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Exergaming Effects on Physical Activity Beliefs and Intention among At-Risk Hispanic Youth

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With the increase of childhood obesity and sedentary behavior, it is essential to discover innovative ways to motivate youth to be more active. Many Hispanic children in the United States in obesogenic environments particularly lack opportunities for physical activity (PA). Exergames (i.e., motion-based video games) may enhance PA among at-risk populations. This study investigated the impact of exergaming on at-risk, Hispanic high school students with respect to physical activity self-efficacy (PA-SE), PA enjoyment, and intention to be physically active through a 10-week Exergaming Activity Program. Instrumentation included the PA-SE Questionnaire and the PA Enjoyment Scale. Paired-samples t-tests, confirmed by Wilcoxon signed rank tests for paired data, revealed that PA-SE, PA enjoyment, and PA intention increased from the beginning to the end of the program, but PA intention was the only measure that was statistically significant. Results provide insight for physical educators and PA leaders into a possible way to increase PA among at-risk youth living in environments where outside PA opportunities are scarce or unsafe.
Keywords: active video gaming (AVG), physical activity, Latino, motion-based video gaming (MBVG)

INTRODUCTION

In the United States, it is estimated that more than 42% of adults and over 18% of children and adolescents aged 2 to 19 years old are obese (Hales et al., 2020; Hales et al., 2017). In children, a lack of physical activity and an increase in sedentary screen time (i.e., averaging 7.5 hours per day in front of a screen) has been named a culprit in contributing to the obesity epidemic, among many other factors (U.S. Department of Health and Human

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Services [USDHHS], 2017). While inactivity and obesity are problems that span the United States, minorities, and Hispanics in particular, are more at risk for obesity.

OBESITY AND HISPANIC AMERICANS

The obesity rate among Hispanic adults is 42.5% (Ogden et al., 2015), and Hispanic adults in the United States have lower levels of leisure-time physical activity compared to non-Hispanic adults (Neighbors et al., 2008). Meanwhile, over 25% of Hispanic children and adolescents aged 2 to 19 years old are obese compared to only 14% of non-Hispanic whites (Hales et al., 2017). Table 1 provides an overview of comparison statistics of white versus Hispanic Americans regarding obesity. Compared to those who are a healthy weight, individuals who are obese are at greater risk for a plethora of serious diseases and health conditions, such as hypertension, sleep apnea, dyslipidemia, type 2 diabetes, coronary heart disease, stroke, and all causes of death (Centers for Disease Control and Prevention, 2020).

Table 1. *Hispanic Americans and Obesity Statistics*

78.8% of American Hispanic women are overweight or obese compared to 64% of non-Hispanic white women.
Compared to non-Hispanic American Whites…
American Hispanic adults are…
…1.2 times more likely to be obese.
American Hispanic children are…
…1.8 times more likely to be obese.
…20% more likely to be overweight.
American Hispanic high school students are…
…50% more likely to be obese.

Note. Source: Office of Minority Health, USDHHS (2020).

Likewise, Hispanic children exercise less than their non-Hispanic counterparts, which has influenced some researchers to hypothesize that decreased physical activity may be a cultural phenomenon among Hispanics. Less acculturated Hispanic adolescents' lower levels of physical activity may reflect cultural influences that may not promote participation in physical activity and organized sports (Liu et al., 2009). In addition, physical activity among overweight and non-overweight Hispanic children and adolescents decreases dramatically in both male and female Hispanic children as they age (Butte et al., 2007).

Moreover, obesity of all American ethnic groups is positively associated with lower socioeconomic status (SES) (Centrella-Nigro, 2009). "Obesogenic" areas promote obesity in the population due to the lack of access to healthy foods and opportunity for physical activity (Centrella-Nigro, 2009). It is clear that low-SES, Hispanic individuals are at an even greater risk for obesity, and therefore, special attention to increasing physical activity among this group is essential. While traditional activities may suffice in affluent areas, youth living in obesogenic environments may not have access to sport or fitness clubs, open play fields, or other organized physical activity venues. Health and physical educators in these environments must find alternative ways to attract youth to be physically active, especially given the limited resources and space.

VIDEO GAMES AND AMERICAN YOUTH

Technologies such as television and video games continue to be mentioned as leading culprits of childhood obesity and lack of physical activity (USDHHS, 2017). Video gaming is pervasive among Americans, despite gender and SES. Seventy-five percent of American households include at least one video game player, with 70% of kids under 18 years old play video games (Entertainment Software Association, 2020). Despite video games being partially blamed for youth inactivity levels and the rise of obesity, motion-based video gaming (i.e., exergaming) is now generally recognized as a way to reduce sedentary screen time (Jenny, Schary et al., 2017).

Exergaming. Motion-based video gaming, also called exergaming or active video gaming, combines video gaming with physical exercise as the games employ motion-sensing technologies where players must perform large muscle group movements in order to play the game (Jenny et al., 2013). Sensors, cameras, and software detect the player's body movements and these fine and gross motor movements are then reflected in the game's avatar's movements on screen. Sample exergaming platforms include the Xbox Kinect, PlayStation Move Motion with virtual reality, Nintendo Wii Fit, and Nintendo Switch Ring Fit. Due to their limited space requirements, paired with gaming's strong interest from youth, exergames may provide an accessible opportunity for physical activity for the aforementioned at-risk Hispanic youth living in areas with limited resources.

Exergaming and health. Although many exergames were originally designed for entertainment, health researchers and practitioners continue to recognize their potential value to motivate improved health-related fitness and increase physical activity (Peng et al., 2011; Penko & Barkley, 2010). Much research on exergaming involves impacts of physical activity levels, participants' body weight, and physiological outcome measures such as energy expenditure and heart rate.

Exergames have been demonstrated to provide light-to moderate (Temlali & Jemni, 2017; Peng et al., 2012) or moderate-to-vigorous (Gao et al., 2020; Staiano et al., 2018) intensity physical activity, reduce abdominal subcutaneous adiposity (Temlali & Jemni, 2017), afford an effective exercise behavior change strategy (Street et al., 2017), improve blood pressure and colesterol (Staiano et al., 2018), increase cognitive flexibility (Gao et al., 2019), and reduce body weight or improve body mass index (Hernández-Jiménez et al., 2019; Staiano et al., 2018; Temlali & Jemni, 2017) – particularly with underserved minorty youth (Gao et al., 2020).

Video gaming and exergaming in physical education. Other studies have investigated utilizing video games in physical education. Sport video games have been shown to increase cognitive sport knowledge across varying sports and motivate future intentions for playing that sport in real life (Jenny, Chung et al., 2017; Jenny & Schary, 2014; Jenny & Schary, 2016). Moreover, one study revealed that elementary physical education students enjoy exergaming more than traditional physical education class but feel they "work harder" in traditional physical education class (Shewmake et al., 2015). Despite benefits, researchers note challenges of exergaming in physical education, such as cost of equipment, game design impacting participant activity time and effort to play compared to traditional physical activities (Zhang et al., 2016). Finally, a review of exergaming's role in teaching motor skills revealed that while they may be beneficial in teaching beginner's basic sports concepts or assist those with disabilities in participating in physical activities they may otherwise not be able to do, exergames do not accurately teach sport-specific motor movements (Jenny, Schary et al., 2017). Thus, the most appropriate purpose of including exergames into physical education may be to motivate physical activity and not teach precise physical movements.

SELF-EFFICACY AND ENJOYMENT REGARDING PHYSICAL ACTIVITY AND EXERGAMING PARTICIPATION

One of the most powerful determinants of behavior is self-efficacy, which is defined as one's beliefs in his or her capabilities to perform a task, and largely develops from mastery experiences (Bandura, 1997). If people successfully perform a task, they will believe that they have the capabilities necessary to take on in that task in the future, due to an increase in self-efficacy. For example, successful participation with physical activity may lead to an increase in confidence, or self-efficacy, and therefore, lead to future pursuits with physical activity.

Additionally, enjoyment is another construct that has been shown to be an underlying factor impacting physical activity participation. Enjoyment of physical activity is part of the national K-12 physical education standards for a physically literate individual (Society of Health and Physical Educators [SHAPE] America, 2020). Enjoyment is highly correlated with competence (Cairney et al., 2007), a primary motivator for physical activity among middle and high school students (Woods et al., 2007), and directly relates to active physical activity engagement (Graber & Locke, 2007).

Unlike self-efficacy, enjoyment has been a key psychosocial outcome measure in exergaming-related research. Graves et al. (2010) found that enjoyment for physical activity was significantly higher for exergames (e.g., Nintendo Wii) compared to treadmill walking or jogging and handheld gaming among adolescents and adults. Likewise, other research reports high levels of enjoyment while playing exergames across varying populations (Sell et al., 2008; Trout & Zamora, 2006).

As levels of physical activity decline and obesity rates rise in children, the popularity of video gaming among youth continues to increase. Consequently, participation with exergames may play a role in the development of self-efficacy and enjoyment beliefs with regard to physical activity, particularly among Hispanic youth who are at greater risk for obesity. Therefore, the purpose of this exploratory study was to investigate the impact of exergaming on at-risk Hispanic high school youth with respect to physical activity self-efficacy and enjoyment beliefs. The guiding research question was: Does participation in exergaming activities influence physical activity self-efficacy, enjoyment, and behavioral intention among at-risk Hispanic high school students?

METHODS

PARTICIPANTS

Participants in this study consisted of students attending an alternative high school in an inner-city setting in the southcentral United States who were described as at-risk and low-SES (8 females, 8 males). Participants enrolled in an Exergaming Activity Program as part of their school curriculum in conjunction with a nearby university. All study participants identified as Hispanic and were between the ages of 16 and 18 years old (M age = 16.9., SD = .806).

INSTRUMENTATION

Demographic Questionnaire. A demographic questionnaire was used to collect age, gender, and race. In addition, the participants were asked to provide information about their average physical activity engagement frequency and duration for the past month and physical activity intention for the future month. Finally, participants were asked to provide information about their video gaming behaviors with regard to type (e.g., sedentary or active exergaming), frequency, and duration.

Self-Efficacy Questionnaire. Participants completed the Physical Activity Self-Efficacy 8-item, 5-point Likert scale questionnaire (Dishman et al., 2005), on the first and last days of the Exergaming Activity Program. Participants rated their levels of agreement from 1 (disagree a lot) to 5 (agree a lot) on items such as, “I can be physically active during my free time on most days” and “I can ask my parent or other adult to do physically active things with me." The scale has been successfully administered with elementary and secondary aged students, with previous internal consistency reports with a Cronbach alpha level of .79 (Dishman et al., 2005).

Enjoyment Questionnaire. Participants also completed the 7-item version of the Physical Activity Enjoyment Scale (Dishman et al., 2005). The items were measured on a 5-point Likert scale ranging from 5 (disagree a lot) to 1 (agree a lot). All of the items were negatively worded, thus resulting in reverse scoring. Examples included: "When I am active, I feel bored" and "When I am active, it's not fun at all." The instrument has been successfully used with adolescents (Crocker et al., 1995) and children (Dishman et al., 2005) with Cronbach's alpha coefficient reports of .90 and above.

PROCEDURES

The institutional review board approved all measures and procedures before the study began, and all participants provided consent (if 18 years or older) or parental consent and minor assent (if under 18 years). Participants were invited to participate in the Exergaming Activity Program one day per week for 10 weeks during their final class period of their assigned day. Students who enrolled in the program were then invited to participate in the study. The Exergaming Activity Program took place in a research-laboratory setting on a university campus near the high school. Participants were gender-separated (due to school policy) in groups and ranged from five to eight students each. The participants partook in rotational exergaming activities for 45 minutes across 10 sessions over 10 weeks (one session each week).

Exergaming activities included: 1) Xbox Kinect Sports, Zumba, Adventures, and Dance Central, 2) PlayStation Exerbike Madagascar Karts and Sonic Racing, and 3) Nintendo Wii Dance Dance Revolution. Participants were directed to rotate game stations every 15 minutes and were given the option of open choice of activities for 4 out of the 10 visits, whereas the other 6 visits consisted of directed activities. The aforementioned paper-based questionnaires were completed by participants on the first day and repeated on the last day of the Exergaming Activities Program.

DATA ANALYSIS

The data were analyzed using IBM SPSS Statistics. Paired t-tests were used to analyze background and individual response item data on the surveys from pre- to post-test. Also, a paired-samples t-test was conducted to evaluate the impact of the intervention on students' scores on self-efficacy for physical activity using the Physical Activity Self-Efficacy Scale. Self-efficacy scores were calculated by averaging the eight items' scores on a scale of one to five.

A paired-samples t-test was also conducted to evaluate the impact of the intervention on students' enjoyment for physical activity using the Physical Activity Enjoyment Scale. Enjoyment scores were calculated by averaging the seven items' scores on a scale of one to five. A paired-samples t-test was also utilized to evaluate the impact on students' scores on past behavior (PB) with regard to physical activity prior to, and intended behavior (IB) for physical activity after the exergaming program. PB and IB were measured by indicating how many days per week the participant engaged in physical activity in the past month (prior to the exergaming program for past behavior) and how many days per week the participant intended to engage in physical activity over the next month (following the exergaming program for intended behavior). Scores ranged from 1 (0 days per week) to 4 (6-7 days per week). Pearson correlations were performed to test for significant relationships between self-efficacy, enjoyment, and intention for physical activity. Finally, due to the small sample within this study and to address concerns relating to statistical power, a non-parametric Wilcoxon signed rank test for paired data was also used to confirm each paired-samples t-test finding (Ott & Longnecker, 2010).

RESULTS

PRIOR VIDEO GAMING BEHAVIOR

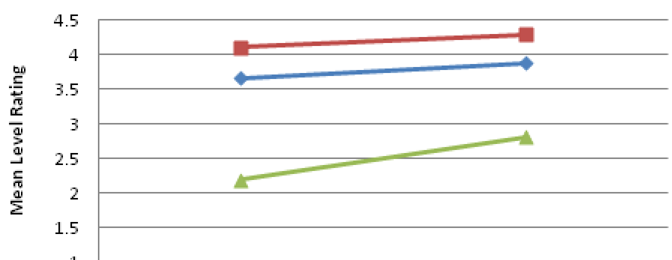
In the month prior to the study, half of the participants reported playing seated video games (SVG) once or twice a week, while 31% reported playing a few times per week; 6% played every day, and 13% did not play SVG at all in the previous month. In addition, half of participants reported playing SVG for up to 30 minutes per day, while 13% of participants reported playing for over 60 minutes per day. Participants also reported playing exergames every day (6%), a few times per week (6%), once or twice (50%), or not at all (38%) in the month prior to the study. Fifty percent of participants used AVG for up to 30 minutes per day of play.

SELF-EFFICACY FOR PHYSICAL ACTIVITY

Within the study, Time 1 refers to prior to the Exergaming Activity Program, while Time 2 relates to after the program. Self-efficacy (SE) scores from Time 1 (M = 3.66, SD = .90) to Time 2 (M = 3.88, SD = .63), $t(15)$ = .932, p = .366 (two-tailed) showed no significant difference. The Wilcoxon signed-rank test confirmed this result (Z = -.914, p = .361). The mean increase in SE scores was 0.18 with a 95% confidence interval ranging from -0.96 to 0.60. The eta squared statistic (.05) indicated a moderate effect size according to Cohen's guidelines (1988).

ENJOYMENT OF PHYSICAL ACTIVITY

There was not a statistically significant difference in Enjoyment scores from Time 1 (M = 4.11, SD = 1.10) to Time 2 (M = 4.29, SD = .92), $t(15)$ = -.490, p = .631 (two-tailed). The Wilcoxon signed-rank test confirmed this result (Z = -.315, p = .753). The mean increase in Enjoyment (ENJ) scores was 0.21 with a 95% confidence interval ranging from -0.69 to 0.27. The eta squared statistic (.02) indicated a small effect size.



	Time 1	Time 2
SE	3.66	3.88
ENJ	4.11	4.29
PAB	2.19	2.81

Figure 1. Pre- and post- Exergaming Activity Program level reports on self-efficacy (SE), enjoyment (ENJ), and past (T1) and intended (T2) physical activity behavior (PAB).

PHYSICAL ACTIVITY BEHAVIOR

Physical activity behavior scores from past behavior to intended behavior (IB) showed a significant increase from past behavior (M=2.19, SD = .83) to intended behavior (M=2.81, SD = .91), $t(15)$ =2.3, p = .036 (two-tailed). The Wilcoxon signed-rank test confirmed this result (Z = -2.06, p = .040). The mean increase in behavior scores was 0.62 with a 95%

confidence interval ranging from -1.21 to -.045. Figure 1 displays the changes in SE, ENJ and IB. The eta squared statistic (.26) indicated a large effect size.

Pearson correlations (see Table 2) revealed no significant relationships between self-efficacy (T2), enjoyment (T2), and intended future physical activity behavior. In addition, an independent samples t-test showed no significant differences between females and males in video gaming behavior, physical activity past behavior, self-efficacy for physical activity, enjoyment of physical activity, or intention behavior to be active in the future.

Table 2. *Relationships between Self-efficacy, Enjoyment, and Intended Future Physical Activity Behavior*

Belief		SE T2	ENJ T2	IB
SE T2	Pearson Correlation	1	.084	.319
	Sig. (2-tailed)		.756	.228
	Sum of Squares and Cross-products	5.969	.732	2.750
	Covariance	.398	.049	.183
	N	16	16	16
ENJ T2	Pearson Correlation	.084	1	.331
	Sig. (2-tailed)	.756		.211
	Sum of Squares and Cross-products	.732	12.612	4.143
	Covariance	.049	.841	.276
	N	16	16	16
IB	Pearson Correlation	.319	.331	1
	Sig. (2-tailed)	.228	.211	
	Sum of Squares and Cross-products	2.750	4.143	12.438
	Covariance	.183	.276	.829
	N	16	16	16

Note. SE T2 = Self-Efficacy Time 2; ENJ T2 = Enjoyment Time 2; IB = Intention Behavior.

DISCUSSION

The purpose of this study was to investigate the potential impact of a 10-week exergaming program on at-risk, Hispanic youth's physical activity self-efficacy and enjoyment beliefs and physical activity intentional behavior.

PHYSICAL ACTIVITY SELF-EFFICACY AND ENJOYMENT

While increases in both self-efficacy and enjoyment beliefs for physical activity were not significant, the slight increase may suggest that youth may feel positively about exergaming as a physical activity option. Self-efficacy has been established as a significant predictor for engagement in exercise and physical activity (McAuley & Blissmer, 2000; Baranowski et al. 1998), and exergaming is an innovative way to increase self-efficacy for physical activity (Liberman, 2006). For example, Dos Santos and colleagues (2016) studied children in an exergaming program and found statistically significant increases in exercise self-efficacy, particularly among overweight children. While not significant, the youth in the current study did experience an increase in self-efficacy for physical activity, indicating they may feel positively about exergaming as a physical activity option. Given that self-efficacy is a positive predictor of participation in physical activity and is positively correlated with higher physical activity engagement during exergaming (Huang & Gao, 2013; Gao et al., 2011), exergaming may be a viable option for inclusion in physical education or physical activity settings. Specifically, physical education teachers can integrate exergaming as a means to increase engagement in physical activity both immediately through exergaming or as a way to increase self-efficacy for physical activity, in general. Teachers should strive to create positive exergaming environments where students achieve success, since successful experiences are more likely to lead to an increase in self-efficacy (Bandura, 1997). Krause and Benavidez (2014) suggested selecting specific exergames that enhance curriculum, provide opportunities for successful, active practice, facilitate learning outcomes, consider appropriateness for children, and provide positive feedback to users. "Careful selection, monitoring, and supplemental instruction and feedback are the keys to successful exergaming implementation and can result in increased physical activity and sport self-efficacy beliefs" (Krause & Benavidez, 2014, p. 20).

Logic would posit that if one has a high self-efficacy in participating in a particular activity, it may be that he or she would also be more likely to enjoy the activity. Past research on enjoyment and exergaming has found that exergames generally are enjoyable (Jenny et al., 2013; Moholdt et al., 2017), and may even provide more situational interest compared to traditional sedentary educational video gaming (Sun & Gao, 2016). In addition, O'Loughlin et al. (2019) suggested that permitting participants to exergame at "light" or "moderate" intensities may be more enjoyable, practical and achievable for children and adolescents, which may in turn facilitate physical activity sustainability. Exergaming for enjoyment and fitness are positively correlated with the exergaming frequency with family and friends, as well as exergaming intensity (O'Loughlin et al., 2020). Thus, physical educators should consider intensity of exergames that might impact participant enjoyment levels, but concern should also be made for students to assist in achieving daily recommended physical activity minutes. In short, exergaming can be viewed as an enjoyable way to facilitate physical exercise in individuals who may not otherwise be motivated to perform physical activity (Moholdt et al., 2017).

In addition, features within video games utilized in exergaming can facilitate player self-efficacy and enjoyment because the user is afforded in-game control, challenge, creative self-expression, constant feedback from the game, and competition within the game (Sheehan & Katz, 2010). Including exergaming into instruction also ties into the recent trend of educators introducing game-like elements (e.g., competition, rules, point scoring) into education in order to make learning motivating and fun, called "gamification" (Jenny et al., 2020). Specifically, because many exergames allow users to choose the difficulty level, players can choose a level where they may be successful, yet challenged, within their zone of proximal development, thus increasing chances of stimulating intrinsic motivation, self-efficacy and resulting enjoyment (Sheehan & Katz, 2010). Therefore, physical educators must help students choose appropriate exergaming difficulty levels within the games that provide differentiation of instruction across all students.

Recent research involving exergaming have included virtual reality (VR) exergames, which have shown promise as motivating children to perform physical activity in school settings (Roshanpour & Nikroo, 2020). Physical educators might also consider VR exergaming into programming in an effort to stay ahead of current trends to increase student physical activity enjoyment. Overall, the current study's participants' self-efficacy and enjoyment belief ratings were moderately positive to begin with, and therefore, a large increase may be more difficult to achieve.

BEHAVIORAL INTENTION FOR PHYSICAL ACTIVITY

The increase from past physical activity behavior to the intention for physical activity behavior, although significant, were small. Given the rating scale, participants indicated that past physical activity engagement was approximately one day per week, while intended physical activity scores indicate that they planned to increase to two to three days per week. Despite the increase, two to three days per week does not meet the recommended guidelines for physical activity.

It is recommended that children and adolescents between 6 to 17 years old attain at least 60 minutes of moderate-to-vigorous physical activity each day (USDHHS, 2018), significantly more than the sample reported for future intentions after the exergaming intervention. Educators should consider utilizing exergames as part of a Comprehensive School Physical Activity Program (CSPAP). A CSPAP is an organized strategy to utilize all opportunities and resources for school-based physical activity (i.e., physical education; physical activity before, during, or after school; staff, family and community engagement) to help facilitate students in achieving 60 minutes of moderate-to-vigorous physical activity every day (SHAPE America, 2015). An aim of the current study was to determine if exergames could be used as a way to increase physical activity in an interesting and accessible way that may stimulate further physical activity. Therefore, exergames could be incorporated into a CSPAP through physical education, recess, short "brain breaks" between traditional classroom activities, or included into before or after school physical activity programs.

In other words, practitioners must be cognizant that exergames can be fused into a school-wide physical activity initiative and need not only be considered as a physical education activity. For example, educators could consider including exergaming into an after-school programs and provide up to 30 minutes of moderate-to-vigorous physical activity each day as recommended for after-school programming (SHAPE America, 2015). This may motivate some additional future physical activity behavior, but students may still not meet daily physical activity recommendations. Thus, exergaming should not be viewed as an entire physical activity solution. More research and physical activity interventions are warranted targeted at additional strategies that may specifically assist at-risk Hispanic youth in increasing daily physical activity.

Moreover, the actual exergame utilized can also impact future physical activity intentions and behavior. For instance, Dos Santos and colleagues (2016) studied 55 children enrolled in an exergaming program and found that 97% of children reported interest in future fitness programs and 96% of children who did not play sports prior to exergaming started practicing sports. Additionally, Soltani et al. (2020) found that a swimming exergame can encourage future general physical activity intentions, but not specifically swimming intentions – surmising that the novelty and entertainment elements of exergaming may facilitate players' attitudes toward physical activity. Therefore, physical educators may use exergames to promote situational interest in physical activity, but players' future exercise intentions are not always exergame activity-specific.

Overall, the lack in correlations among the three variables may indicate that other, unknown factors may have played a role in facilitating physical activity plans for the future. For example, at-risk youth students in inner cities may not be able to access resources or safe physical activity environments. Moreover, after experiencing a bowling simulated exergame, the students might want to go bowling, but they may not have the money to play, transportation to get to a bowling alley, or facilities nearby to go bowling. Therefore, the inclusion of exergaming by physical educators in schools may provide these students access to safe physical activities that these students may not otherwise be able to perform.

LIMITATIONS AND FUTURE RESEARCH

This study was not without limitations. A larger sample size may have impacted the non-significant results within this study. As noted previously, a ceiling effect may have occurred regarding self-efficacy and enjoyment. Moreover, results could also have been impacted by the students being separated by gender, which could have positively or negatively affected self-efficacy, enjoyment, or behavior intention measures. This study is limited to the sample chosen (i.e., inner-city high school Hispanic students) and exergames utilized. Future studies may employ a larger sample size with other target populations regarding ethnicity or age range.

In addition, individual exergame data were not collected in terms of self-efficacy and enjoyment. Participants may have felt more confidence or enjoyment with certain exergames than with others. Also, competence on exergames was not measured, which could have influenced self-efficacy levels based on level of mastery experience (Bandura, 1997). Competence measures should also be included and compared with belief measures. Informal observations of the researchers, however, indicated that participants' effort and excitement for particular exergames increased or decreased with success level. Future studies could collect measures on individual exergames. Finally, past research suggests teaching affective life skills (e.g., effort, teamwork, fair play, caring for others, self-control, accepting decision from others, treating others with respect) to physical education students affected by poverty (Jenny & Rhodes, 2017). Future studies might also see how exergames might be utilized as a vehicle to teach life skills for at-risk youth.

CONCLUSION

The need for alternative and accessible physical activity opportunities that interest youth living in obesogenic environments is paramount as more research focuses on innovative physical activity options. The results of this study showed that participation with exergaming activities once per week over 10 weeks did not significantly impact physical activity self-efficacy and enjoyment beliefs among low-SES, at-risk, Hispanic youth. However, intention to be physically active in the future increased after the exergaming intervention. Health and physical education teachers may consider utilizing exergames with students in an effort to increase physical activity behaviors.

REFERENCES

Bandura, A. (1997). Self-efficacy: The exsercise of control. New York: Freeman.

Baranowski, T., Anderson, C., & Carmack, C. (1998). Mediating variable framework in physical activity interventions—How are we doing? How might we do better? *American Journal of Preventive Medicine, 15*, 266–297.

Butte, N. F., Puyau, M. R., Vohra, F. A., Adolph, A. L., Mehta, N. R., & Zakeri, I. (2007). Body Size, Body Composition, and Metabolic Profile Explain Higher Energy Expenditure in Overweight Children1,2. *The Journal of Nutrition, 137*(12), 2660-2667.

Cairney, J., Hay, J., Mandigo, J., Wade, T., Faught, B. E., & Flouris, A. (2007). Developmental coordination disorder and reported enjoyment of physical education in children. *European Physical Education Review*, *13*(1), 81-98.

Centers for Disease Control and Prevention. (2020, September 17). The health effects of overweight and obesity. https://www.cdc.gov/healthyweight/effects/index.html

Centrella-Nigro, A. (2009). Hispanic children and overweight: causes and interventions. *Pediatric Nursing, 35*(6), 352.

Crocker, P. R. E., Bouffard, M., & Gessaroli, M. E. (1995). Measuring enjoyment in youth sport settings: A confirmatory factor analysis of the Physical Activity Enjoyment Scale. *Journal of Sport and Exercise Psychology, 17*(2), 200.

Dishman, R. K., Motl, R. W., Sallis, J. F., Dunn, A. L., Birnbaum, A. S., Welk, G. J., . . . Jobe, J. B. (2005). Self-Management Strategies Mediate Self-Efficacy and Physical Activity. *American Journal of Preventive Medicine*, *29*(1), 10-18.

Dos Santos, H., Bredehoft, M. D., Gonzalez, F. M., Montgomery, S. (2016). Exercise video games and exercise self-efficacy in children. *Global Pediatric Health, 3*, 1-6. doi:10.1177/2333794X16644139

Entertainment Software Association. (2020). 2020 essential facts about the video game industry. https://www.theesa.com/esa-research/2020-essential-facts-about-the-video-game-industry

Gao, Z., Lee, J. E., Zeng, N., Pope, Z. C., Zhang, Y., & Li, X. (2019). Home-based exergaming on preschoolers' energy expenditure, cardiovascular fitness, body mass index and cognitive flexibility: A randomized controlled trial. *Journal of Clinical Medicine, 8*(10), 1-13. doi: 10.3390/jcm8101745

Gao, Z., Zeng, N., McDonough, D., & Zu, X. (2020). A systematic review of active video games on youth's body composition and physical activity. *International Journal of Sports Medicine*, *41*(9), 561-573. doi: 10.1055/a-1152-4959

Graber, K. C., & Locke, L. F. (2007). Are the National Standards Achievable?--Conclusions and Recommendations. *Journal of Teaching in Physical Education, 26*(4), 416-424.

Graves, L. E. F., Ridgers, N. D., Williams, K., Stratton, G., Atkinson, G., & Cable, N. T. (2010). The physiological cost and enjoyment of Wii Fit in adolescents, young adults, and older adults. *Journal of Physical Activity and Health*, *7*(3), 393.

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2017). Prevalence of obesity among adults and youth: United States, 2015–2016. *NCHS Data Brief, 288*, 1-8. https://www.cdc.gov/nchs/data/databriefs/db288.pdf

Hales, C. M., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2020). Prevalence of obesity and severe obesity among adults: United States, 2017–2018. *NCHS Data Brief, 360*, 1-8. https://www.cdc.gov/nchs/data/databriefs/db360-h.pdf

Hernández-Jiménez, C., Sarabia R., Paz-Zulueta, M., Paras-Bravo, P., Pellico, A., Azcona, L. R…Santibáñez, M. (2019). Impact of active video games on body mass index in children and adolescents: Systematic review and meta-analysis evaluating the quality of primary studies. *International Journal of Environmental Research and Public Health, 16*(13), 1-37. doi: 10.3390/ijerph16132424

Huang, C. & Gao, Z. (2013). Associations between students' situational interest, mastery experiences, and physical activity levels in an interactive dance game. *Psychology, Health, and Medicine, 18*, 233-241.

Jenny, S. E., Chung, J. J., Rademaker, S. M., & Schary, D. P. (2017). Learning a sport through video gaming: A mixed-methods experimental study. *Journal of the Canadian Gaming Studies Organization, 10*(17), 1-20.

Jenny, S., Hushman, G., & Hushman, C. (2013). Pre-service teachers' perceptions of motion-based video gaming in physical education. *International Journal of Technology in Teaching and Learning, 9*(1), 96-111.

Jenny, S. E., Krause, J. M., & Armstrong, T. (2020). *Technology for physical educators, health educators, and coaches*. Human Kinetics.

Jenny, S. E., & Rhodes, S. (2017). Physical education professionals developing life skills in children affected by poverty. *The Physical Educator*, *74*, 653-671. https://doi.org/10.18666/TPE-2017-V74-I4-7524

Jenny, S. & Schary, D. (2014). Exploring the effectiveness of learning American football through playing the video game "Madden NFL". *International Journal of Technology in Teaching and Learning, 10*(1), 72-87.

Jenny, S. & Schary, D. (2016). Virtual and "real-life" wall/rock climbing: Motor movement comparisons and video gaming pedagogical perceptions. *Sports Technology*. doi: 10.1080/19346182.2015.1118110

Jenny, S. E., Schary, D. P., Noble, K. M., & Hamill, S. D. (2017). The effectiveness of developing motor skills through motion-based video gaming: A review. Simulation and Gaming: An International Journal of Theory, *Practice and Research, 48*(6), 722-734. doi: 10.1177/1046878117738552

Krause, J. M., & Benavidez, E. (2014). Potential influences of exergaming on self-efficacy for physical activity and sport, *Journal of Physical Education, Recreation & Dance, 85*(4), 15-20. doi: 10.1080/07303084.2014.884428

Liberman, D. A. (2006). What can we learn from playing interactive games? In: Vorderer, P., & Bryant, J. (eds.). *Playing Video Games: Motives, Responses and Consequences.* Mahwah, NJ: Lawrence Erlbaum, 379-397.

Liu, J., Probst, J. C., Harun, N., Bennett, K. J., & Torres, M. E. (2009). Acculturation, physical activity, and obesity among Hispanic adolescents. *Ethnicity and Health, 14*(5), 509-525.

McAuley, E., & Blissmer, B. (2000). Self-efficacy determinants and consequences of physical activity. *Exercise and Sport Sciences Reviews, 28*, 85–88.

Moholdt, T., Weie, S., Chorianopoulos, K., Wang, A. I., & Kagen, K. (2017). Exergaming can be an innovative way of enjoyable high-intensity interval training. *BMJ Sports & Exercise Medicine, 3*(e000258), 1-6. http://dx.doi.org/10.1136/bmjsem-2017-000258

Neighbors, C. J., Marquez, D. X., & Marcus, B. H. (2008). Leisure-time physical activity disparities among Hispanic subgroups in the United States. *American Journal of Public Health, 98*(8), 1460–1464.

Ogden, C. L., Carroll, M. D., Fryer, C. D., & Flegal, K. M. (2015). Prevalence of obesity among adults and youth: United Staes 2011-2014. *NCHS Data Brief, no 219*, Hyattsville, MD: National Center for Health Statistics.

O'Loughlin, E. K., Barnett, T.A., McGrath, J. J., Consalvo, M., & Kakinami, L. (2019). Factors associated with sustained exergaming: Longitudinal investigation. *JMIR Serious Games, 7*(2), e13335. doi: 10.2196/13335

O'Loughlin, E., Sabiston, C.M., Kakinami, L., McGrath, J. J., Consalvo, M., O'Loughlin, J. L., & Barnett, T. A. (2020). Development and validation of the reasons to exergame (RTEX) scale in young adults: Exploratory factors analysis. *JMIR Serious Games, 8*(2), e1626. https://games.jmir.org/2020/2/e16261

Ott, R. L., & Longnecker, M. (2010). An introduction to statistical methods and data analysis (6th ed.). Brooks/Cole.

Peng, W., Crouse, J. C., & Lin, J.-H. (2012). Using Active Video Games for Physical Activity Promotion: A Systematic Review of the Current State of Research. *Health Education and Behavior*.

Peng, W., Lin, J.H., & Crouse, J. (2011). Is Playing Exergames Really Exercising? A Meta-Analysis of Energy Expenditure in Active Video Games. *Cyberpsychology, Behavior and Social Networking, 14*(11), 681-688.

Penko, A. L., & Barkley, J. E. (2010). Motivation and Physiologic Responses of Playing a Physically Interactive Video Game Relative to a Sedentary Alternative in Children. *Annals of Behavioral Medicine, 39*(2), 162-169.

Roshanpour, R. & Nikroo, M. H. (2020). Investigating the impact of virtual reality and gamification on improving physical activities in school. *Research Square*, 1-20. https://doi.org/10.21203/rs.3.rs-47976/v1

Soltani, P., Figueiredo, P., Vilas-Boas, J. P. (2020). Does exergaming drive future physical activity and sport intentions? *Journal of Health Psychology, 25*(2), 1-28. https://hal.archives-ouvertes.fr/hal-02468070

Sell, K., Lillie, T., & Taylor, J. (2008). Energy expenditure during physically interactive video game playing in male college students with different playing experience. *Journal of American College Health, 56*(5), 505-512.

Sheehan, D., & Katz, L. (2010). Using interactive fitness and exergames to develop physical literacy. *Physical & Health Education Journal, 76*, 12–19.

Shewmake, C. J., Merrie, M. D., & Calleja, P. (2015). Xbox Kinect gaming systems as a supplemental tool within a physical education setting: Third and fourth grade students' perspectives. *The Physical Educator, 72*(5), 142-152.

Society of Health and Physical Educators America. (2015). Position statement – Comprehensive school physical activity programs: Helping all students log 60 minutes of physical activity each day. https://www.shapeamerica.org/advocacy/positionstatements/pa/upload/Comprehensive-School-Physical-Activity-Programs-Helping-All-Students-Log-60-Minutes-of-Physical-Activity-Eeach-Day.pdf

Society of Health and Physical Educators America. (2020). SHAPE America national standards and grade-level outcomes for K-12 physical education. https://www.shapeamerica.org/standards/pe

Staiano, A. E., Beyl, R. A., Guan, W., Hendrick, C. A., Hsia, D. S., & Newton Jr., R. L. (2018). Home-based exergaming among children with overweight and obesity: A randomized clinical trial. *Pediatric Obesity*, *13*(11), 724-733. doi: 10.1111/ijpo.12438

Street, T. D., Lacey, S. J., & Langdon, R. R. (2017). Gaming your way to health: A systematic review of exergaming programs to increase health and exercise behaviors in adults. *Games for Health Journal, 6*(3), 136-146.

Sun, H., & Gao, Y. (2016). Impact of an active educational video game on children's motivation, science knowledge, and physical activity. *Journal of Sport and Health Science, 5*(2), 239-245. doi: 10.1016/j.jshs.2014.12.004

Temlali, T. Y. & Jemni, M. (2017). Effects of different types of exergaming on physiological responses in different age groups any good for countries with hot climates? Literature review. *Obesity and Control Therapies, 4*(3), 1-10.

U.S. Department of Health and Human Services. (2017, January 26). Facts and statistics: Physical activity. https://www.hhs.gov/fitness/resource-center/facts-and-statistics/index.html

U.S. Department of Health and Human Services. (2020, March 26). Obesity and Hispanic Americans. https://minorityhealth.hhs.gov/omh/browse.aspx?lvl=4&lvlid=70

U.S. Department of Health and Human Services. (2018). Physical activity guidelines for Americans (2nd ed). https://www.cdc.gov/healthyschools/physicalactivity/guidelines.htm

Woods, A. M., Bolton, K. N., Graber, K. C., & Crull, G. S. (2007). Influences of Perceived Motor Competence and Motives on Children's Physical Activity. *Journal of Teaching in Physical Education, 26*(4), 390-403.

Zhang, T., Moore, W., Gu, X., Chu, T. L., & Gao, Z. (2016). Promoting children's physical activity in physical education: The role of active video gaming. *JTRM in Kinesiology*, 1-13.