arduous task for caregivers. With an increase in a sedentary lifestyle, today's youth spend more time in front of a screen - an average of 6 to 8 hours daily- rather than engaging in active play (Lou, 2014). As such, researchers have turned to Exergaming as a way to benefit from increased screen time. A study that surveyed 4,136 children between the ages of 2 and 17 years old discovered that 91% of children reported video game usage (Granic et al., 2014). Citing that previous research has found videogames to have the ability to provide youth with cognitive and emotional experiences that enhance their well-being. Prior studies have shown the impact Exergaming has on reducing childhood obesity by motivating youth to participate in physical activity (Granic et al., 2014), but no study has directly compared a specific Exergame activity to its real-life counterpart to determine whether exergaming elicits the same if not higher heart rate levels and physical movement as real life play. Therefore, the purpose of this study was to determine if youth's physical activity levels were significantly different between real life play and Exergame play. Results obtained from this study may provide insight as to whether Exergaming does effectively replace real life play.

II. Methods

2.1. *Participants*

During the fall of 2018 and spring of 2019, ten children between the ages of 7 and 14 years, attending a school in southeastern Louisiana, were recruited and enrolled in an after-school exercise program located at a local university laboratory. Aside from age, and participation in the after-school exercise program, there were no additional criteria for sampling. Informed consent/assent were obtained by both the children and their legal guardians prior to the commencement of study-related activities.

2.2. *Instruments*

The variables that were recorded and observed for the purpose of future analysis were heart rate and total steps. To capture the participant's heart rate, FitBit Charge 2's were worn by the children as they exercised. A main reason why Fit Bit Charge 2's were used for this study was because the devices allowed the collection of both heart rate and step data. In addition, the children were 100% compliant with wearing them. Heart rate was recorded after five minutes of rest and 15 minutes into the activity. Total steps were calculated by recording the number of steps pre exercise and post and then subtracting the number of steps pre exercise from the number of steps recorded post exercise.

2.3. *Procedure*

For 14 weeks, between the Fall 2018 and Spring 2019 semesters, ten children attended the Project Interactive Physical Activity Lab (I-PAL) twice a week for two hours each session. They engaged in various activities including zumba, Just Dance, walking, jogging, bowling, soccer, baseball, tennis and football. Each activity was run by undergraduate students enrolled in a research methods course run through the Family and Consumer Sciences program. A total of four undergraduates helped run the lab and collected data, with supervision by the course instructor. Prior to commencing with any research activities, the undergraduates completed extensive training, which included obtaining a Collaborative Institutional Training Initiative certification and learning lab protocol.

Children came Tuesday and Thursday of each week, with one day centered on real play and the other day on Exergaming. Each week, a different physical activity was introduced. There was not an assigned day for real play nor an assigned day for Exergaming. External factors such as weather, gym availability, and student assistance would determine whether the children engaged in real play or Exergaming that day. For Exergaming the children would perform the activity on the lab's XBox consoles for a total time of 20 minutes using "Kinect Sports" seasons 1 and 2. Four game consoles were used, with one child per console. For real play, the children would perform the same activity, only this time in a "real-life" setting and usually with the rest of the children in the lab. During week 8, students repeated the activities covered in weeks 1-8 in the same order.

Before beginning any activity, each child's steps were recorded from their FitBit Charge 2. After, the undergraduate students would instruct each child to sit quietly and rest for five minutes before starting the activity. At the end of the resting period, each child's heart rate was recorded by collecting their heart rate off of the FitBit Charge 2. Their heart rate would be recorded again by the undergraduates 15 minutes into the activity. Heart rate was collected at 15 minutes and not 20 to allow for the collection of each child's heart rate before stopping the activity. Once the children stopped and started to cool down, their heart rate dipped quickly making it difficult to capture an accurate reading. When the children completed the activity, they were asked to stand still in place to allow for the undergraduate students to record their steps gained during the activity. All recorded observations were handed in to the course instructor at the end of each session.

2.4. *Data Analysis*

Paired samples T-Tests were used to test for significant differences between real life and Exergame activities. The primary outcome variable was heart rate and the secondary outcome variables were total steps acquired during the activity and overall enjoyment.

III. Results

3.1. *Steps Analysis*

As depicted in Table 1, of the 14 sets of pairs analyzed in SPSS using a paired samples t-test analysis, 11 pairs boasted significant results.

Table 1. Descriptive Data and t-test Results for Real Life and Exergame Steps Pairs.

Week	**M**	**SD**	**Mean**	**t**
	(Real Life, Exergame)	(Real Life, Exergame)	Difference	
Week 1	1513.36, 1138.18	1315.88, 337.49	375.18	.78
Week 2	2611.69, 1371.38	686.59, 562.93	1240.31	5.74***
Week 3	799.10, 534.55	276.49, 330.93	264.55	2.93**
Week 4	1100.55, 630.82	458.13, 304.97	469.73	2.84**

Week	M	SD	Mean	t
Week 5	3383.00, 425.33	3223.54, 305.77	2957.67	2.96**
Week 6	988.27, 405.00	454.54, 240.69	583.27	4.16**
Week 7	1998.80, 385.00	699.34, 174.92	1613.38	8.62***
Week 8	1308.15, 1167.00	403.96, 377.26	141.15	.70
Week 9	1875.38, 1529.38	996.23, 655.63	346.00	1.00
Week 10	989.92, 302.00	511.28, 199.27	687.92	4.95***
Week 11	1192.10, 626.80	261.50, 397.86	565.30	3.08*
Week 12	1048.75, 433.67	734.00, 347.52	615.08	2.44*
Week 13	1135.31, 443.77	576.82, 351.15	691.54	4.46***
Week 14	1423.00, 440.33	747.73, 284.30	982.67	4.02**

Notes: $p<.05$*,* $p<.01$**, $p<.001$***.

Paired samples T-Tests were used to test for significant differences between real life and Exergame activities. The primary outcome variable was heart rate and the secondary outcome variables were total steps acquired during the activity and overall enjoyment.

As depicted in Table 2, of the 14 sets of pairs analyzed through a paired samples t-test analysis, 4 pairs boasted significant results.

3.2. *Heart Rate Analysis*

Table 2. Descriptive Data and t-test Results for Real Life and Exergame Heart Rate Pairs.

Week	M	SD	Mean	t
	(Real Life, Exergame)	(Real Life, Exergame)	Difference	
Week 1	143.55, 121.36	14.57, 18.84	22.19	3.89**
Week 2	156.85, 128.08	15.87, 18.26	28.77	6.75***
Week 3	139.54, 121.81	12.52, 8.51	17.73	4.82***
Week 4	149.18, 145.82	20.19, 17.57	3.36	.45
Week 5	146.00, 128.67	25.73, 10.85	17.33	2.14
Week 6	146.78, 149.56	8.67, 22.91	-2.78	-.32
Week 7	157.56, 142.00	15.35, 12.35	15.56	3.05
Week 8	145.77, 138.23	11.83, 15.23	7.54	1.98
Week 9	158.54, 128.62	15.84, 14.41	29.92	6.99***
Week 10	137.62, 134.23	14.41, 20.55	3.39	.50

Week	M	SD	Mean	t
Week 11	147.92, 141.85	22.64, 24.39	6.07	1.30
Week 12	141.00, 139.46	16.50, 14.38	1.54	.29
Week 13	151.15, 147.15	12.49, 20.82	4.00	.58
Week 14	146.85, 139.15	22.29, 13.88	7.70	.98

Notes: $p<.01$**, $p<.001$***.

IV. Discussion

The purpose of this study was to test the efficacy of Exergame play to determine if youth's physical activity levels were significantly different between real life play and Exergame play. The results demonstrated that while there were significant differences in steps between real life and Exergame, there weren't as many significant differences between heart rate levels for both options. While the children didn't move as much during Exergame as they did during real play, they were still able to bring their heart rate up to similar rates as they did while engaging in real play. Suggesting that Exergame does produce similar physical activity levels among youth as real life play.

The main limitation to this study was the sample size, which decreases the power of the study. In addition, both conditions were not equal in that Exergame was done as an individual activity while real play was conducted in a group setting. Working out as a group may have influenced each other's effort levels, though children were unable to view each other's step or heart rate data.

V. Applications/Conclusions

Based on the data and observations obtained from this cohort, a few conclusions may be drawn. The first being that an increase in overall steps may not always correlate with an increase in heart rate. Even though the children tended to accumulate more steps while engaging in real play versus Exergame, that did not always mean that there was a significant difference in heart rate levels between the two modes of play. Various Exergame sessions produced similar heart rate levels for the children as real play.

The second conclusion draws on the first one, in which Exergaming may have just as much of a positive benefit on children's health as real play. Higher heart rate zones help to burn more calories, and if Exergaming can achieve similar heart rate levels as real play, Exergaming may be a valid substitute for real play options. External factors such as living in areas not conducive for real play or not having anyone else to engage in real play may limit a child's ability to partake in physical activity. Exergaming could provide solutions to such barriers.

As previously mentioned, surveys have found video games to be highly attractive among adolescents and teens. Therefore, future studies should take into account children's level of enjoyment when replicating this model to see if children would be more likely to engage in Exergaming over real play. If it were found that children enjoy Exergaming more than real play, that would build an even stronger case for why parents and health educators should invest in this influential technology to combat childhood obesity.

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