

## Effects of Active Video Games on Parental Support among Overweight and Obese Adolescents in China: A Pilot Study

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### Abstract

The purpose of this study is to explore the effect of AVG intervention on the parental support of overweight and obese male adolescents under a family-based parental involvement model. A cluster randomised controlled trial (C-RCT) was conducted with 12- to 14-year-old participants, divided into three groups: (1) Parental Involvement in Active Video Games (PIAVG), (2) Single Player Active Video Games (SPAVG), and (3) Control (watching TV-WTV). The intervention lasted for two weeks, during which changes in parental support levels were assessed at baseline and post-intervention. No significant changes were observed within the three groups. However, notably, the PIAVG group demonstrated slightly improvement in the measured outcomes than the WTV group in the inter-group comparison, but it has no statistical significance. The findings suggest that parental involvement in active video games enhances the effectiveness of such interventions, leading to better parent-child relationships among overweight and obese adolescents. This underscores the potential for family-based interventions to combat adolescent obesity in this population.

**Keywords:** Active Video Games, Overweight Adolescents, Physical Activity, Parental Involvement, Cluster Randomised Controlled Trial

### Introduction

In recent decades, the prevalence of obesity in children has increased dramatically, as the number of overweight and obese children has risen substantially from 4% in 1975 to 18% in 2016 (WHO, 2021). Recent estimates report that more than 330 million children and adolescents aged 5–19 years were overweight or obese in 2016 (2018 Global Nutrition Report, 2018). Overweight and obesity among adolescents increase the risk of obesity in adulthood (Yuca et al., 2017) and are associated with cardiovascular diseases and long-term complications (Llewellyn et al., 2016). At the same time, overweight and obesity, as the main risk factors for chronic diseases, will also lead to long-term morbidity and early death in adulthood (Robinson et al., 2014).

Previous studies indicated that, compared to unhealthy and damaging parent-child relationships, individuals with intimate and positive parent-child relationships have significantly exhibited higher levels of psychological health (Hazel et al., 2014). However, with the advancement of technology, the use of screen media such as televisions, computers, and screen-based devices is becoming increasingly widespread. The frequency and duration of contact between adolescents and electronic devices have significantly increased, resulting in varying degrees of impact on their academic performance and exacerbating parent-child conflicts (Song et al., 2022).

Among the psychosocial factors that influence children's PA, parental support plays a vital role in promoting and shaping their children's behaviours. Studies have shown that parents' support for PA is positively associated with children's PA (Y. Liu et al., 2017; Hong et al., 2020; Kellou et al., 2014). However, Amid the COVID-19 pandemic, many parents experienced disruptions to their socioeconomic status (SES) due to unsteady employment and uncertain income. The disturbances were associated with declining mental health, insufficient sleep, and disruptive conduct in children's health, resulting in varied degrees of reduced parental support for physical activity (X. Zhang, 2022; Bates et al., 2021).

Thus, this research aims to provide insights that can inform evidence-based interventions for addressing overweight and obesity in male adolescents in China. By clarifying the effects of parental involvement in AVG play, the research intends to contribute to developing strategies that empower parental support of overweight and obese adolescents in China, promoting healthier lifestyles.

## **Materials and Methods**

### *Study Design*

The research design was based on a Cluster Randomized Controlled Trial (CRCT). This true experimental design consists of two intervention groups: parental involvement AVG play (PIAVG) and single-player AVG (SPAVG), and one control group: watching television (WTV). Clusters were composed of the three middle schools randomly selected from six middle schools in Jiaozuo City, China, with students ages 12 to 14 years.

### *Participants*

For this trial, overweight and obese male adolescents were enrolled in the three designated middle schools in Jiaozuo, China. There are three steps to screening participants to evaluate the eligibility of potential participants. First, overweight and obese male adolescents were recruited via word of mouth and referral from the school-based wellness clinic and physical education teachers since the clinic has physical examination data for each student. At the same time, physical education teachers can determine overweight and obese students through observation. Secondly, the research asked the participants and their parents through decided inclusion and exclusion criteria. The details are shown in Table 1.1.

Table 1.1

*Inclusion and Exclusion Criteria*

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**Inclusion Criteria**

- (a) The family needs to install a TV and 2-3 meters of open space in front of the TV;
- (b) The family has never purchased a game console similar to AVG before;
- (c) Ensure that at least one parent has enough time to accompany his or her child to complete the experimental task;
- (d) The students' BMI percentile should be more than 85;
- (e) There are no other sports besides daily physical activities;
- (f) The age of the experimental subjects should be 12-14 years old.

**Exclusion Criteria**

- (a) Having self-reported physical and/or mental disabilities;
  - (b) Contradictions to PA participation as determined by PAR-Q responses;
  - (c) Relevant weight loss drugs taken within half a year;
  - (d) Single-parent family;
  - (e) Having motion sickness reaction when exercising under AVG based condition.
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Once the student meets all the criteria above, the participant is confirmed in this study. Subsequently, complete the informed consenters. Subsequently, participants received a link to rent AVGs online, according to the required brand and model. Finally, the researcher will refund everyone's rental fees to the participants. The minimal intended study sample size of 24 participants starting with the training program was based on similar feasibility studies (Nawaz et al., 2016; Wüest et al., 2014).

**AVG Intervention**

The intervention protocol was developed using past research. Additionally, six experts reviewed and validated the intervention protocol. The type of intervention programme includes PIAVG, SPAVG, and WTV. The final part is intervention validity. This section presents the chosen measurements. It mainly contains one instrument called the Nintendo Wii. This intervention lasted for two weeks, thrice weekly, 30 minutes per session. Based on the article (Hwang et al., 2019), according to the characteristics of the Nintendo Wii, to increase the subject's compliance with the game and maximise the training effect, each gaming session consisted of upper body, cardio, and sports games (Staiano et al., 2013). Routines were pre-determined and varied daily, gradually increasing in difficulty throughout the program. AVG participants were tracked for individual progress in the two experimental groups by earning points, continuously reported by the Wii console as the participants played. After each game session, the participants can take photos, record the current game's data through the TV screen, and send it to their WeChat group. The control group was informed to engage in 30-minute TV-watching behaviour thrice weekly.

**Measurements**

**i. Height and weight.** Height and weight were measured using a wall-mounted stadiometer and calibrated scale. Two measurements were taken for each variable to the nearest 0.1 unit, with a third measurement taken if there was a greater than 0.5-unit difference. The website calculated the BMI percentile (*Baylor College of Medicine, 2020*).

**ii. Age.** The age calculation is based on each subject's ID card date.

**iii. Parental Support (PS).** Parental support. Parents' specific support for physical activities includes five items: encouragement for their children to participate in physical activities,

evaluation, providing convenient transportation, participating in sports with their children, and watching (accompanying) their children's sports. Each item is scored according to the weekly frequency, and all the items are rated using a 5-point Likert scale transformed into a 1-5 scale (never=1, one time=2, 2-3 times=3, 4-5 times=4, and 6-7 times=5). Add the scores for each question, the total score for parental support, and the total score range of 5-25 points. The higher the score, the more parental support, and vice versa. The Chinese version of the scale of parental support is a subscale of social support (Prochaska et al., 2002) and was also found to have good reliability. The Cronbach's  $\alpha$  value is 0.830 (Yang et al., 2019).

### **Statistical Analysis**

The study collected data primarily through statistical analysis and descriptive analysis. All quantitative data were collected during the experiment and analysed using SPSS software (version 23; IBM Company, Chicago, IL, USA). Statistical significance was determined using two-tailed p-values at the 0.05 alpha level. Data cleaning and hypothesis testing were performed before analysis. Researchers use descriptive techniques for quality checking, including identifying missing data, outliers, and coding errors. All variables were analysed using descriptive statistics. Means and standard deviations (SD) or medians and interquartile range (IQR) were used to describe continuous variables (according to their distribution), and frequency and percentage were used to describe categorical variables. It is helpful to define each variable individually, including its characteristics, demographic data, and research variables.

Before data analysis, group homogeneity was assessed using a one-way ANOVA for continuous variables. Standard empirical statistical test rules for normality ensure that the P-value in the Shapiro-Wilk test is more significant than 0.05 (Jurečková & Pícek, 2007). In the pre-test, the data were checked for homogeneity of variances using Levene's test. A generalised estimating equation (GEE) model evaluated intervention programmes' effectiveness on dependent variables. GEE extends the logistic regression model to allow for clustering (Peters et al., 2003). This study illustrates the longitudinal data analysis on physical activities among male overweight and obese adolescents using GEE under various intervention correlation assumptions.

### **Results**

#### *Primary Outcomes*

Before testing the research hypotheses, a one-way ANOVA was used to determine the homogeneity of the research variables for all groups. This included demographic variables such as age, height, weight, BMI percentile, and PS. According to the results, there were no significant differences among groups at the pre-test for all research variables ( $p > 0.05$ ). See Table 1.2 for details.

Table 1.2

*Mean Comparison among Groups for Demographic Variables and Parental Support in Pre-test (Mean, SD)*

Variables	PIAVG n=8	SPAVG n=8	WTV n=8	F-value	P-value
Age	12.56 (0.548)	12.73 (0.588)	12.45 (0.702)	0.135	0.824
Height	159.48 (3.548)	158.41 (3.218)	159.46 (2.837)	0.015	0.896
Weight	57.991 (2.372)	57.427 (1.872)	57.112 (2.421)	0.757	0.329
BMI percentile	88.861 (2.252)	89.400 (1.660)	89.526 (1.637)	0.345	0.583
PS	6.721 (1.345)	6.685 (1.478)	6.721 (1.521)	0.623	0.631

### Evaluating the Effectiveness of the AVG Intervention on PS among Groups

The effects of PIAVG, SPAVG, and WTV on PS were observed through the PS scale. A GEE technique was applied to test whether there is a statistically significant difference among groups across time. Descriptive data (mean and standard error) for PS levels are shown in Table 1.3.

Table 1.3

*Descriptive Statistics (Mean and SE) of PS among Groups Across the Time*

Variables	Time	PIAVG	SPAVG	WTV
PS	Pre-test	6.721 (0.263)	6.685 (0.301)	6.721 (0.365)
	Post-test	6.810 (0.308)	6.658 (0.368)	6.645 (0.346)

PS - Parental Support.

The main effect of group and time on the level of PS ( $\chi^2=2.861$ ,  $p=0.288$ ,  $\chi^2=3.256$ ,  $p=0.353$ ) was not statistically significant, and the interaction between groups and time (group\*time) on PS was still no significant difference ( $\chi^2=2.182$ ,  $p=0.061$ ), showing that groups had no significantly different pattern over time. The details are shown in Table 1.4.

Table 1.4

*Results of GEE on LTS and PS Score*

Variables	Source	Wald Chi-Square	df	p-value
PS	Group	2.861	2	0.288
	Time	3.256	2	0.353
	Time*Group	2.182	4	0.061

Note. \* Mean difference is significant at the 0.05 level.

The post hoc test (Bonferroni) was applied to determine the differences in PS among three groups of overweight and obese male adolescents across time (Table 1.5). There was no statistically significant change among groups between the pre and post-time for PS. The p-values are all greater than 0.05.

Table 1.5

*Pairwise Comparison of PS Mean Score across Time for Three Groups*

Variables	Group	Time	Mean Difference	SE	p-value	95%CI	
						Lower	Upper
PS	PIAVG	Pre-Post	0.274	0.676	0.071	-0.752	0.796
	SPAVG	Pre-Post	0.102	0.531	0.238	-0.266	0.355
	WTV	Pre-Post	0.126	0.205	0.397	-0.310	0.542

Note. \* Mean difference is significant at the 0.05 level.

The Post Hoc (Bonferroni) test was applied to compare the mean value. The results are summarised in Table 1.6. No significant differences were seen for PS among groups at the pre-test ( $P > 0.05$ ). While at the post-test, one significant difference was seen between PIAVG and WTV ( $P = 0.021$ ).

Table 1.6

*Pairwise Comparison among Groups at Pre-test and Post-test for PS*

Variables	Time	Between Groups	Mean Difference	p-value	95%CI	
					Lower	Upper
PS	Pre-test	PIAVG vs SPAVG	-0.494	0.487	-1.151	0.565
		PIAVG vs WTV	-0.368	0.365	-1.344	1.467
		SPAVG vs WTV	0.584	0.272	-0.567	1.323
	Post-test	PIAVG vs SPAVG	0.072	0.365	-1.488	1.336
		PIAVG vs WTV	0.476	0.081	-0.408	1.542
		SPAVG vs WTV	0.612	0.536	0.548	1.865

Note. \* Mean difference is significant at the 0.05 level.

## Discussion

The PS results showed improvement in all the intervention groups. Within-group comparisons revealed no different effects on PS among groups over time. The following discussion presents a more reasonable explanation.

Several previous studies have different results from this one. AVGs as a family activity highlight their role in increasing motivation and engagement in physical activity and fostering positive family interactions and support (Rhodes et al., 2018). Similarly, after a four-week parental involvement AVG intervention, the adolescents with autism in the experiment group showed a significant effect on PS (Hatfield et al., 2023). One study reported that playing AVGs with siblings or parents could promote parental and peer support, thereby improving physical activity (Marker & Staiano, 2015). Another study about an eight-week AGV intervention in a school setting indicated that the AVG experiment group significantly affected teacher and parental support (Vernadakis et al., 2015).

In addition, although some studies have not directly demonstrated the effect of AVG intervention on parental support, variables related to it (such as peer support and social support) may support the results of this study. After a 20-week group-based AVG intervention, the overweight and obese adolescents showed a significant difference in peer support (Staiano et al., 2013). Similarly, after a 12-week group-based AVG intervention, the overweight and obese girls showed substantial differences in peer support (Ae et al., 2018). On the other hand, based on the school setting, a study about a 9-month AVG intervention

also reported that the experimental group showed a significant difference in social support after the intervention (Gao et al., 2019). Although the current volume of literature on parental involvement in AVG is small, both AVG and group-based AVG hold promise as engaging alternatives to traditional physical activity interventions and may promote positive outcomes in PS for children and adolescents in home settings. Based on the above discussion, the reason for the results of this experiment may be due to the short experimental period. Therefore, similar studies in the future may discover significant effects in more extended periods.

Notably, although AVG has many positive effects that can provide parental, peer, and social support, based on the nature of AVG, there are inevitably some concerns about AVG from parents, such as children's addiction to games, violent content, and safety in AVGs (McMichael et al., 2020). Therefore, in future research on the impact of AVG intervention on adolescents, the researchers should fully consider parents' concerns, strictly control the experimental process, and cautiously choose game content to minimise adverse effects as much as possible.

### **Limitations**

The small sample size may have restricted identifying substantial training effects when comparing measurements taken before and after the intervention. Nevertheless, pilot studies are specifically conducted to produce initial data that enables establishing systems and protocols for future investigations. Applying the "rule of 12," we can be assured of our values (Moore et al., 2011). Moreover, the training period should be extended in future studies to increase the potential for training improvements.

### **Conclusion**

The results of this study indicate that while there were no statistically significant changes within each of the three groups individually, these findings suggest that parental involvement in active video games should be conducted over longer periods, which may enhance the effectiveness of such interventions. This highlights the potential for family-based approaches to improve parental support outcomes in overweight and obese adolescents.

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### **Conflict of Interests**

The authors declare that there are no conflicts of interest.

### **Author Contributions**

All authors have contributed equally in terms of ideas and preparation of the manuscript.

### **Data Availability Statement**

The datasets used and analysed during the current study are available from the corresponding author upon reasonable request.

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