Children and Video Games:
An Extensive Look At Health & Nutrition Interventions

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Senior Thesis
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April 17, 2022
Abstract

This paper takes a deep dive into the ways children can learn about nutrition and exercise, finding that SES and social relationships and environments were some of the most important factors that affected a child’s learning. Then the paper takes a look at interventions for both nutrition and exercise, looking for common themes and gaps in the literature, finding that interventions are the most effective when they provide access to resources and addresses the previously mentioned learning factors. On the other hand, some setbacks are that most of these interventions don’t do much outside of the school environment and most of the effectiveness depends on the child and if they are interested in these interventions or not. The thesis closes with a discussion of video games being a very effective intervention that can cover most of the problems that normal interventions have, but problems arise through balancing entertainment and education for nutrition video games and conflicting reports on issues of exercise intensity for exercise games as well as overall cost and technical issues for all types of games. Overall the thesis concludes that nutritional interventions are effective when they involve both education and access to resources, exercise interventions are effective when they keep the child engaged in exercise, and video games can be a way to address the problems with current health interventions.

*Keywords: Nutrition, Exercise, Video Games, Children, Socioeconomic Status*
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Nutrition and exercise have always been vital subjects to teach children about. Establishing a healthy diet and a physically active lifestyle early on in their lives would greatly improve their physical and mental health, as many studies have shown. On top of that, studies have also shown that better nutrition can also lead to better academic performance as well. A study by Glewwe and colleagues (2001) analyzed 3289 children from the Cebu Longitudinal Health and Nutrition Survey (CLHNS), comparing their “nourishment levels” with their schooling levels, grades, and times held back or delayed enrollment, and found that better nutrition led to better academic performance. In terms of exercise, Kall and colleagues (2014) showed that taking part in school exercise programs led to higher levels of academic success by comparing math and English grades for 5th grade Swedish students who did or didn’t take part in their school’s exercise program. There are many ways that children are taught nutritional behaviors like meal portioning and food groups and exercise behaviors such as exercise plans and efficient exercise routines for calorie burning: school and government programs, national actions and reforms, and even video games. But before I delve deeper into how nutrition and exercise programs can help children learn and establish good habits, knowledge on how they learn these thoughts and behaviors should be established.

How Do Children Learn About Health Behaviors?

The first way that children can learn is through parental influence and other social group factors. In a study done by Kiuru and colleagues (2012), they performed a longitudinal study with 864 Finnish students, their parents, and their teachers from the First Steps Study inquiring about their teaching styles to see what kinds of interaction styles from parents and teachers are
the most effective for educating children, using their reading and spelling grades as a measure of success. More specifically, they wanted to see if authoritative parenting, the parenting style where they demand a lot for their child while also giving them the same amount of love and affection. Their findings showed that authoritative parenting was a great predictor of higher development of spelling skills (Kiuru et. al, 2012). Thus, high quality parenting can contribute to more successful learning in children, which can relate to more successful learning about nutrition and exercise.

The next way that children can learn about these health habits is through structural factors like socioeconomic status (SES). Naturally, SES shapes the learning environment for a child. For example, some aspects of the learning environment that can help influence how children learn are learning locations, access to certain buildings, services, and facilities, and the people they learn from. Fernald and colleagues (2012) observed how SES can affect how children learn about nutrition specifically by performing a literature review focused on the relationship between SES levels and health outcomes as well as results from a survey they administered to families in Senegal, Peru, India, and Indonesia inquiring about their children’s success and development. They found that overall, wealthier families and homes that are more involved in the children’s learning are related to better development (Fernald et. al, 2012). This shows the importance of SES as well as reinforcing the importance of familial involvement in a child’s learning and development process.

One more interesting finding is that screen time can also be an important aspect of learning for children. In this age where children are becoming more engaged with digital media through iPads and iPhones, being able to control the amount of screen time children devote to learning and education becomes much more important. Monteiro and colleagues (2022),
examined the effects of screen time on learning and development and recorded the views of parents and teachers on the amount of screen time children receive and how it affects their learning. After interviewing 9 teachers and 266 parents from Portugal, they found that TVs, smartphones, and tablets were the screens used the most, with children spending about 1-2 hours on the TV on weekdays and over 2 hours on the weekends (Monteiro et. al, 2022). They also found that teachers tend to believe that the amount of screen time was more distracting and made it harder for children to learn a language (Monteiro et. al, 2022). This shows that screen time has become a more prominent source of engagement for children and is something that I believe should be taken advantage of when considering ways of educating children.

Now that I have covered some background information on the role that quality parenting, SES, and screen time have on child learning, I can now focus more on their specific effects on learning nutrition and exercise. More specifically, I will be observing how children learn about both of these aspects of health. Then, I will focus on a deep analysis of the current programs that promote the education of nutrition and exercise. From there, I move onto a deeper dive into the idea of educational and exercise video games to find out the cost and benefits of these games. After that, I point out some gaps in research for these games as I then propose a game that can address these gaps and improve on the current games.

**Nutritional Knowledge Is Key**

**The Power Of SES and Social Relationships**

Starting with nutrition, we can review how children learn and establish their knowledge of nutrition and healthy eating. Looking at the previously mentioned literature review by Fernald and colleagues (2012), they found that factors such as familial wealth as well as familial involvement in the child’s learning both positively affect how children develop. The significance
of these results shows us that these considerations are needed in order to teach children about nutrition. More specifically, they found that children from wealthy households had higher development scores and better growth score variables compared to children in poorer households (Fernand et. al, 2012). From these results, they concluded that and proposed that some factors that contributed to these results are inappropriate feeding, unsafe foods, and lower access to healthy foods (Fernand et. al, 2012). What this shows us is the factors that can explain why those with higher SES have more academic success and can likely healthier nutrition habits (Fernand et. al, 2012). All of this, however, would likely hinge upon the amount of attention the parents and family pay to their child’s nutrition by making sure they eat the right foods in the right amount.

A literature review by Black and colleagues (2020) carefully analyzed SES and how it can affect children’s nutrition as well as development. They found that some of the most important SES factors were poverty and food insecurity, where a lack of funds to buy healthy food or a lack of stores that have fresh and healthy foods in stock constantly are factors that can severely hinder a child’s nutritional habits as well as their development (Black et. al, 2020). From there they discussed possible solutions to solve this problem for the entire family, helping not only the children with their nutrition and development, but also the parents with giving them ways of affording the healthy foods needed as well (Black et. al, 2020). One of the solutions that they proposed involved establishing a “social safety net”, which is just another name to describe financial assistance for families with a lower SES with access to housing, food, education, and health care, and giving parents easier access to childcare services (Black et. al, 2020). What this shows is that SES cannot be ignored as a factor and a barrier for resources that would otherwise help children develop healthy nutritional habits.
What Makes A Nutritional Intervention Effective?

First off, we need to see what sorts of interventions are the most effective. A literature review conducted by Van Cauwenberghe and colleagues (2010) on 42 studies completed in the E.U. concluded that for children, interventions that combine both an educational component to establish healthy dietary patterns as well as a component that supplies children with access to healthy food needed to reinforce their learning are the most effective types of interventions. However, for adolescents, they found that educational interventions alone were effective enough, but ones that also involved shaping school lunches to fit the dietary behaviors being taught as well as better access to healthy foods contribute to increasing the effectiveness of nutritional interventions in children (Van Cauwenburghe et. al, 2010). What this shows us about nutritional interventions is that the mission is not just to educate them, but to set them up for success and reinforce their learning outside of the school environment. They also support the idea that SES is an important factor because programs that have a component that provides children with more ways to get healthy food are more effective (Van Cauwenburghe et. al, 2010). Another literature review that supports this idea was done by Westenhoefer and colleagues (2001) that analyzed the aspects of health interventions that were the most effective. They found that the most effective interventions were those that introduced a variety of foods and nutrients, which gives children a sense of choice (Westenhoefer et. al, 2001). They also found another aspect that was likely to shape a child’s nutritional development: the social landscape, or a child’s social relationships and influences, help shape a child’s nutritional development. I will now use these results and consider the types of interventions involved with the education of nutrition for children. I will start with an analysis of national and government interventions and end with an analysis of more person-based and personal nutrition interventions, covering a broad range of interventions.
An Introduction to Nutritional Interventions

The National School Lunch Program, or NSLP. This is a government program that helps children maintain a healthy diet in school by providing schools enlisted in the program with nutritionally balanced lunches at a reduced or no cost to students (https://www.fns.usda.gov/nslp). Gleason and colleagues (2003) analyzed the effectiveness of this program and wanted to see if the NSLP was actually as effective as intended. In their study, they analyzed responses from a 3-year-span of the Continuing Survey of Food Intakes by Individuals (CSFII) from 1994-1996 to see if participation in the NSLP was related to certain levels of fat, sugar, and calorie intake (Gleason et. al, 2003). The main trends they saw from their analysis were that participation in the NSLP was significantly negatively correlated with added sugar intake and significantly positively correlated with vitamin and mineral intake with nutrients such as Vitamin B12 and Calcium (Gleason et. al, 2003). Another national program that helps provide children with healthier school lunches is the Let’s Move Salad Bars to Schools program (LMSB2S), which is a program that works with Michelle Obama’s Let’s Move exercise campaign that gives children access to a better variety of fruits and vegetables by introducing salad bars to school cafeterias. Through a literature review, Harris and colleagues (2012) found that this program has potential in terms of promoting healthy eating by giving over 70,000 school-children easier access to a variety of fruits and vegetables. Even though this shows how important providing access to healthy and affordable foods is to the success of these nutrition interventions, there are still problems that remain when it comes to the child’s participation, ultimately determining how effective interventions will be.

One such issue would be the idea that kids still have control over what they eat, so they can pick and choose parts of the meal they want to eat or throw away. This is what Smith and
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colleagues (2014) were wondering when they studied the amount and types of food waste from elementary and middle school lunches in Colorado (Smith et. al, 2014). They took note of food choice by seeing what percentage of students took certain pre-packaged lunch foods and measured food waste by comparing the weights of the lunches before and after the children eat them as well as comparing pictures of the food before and after consumption as well as taking note of trends involving different food groups by separating the lunches into 5 categories: meat or meat alternative entrees, canned fruit, fresh fruit, vegetables, and grains and milk (Smith et. al, 2014). They saw that canned fruit, fresh fruit, and vegetables were the most wasted foods in the lunch, each having around 30-40% wasted, but the most concerning aspect was how little the students chose to have vegetables in their lunch, with less than 40% of students taking them overall compared to about 75% of students taking canned or fresh fruits (Smith et. al, 2014). Another interesting finding was that the most commonly picked food was milk due to there being flavors of milk such as chocolate or strawberry (Smith et. al, 2014). What this shows us is that just educating children and giving them a choice might not be enough because the school environment might not be doing enough to help encourage children to make healthy food choices, which is where another government intervention tries to remedy.

The last government-based intervention that we will discuss is the MyPlate Program, which is an initiative that helps children with meal portioning through helpful diagrams and phone apps that assist with portioning (https://www.myplate.gov/eat-healthy/what-is-mypate). The difference between this and the previously mentioned government interventions is that MyPlate gives children the direct power to control and portion their meals outside of the classroom. Metzler and colleagues (2018) tested the MyPlate program to see if these claims were true by having students take the Discovering MyPlate program that teaches them about food
groups and portioning for 30-minute increments for 5 days, finding that MyPlate was effective in teaching children about nutrition itself, but the effectiveness of MyPlate programs related to nutritional behaviors and dietary habits remains to be seen (Metzler et. al, 2018). What this shows is that the MyPlate program can help by providing children with more education and the potential of the MyPlate phone apps and programs is a promising sign for developments, but the issue of gaining and maintaining children’s interest in these programs are still present.

Now moving to a more local or community-based set of interventions, one of the first types of interventions that might come to mind are school health fairs since it focuses on providing help and education to one specific area. A policy brief by Freedman and colleagues (2010) detailed how health fairs can be effective ways of teaching children about nutrition and exercise by observing the amount of knowledge gained by 267 student participants, quizzing them on their ability to identify vitamins and minerals, to know how to portion meals, and to balance their energy, all of which was taught by the health fairs. Because the results show that the health fairs were effective, it shows that they can be considered as a valid intervention due to being a condensed and engaging form of education that children find fun, but the problem still lies in maintaining their learning over time (Freedman et. al, 2010). One possible solution to the engagement issue is video game-based interventions.

Video games were initially not considered to be a tool for education, but through early attempts like the Magic School Bus and Carmen Sandiego series to games like Brain Age, educational video games have created their own market with websites like abcmouse.com and consoles and games made by companies like Leapfrog and VTech. With this in mind, we can reasonably assume that there are games available or in the works that can help with educating children. Froome and colleagues (2020) proposed one such idea with their “Foodbot Factory”
game where children play games consisting of quizzes, food logs, games within games, and humorous dialogue to keep children engaged and teach them about the different food groups. They allowed children to play each module for 10-15 minutes each day for a total of 5 days and measured their opinions and reviews on the game, showing that the “Foodbot Factory” game has potential to teach children about nutrition where those who played the game showed significantly more nutritional knowledge than those who didn’t (Froome et. al, 2020). Upon further analysis of the game, there needs to be more research on the long-term effects of the game and its effects on learning about nutrition due to the issue not being addressed by the researchers. With this in mind, we can see that keeping children engaged is the key, which can be done by making the game more “fun” or entertaining.

Another game called Monster Appetite by Hwang and colleagues (2012) taught children how to build healthy meals that fit a calorie limit in order to help their virtual monster be fed and healthy. They found that through early testing of their game that involved them answering questions about the game and reviewing it, the overall reception was positive, but there were criticisms on technical issues, clearer instructions, more levels, and inclusions of more types of foods and nutritional facts (Hwang et. al, 2012). The results from this study showed that there is potential in these types of nutrition video games for mobile phones and other portable means because of the types of technological advancements that could be implemented to improve these games such as QR code technology and social-networking components (Hwang et. Al, 2012). In conclusion, video games might fall into the same trap of not keeping children engaged, but developers can consider the opinions of parents, teachers, and children in order to improve the games to make them engaging and educational in the long term as well as using new technological advancements.
The Power of Exercise

Now I move from considering health education to considering exercise education and interventions. From here, I will now look at research that helps us understand how children learn about exercise habits. Then I will shift the focus once again to interventions, starting with national or government-based interventions to community-based interventions before ending with more personal interventions.

Determinants of Exercise Activity/Learning

As mentioned in the introduction, societal factors were important for children’s learning. The previously mentioned Stuckyropp and DeLorenzo (1993) study that examined exercise habits in children found that parents reported that the social determinants such as familial influences were the most important and most effective predictors of exercise. They also found that out of the social determinants studied, the most significant ones were general self-efficacy and friend influence were positively correlated with increased physical activity (Stuckyropp & DiLorenzo, 1993). However, this study was based on cross-sectional data so the long-term impacts of social determinants of exercise have been less well-understood.

Next, Stuckyropp and colleagues (1998) interviewed 121 mother-child dyads asking about the childrens’ exercise habits and how these habits developed over 1-2 months. What they found was that once again, social determinants such as familial influence were statistically significant in predicting the development of healthy exercise habits such as increased exercise knowledge and increased self-efficacy for exercise (Stuckyropp et. al, 1998). They also discovered a new predictor variable of child’s enjoyment/appraisal on exercise habits; for example, the child’s appraisal of exercise being more positive (relative to negative) predicted higher levels of physical activity (Stuckyropp et. al, 1998). Lastly, they saw that the longitudinal
results showed that the most important factors and predictors of exercise in children were social support and group participation compared to access to home equipment and parent enjoyment of exercise (Stuckyropp et. al, 1998). With this information on how children learn about exercise established, I will now move onto analyzing the different exercise interventions available.

**Nation-wide Interventions**

Starting with a wider and national scope on interventions, I next look at government interventions that have been established that try to promote a healthy lifestyle for children. First, there is the NFL Play 60 program, which was launched in 2007, which has contributions from the National Football League (NFL) that total up to around $352 million for Play 60 programing which has provided over 73,000 schools and 38 million children with access to health resources that help boost their activity levels ([https://www.nfl.com/causes/play60/](https://www.nfl.com/causes/play60/)). There are also multiple studies that sought to analyze the effectiveness of this program as well.

The first study I will be looking at comes from Welk and colleagues (2016) where they looked at the effectiveness of the program. For the study, they had students take part in a 4-week fitness program offered by the NFL and its 32 teams where the students participated while their calorie intake and physical activity were measured (Welk et. al, 2016). They found that there were links to participation in the program and healthier habits, but there was much more research that needed to be done in order to confirm the effectiveness of the Play 60 program, especially when considering other variables such as teacher influence (Welk et. al, 2016). This is where the study by Saint-Maurice and colleagues (2017) steps in. Their study shares a very similar procedure to the Welk study, but instead, they decided to research the effects of the Play 60 program on BMI for the students (Saint-Maurice et. al, 2017). From this, they found that children
who took part in the program were much less likely to have a BMI that needed improvement or was a health risk, showing that the Play 60 Program in this case.

In general, the common themes surrounding the Play 60 Program show that the program builds its merit on building a consistent exercise routine for children through encouraging them to engage in physical activity for at least 1 hour every day. With results that showed that program participation was related to a healthier BMI and higher levels of physical activity, meaning that the Play 60 program is an effective intervention for encouraging children to develop healthy exercise habits and maintaining them over a long period of time, but not as effective for teaching children about different ways to exercise and how to do them (Welk et. al, 2016; Saint-Maurice et. al, 2017).

Another national intervention that tackled exercise in children was the Let’s Move Campaign that was established by Michelle Obama in 2010. This program focuses on not only educating the children on healthy habits, but also teaches the parents how to help their child with learning as well (https://letsmove.obamawhitehouse.archives.gov). A literature review by London and colleagues (2011) showed that the Let’s Move Program was effective by showing that participation in the program led to better health outcomes and better fitness levels through lower levels of sedentary behavior and higher levels of physical activity. What this means is that the Let’s Move program was able to help children establish healthy exercise behaviors from their study (London et. al, 2011). However, there are studies that point out some gaps in the program that could affect the effectiveness of the Let’s Move program.

Wojcicki and colleagues (2010) performed a literature review to analyze the Let’s Move program, specifically looking at certain groups of people who might not receive enough help from the program. They found that overall, the program is effective in helping children establish
healthy exercise habits, but there were groups that still needed help such as pregnant-women, infants, and pre-school children (Wojcicki et. al, 2010). What this tells us is that the Let’s Move program should expand its target population to include the other age groups that are children who aren’t just elementary school students, giving preschoolers a head start on establishing healthy behaviors as well. Pregnant women also were identified as a group to focus on because being educated on how to teach their children to be healthy is important for the same reason: children can get a head start on establishing good exercise habits.

**Community-Based Interventions**

Next, I look at another type of intervention, the community-based programs that focus on reaching children and their families on a more local level. From here, I analyze a local Let’s Move program from the Southern US that focused on encouraging physical activity. In this literature review conducted by London and colleagues (2011), they reviewed a variety of programs and their effectiveness and found that interventions that were mainly focused on after-school fitness programs involving engagement in physical activity compared to those that teach them about exercise were able to predict better health outcomes for children as well as participation increasing the likelihood for establishing good fitness habits. What this shows is that more locally based interventions for fitness education are very effective and also valid options for fitness education in children. From here we take a quick look at more personal interventions, which involves an intervention we will take a deep look at later: video games.

**Video Games as a Possible Intervention?**

Video games that promote and involve physical activity and exercise, which are also called exergames, are viable ways of establishing healthy exercise habits.
I start with looking at the benefits of exergames. First, a study by Barkley and Penko (2009) examined the effectiveness of exergames like Wii Sports compared to “regular” exercise methods like walking on a treadmill. They had 12 adults try each of 3 exercises: Wii Sports Boxing, walking on a treadmill, and playing regular video games (Barkley & Penko, 2009). After measuring their heart rates and other vitals, they found that Wii Sports Boxing was a very effective exercise alternative to walking on a treadmill due to Wii Sports having results that show a higher HR compared to the other exercises, but another important result shows that they also gauged preferences and showed that Wii Sports was personally preferred over the treadmill exercises (Barkley & Penko, 2009). Another study that looked at the personal preference was from Gao and Zeng (2010) when they specifically reviewed literature to examine the effectiveness of exergames, where they found that exergames promoted a healthier lifestyle, greater psychological well-being as well as improved energy expenditure and motor coordination. This shows that once again, there are physical and psychological benefits for exergames. Fogel and colleagues (2010) also tried to see if exergames were able to help inactive children with establishing exercise habits by observing 4 children in a Southern elementary school and recording time spent on the games and exercises as well as student and teacher testimonials. They found that exergames were related to more physical activity overall, giving them more opportunities to engage in physical activity, and was the universally preferred exercise method (Fogel et. al, 2010). Lastly, Gao and Zeng (2014) performed a literature review that showed that exergames appeal to children and help entice them to exercise through games, but questions the possible lack of intensity, which leads into another discussion on some drawbacks for exergames.
A lot of early research showed that there were doubts on whether or not the exercises were intense enough to replace regular exercise and the conflicting results from different sources. One example is a literature review done by Rizzo and colleagues (2011) that found that most of the early research that was done on these exergames suggested that they were not intense enough to substitute for regular exercise. Del Rio and colleagues (2018) also showed that the main benefits of a gamified exercise program were general positive feelings towards the games, a decrease in social stress, and better feelings of control and responsibility for life issues relating to exercise and weight by having 45 obese children take part in a gamified exercise and nutrition program and recording activity levels and their thoughts. There is also conflict regarding some of the previously mentioned results when Sween and colleagues (2014) showed that there was a strong positive correlation between exergaming and energy expenditure with their results showing that there are certain types of video games that can meet the criteria of being intense enough by the American College of Sports Medicine. An example of the video games they deemed intense enough were dancing games and exercise video games on the Nintendo Wii (Sween et. al, 2014). All this shows that even though there is a lot of research being done on exergames, there needs to be more definitive results that can show us a common trend for the relationship between exergames and energy expenditure for us to consider it a worthwhile substitute for regular exercise.

Considering all of the research done on how children learn about health and nutrition as well as a brief look into the interventions available to each, we can now take a deeper and more analytical look into the interventions to identify gaps and takeaways from each.
A Critical Look at Interventions & Gaps in Their Research

With extensive information on how children learn about exercise and nutrition and how interventions help with educating and establishing healthy habits in children. A deeper analysis on both types of interventions can be done, looking at the beneficial aspects of interventions as well as the gaps and setbacks for many of the types of interventions.

What Makes A Good Intervention?

One of the biggest benefits of interventions is the focus on societal factors and social environment. What we learned from many studies mentioned in this thesis is that SES and other social factors that affect it such as social relationships, parental influence, food security, and home stimulation are all integral to how children learn about and maintain health habits and beliefs (Fernald et. al, 2012; Black et. al, 2020; Stuckyropp et. al, 1998). Another study that adds onto this knowledge is a literature review from Burrows and colleagues (2020) where they set out to find out other factors that can affect how children learn, specifically about nutrition. From their literature review, they found that there should be interventions that also focus on education on ideas like the “ideal body” and the negative connotation that comes from being called “fat”.

There was also a study from Mirtcheva and colleagues (2009) that compared the number of students who participated in the NSLP to the students that were actually eligible for NSLP participation where they found that there was a social stigma associated with NSLP participation because of the fact that lower levels of eligibility, which translated to lower levels of the stigma factor, was statistically significantly associated with lower levels of NSLP participation. What this study showed was that there was an implicit social stigma that likely held certain children back from participating in the NSLP, making it so that social factors even affect the likeliness of someone to get help from these available interventions.
From all of this, what can be inferred is that interventions that shape a child’s social environment in school and home settings can be influential to maintaining the nutrition and exercise habits that they learn. What I mean by this is that for an intervention to be truly effective, it has to address the child’s learning environment. This can be done in many ways, with having educational video integrated into their after-school learning or having applications like the MyPlate companion app that can help with portioning meals in tandem with all of the school fairs and education that children receive in school and from their parents. Another aspect that would have to be considered is the idea that interventions that need to be shaped to consider the social aspects and stigmas associated with health and health interventions. Examples of how that can be accomplished is through teaching children about subjects like body positivity or education on eliminating the negative stigma behind SES and NSLP participation, similar to what was mentioned by Burrows and colleagues (2020).

**Supplies & Resources**

Another important theme that can be found in the interventions is the availability and access to resources that they give children and their families, especially for nutritional interventions. For example, Black and colleagues (2020) showed that food insecurity and poverty are important factors to consider for interventions involving nutrition. This very closely relates to what Cauwenberghe and colleagues (2010) found, which was that nutrition interventions that involve multiple components such as an educational component as well as a component that provides food and other services are the most successful ones for children and adolescents.

What we can imply from these results is the idea that an intervention can truly be successful when it helps provide all of the things that children need to succeed in the interventions, whether it is access to affordable and healthy food for nutrition interventions or
access to gyms, playgrounds, or fitness programs for exercise interventions. This can be accomplished in many different ways for both types of interventions. For nutrition, this can take the form of an intervention that teaches parents and children about how to create a healthy meal plan for the week where they will be given the food needed to make said meals for that week and possibly beyond. Then for exercise, it could be as simple as giving children and adolescents free access to gyms or recreation centers or even providing them with free exercise equipment to use at home in order to help children and adolescents get enough exercise, regardless of SES or other factors. This can take a similar form to what some medical insurance companies already do by providing free gym memberships to encourage patients to exercise more or monthly allowances that can be used to buy fresh fruits and vegetables.

**The Importance of Attention and Interest From Children**

Perhaps one the most prevalent themes that arose from analyzing these interventions was the idea that enjoyment of said intervention has to be considered when creating an intervention because of the fact that children can only learn effectively if they are fully engaged or are enjoying said interventions. A common theme that can be seen with many of the health interventions that were analyzed is that there were short-term effects that show proficiency in learning about nutrition and exercise, but nothing being done to ensure that the child applies their learning outside the classroom or intervention setting. For example, exercise interventions like school health fairs and the NSLP are interventions that are fully based on and revolve around the school environment, making it so children are fully exposed to nutrition and exercise knowledge in school, but after that, there is a lot of variability and uncertainty for children receiving the same amount of care and reinforcement of their learning, if any at all. Studies like the health fair analysis by Freedman and colleagues (2010) as well as all of the previously mentioned NSLP
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studies showed that the programs tend to be effective in helping establish healthy behaviors in a classroom setting, but there were issues that arose in terms of what happens after school. This is where programs like MyPlate come in to try and ensure that children are thinking about how they portion their meals outside of school. Even for exercise programs, having a way to ensure that children have a way to take accountability for exercising at home by encouraging them to maintain an exercise log that tracks their exercise levels.

Agency & Accountability: The Key to an Intervention’s Success

From there we can see that there are more gaps in the interventions that need to be addressed: accountability. Children can learn as much as they want from nutrition classes or do as much exercise in gym class as they can, but how do they apply that learning afterwards? The MyPlate app and exercise logs are helpful for carrying their learning and education outside of the school environment, but keeping them actually engaged and interested in maintaining their learning is easier said than done. This is a case where we see the idea of “easier said than done” in play, where the amount of learning that gets enforced completely depends on the child’s willingness to participate with the interventions after school.

Metzler and colleagues (2018) showed this idea through their study showing that the MyPlate program can be effective for establishing health behaviors in terms of teaching them about the food groups and creating a healthy meal. On the other hand, there were issues that arose where children weren’t able to hone their learning to apply and portion meals outside of school which was suggested by the results that showed that children didn’t show improvements in nutritional behaviors and dietary habits (Metzler et. al, 2018). We can also see a concerning lack of participation in programs like the NSLP too, with the study by Smith and colleagues (2014) showing that children can still waste the healthy food that they are provided through the
NSLP. What this means is that a child’s agency is something we need to consider when creating interventions, as any intervention in an ideal universe, but since children can pick and choose whether or not to fully buy into a program. This can take form in many ways such as a child preferring the taste of unhealthy food over healthy food, societal influences on what foods are good based on what their friends like, or the look and smell of food deterring them from eating certain foods.

**Helping Everyone**

One more gap that I identified while looking through the different studies and interventions is that there is still a lack of coverage for certain groups that might need the help. The Wojcicki literature review (2010) showed that pregnant women, infants, and preschoolers were groups of people that needed help and should have certain services provided for by the Let’s Move program. What this shows is that these interventions should be more wide-reaching and can help with setting up pregnant women with plans to teach their child about nutrition. It also shows that care should be given to infants and preschoolers to help them get a head start on learning about nutrition. What I envision this to look like for pregnant women is counseling and planning for their child’s nutrition, showing them that they can teach children about nutrition and getting them accustomed to eating a healthy diet. For preschoolers and infants, interventions can look like programs that show children that healthy food can taste delicious. Putting the pieces together, a possible idea that can integrate both proposed solutions is a cooking program that teaches children that healthy food can taste good that also teaches parents how to cook those foods and teaches them the recipes, with the ingredients being provided for. Another suggestion for a program is an educational program that teaches children and parents on how to portion and plan meals for the week while also being provided the food necessary to carry out the planning
and portioning. What I had in mind was a program that functioned similarly to the HelloFresh food service that delivers pre-portioned meals that you prepare, but instead of one meal, it would be a week’s worth of meals that the child and their family can eat. This program should also be of little-to-no cost for families with lower incomes or lower SES so that they can have an opportunity at establishing a healthier diet without financial burden.

**Closing Thoughts on Interventions**

In conclusion, health interventions do a lot of good work through educating children about healthy exercise and dietary behaviors. We saw that these interventions help tackle societal and financial barriers such as social stigmas and poverty that might affect their access to resources. We also see that some common benefits of these interventions were easy access to food and resources and an establishment of a good learning environment for nutrition. Even with that there are some setbacks involving certain groups not being helped by these interventions and a possible lack of engagement and enjoyment from the children making the interventions less effective. While that might help, one very big question comes up: “How do we build on the foundations of current interventions to make them seem less like a chore and more appealing and engaging for children?” The answer is something that I mentioned in both types of interventions: video games.

**Video Games… Being Effective Teachers?**

Video games have over time become an interesting case when it comes to its role as a possible health intervention. They have evolved from their reputation as “time-wasters” and the antithesis to healthy living and physical activity to a potentially valuable tool for education. One of the possible reasons why this may be happening is the rise in educational gaming, its increase in popularity, and increasing interest in educational gaming research.
DeVary (2008) takes a detailed look at educational gaming, looking at the benefits and setbacks of educational games as well as the ways video games can be structured to educate children. She found that educational gaming is good for learning a wide array of skills such as critical problem solving and emotional intelligence while passively being taught information and being entertained at the same time (DeVary, 2008). Another important benefit that comes from educational gaming is that children will naturally be interested in video games and will pay more attention compared to other forms of learning and education (DeVary, 2008). This is important because this covers a glaring weakness that many other interventions have: a way to keep children entertained and therefore keeping them engaged with learning. Even with these benefits, there are still some setbacks that were noted.

One setback is the financial cost and burden on those who want to use educational gaming (DeVary, 2008). In order to play most video games, someone would need a console or computer which would, at minimum, cost hundreds of dollars. The games might not be free either, so that would add to the cost even more. If that wasn’t enough of a burden, it would be much harder for schools to justify the cost of teaching children through educational video games since they have to buy enough computers and games for a whole classroom, which can easily cost thousands of dollars. There is also another factor to consider about the cost of educational video games: development and creation. DeVary (2008) found that the cost of development would be an expensive endeavor, citing costs from $500,000 to $2.5 million dollars according to Sawyer in 2004.

Besides that, another downside of educational gaming is the balancing of entertainment and education (DeVary, 2008). Devary (2008) elaborates on this point further by saying that there are many games that prioritize entertainment over education and thus showing us that
educational video games are also a double-edged sword in terms of education and entertainment. What this means is that game developers would need to consider how to balance out the amount of entertainment the children have compared to the amount of material children will learn playing the game. Another related concern was the increased reliance on technology, the undermining of other learning techniques, and the negative effects that can entail (DeVary, 2008). An example of this that was mentioned was the idea that playing certain video games might water down the learning process compared to other learning techniques while pushing parents and teachers to spend more money in order to keep their child learning with new games (DeVary, 2008). With all of these considerations, we can now shift our focus on analyzing nutrition and exercise games specifically.

A Critical Analysis of Video Game Interventions

From looking at all of the video game-based interventions for nutrition and exercise, there are many similarities and differences between the 2. Perhaps the most important difference is the role that the games play in relation to the other interventions. Games that focus on nutritional education usually have the goal of teaching children about nutrition and its different aspects such as the food groups and meal portioning as shown in the “Foodbot Factory” game proposed by Froome and colleagues (2020) or the “Monster Appetite” game by Hwang and colleagues (2012) that helps teach children how to count calories and create healthy meals. These sorts of games serve the role purely as educational games, focusing on teaching children about nutritional topics and applying their knowledge practically by helping them create a healthy meal and considering calorie counts in the process. On the other hand, exercise games are much more focused on entertainment over education since their main goal is getting someone to exercise more. Exergames such as Wii Sports and Wii Fit are great examples of this, being games that
focus on getting children to exercise and keep them exercising on a consistent basis. Now we can look at some common themes that were found in the research done on these games.

The first theme I will be looking at is the idea that nutritional games are niche and are slightly harder to develop. From my search, there were very few studies and game proposals that were related to nutrition, with the Foodbot Factory (2020) and Monster Appetite (2012) games being the only notable examples, which were just prototype games at the time. This leads to another question regarding the idea of video games overall, which are the technical issues and long development process for games. Video games take a long time to develop and also cost a lot of money to do so since there needs to be a development team willing to work on a game for a long time and work tirelessly to finish up the game while troubleshooting errors that come up and incorporating feedback from people who have tried the game. All in all, this just shows how hard these games are to make.

Related to the issue of game development and its difficulty, what can be seen in educational video games is the implementation of new technology and the innovation in how we play or make games as a result. Over time, access to new techniques and technology paved the way for new and innovative ways to play video games, especially those that involved moving your body and exercise. The early days of exercise gaming consisted of games such as Dance Dance Revolution which involved players playing and stepping on a dance pad and moving around, but later on the development of motion controls eventually led to a breakthrough in exercise video games. Nintendo’s Wii console became a massive commercial success during the mid-2000s due to its accessibility and its innovation in how games are played, with the controllers focused on motion controls and having players move around and perform more physical activity. Perhaps the most notable example of this is the game Wii Sports, a game where
the controller helps recreate motions such as swinging a tennis racket, golf club, and baseball, throw a bowling ball, or throwing punches in boxing. This led to the idea of exergames developing from this, with companies like PlayStation and Microsoft developing their own technology to compete with the PlayStation Move and Xbox Kinect respectively. With the new advancements in modern technology, the development of exercise video games can now involve virtual reality, providing for an even more immersive or “realistic” exercise experience. Rizzo and colleagues (2011) looked at the effectiveness of virtual reality exercise games and found that these games typically don’t match the intensity of the sport or activity that they are emulating. Even with that in mind, they note that there can be advances in technology that can help with making the exercises emulate the intensity of the sports properly, especially issues involving clunky peripherals and controllers.

Another benefit of educational video games is that there can be a social aspect to them that can encourage children to participate and keep each other motivated to continue. The social factors involved with learning have already been established and deemed as important when considering how to teach and encourage children to maintain healthy habits, but video games have an added social layer that can be of use to keeping children engaged in learning or consistent with exercise. Relating to social factors, one aspect of video games that can also contribute to a child’s enjoyment of the game is the idea of cooperative and competitive gaming. This paired along with the use of exercise video games can help address the issue of intensity that we will discuss later on. One study that looked at the social factors at play when playing competitive exercise games and how cooperation can help affect how intense the exercise can be was done by Donovan and colleagues (2012). From measuring the heart rates and calories burnt after playing single player and competitive exercise games from the Xbox Kinect and Nintendo
Wii and comparing those measurements, they found that both heart rate and energy expenditure were both significantly higher in the multiplayer games compared to the single player versions (Donovan et. al, 2012). What this reinforces is the importance of social factors in how interventions are shaped and how it can make these video game-based interventions even more effective than they could be.

Perhaps the most important thing to consider about nutritional and exercise video games is that children tend to find them more enjoyable compared to most other learning techniques. Studies like the one performed by Gao and colleagues (2014) showed that enjoyment of an intervention or educational program increases the effectiveness of them, so it would be in the best interest of teachers and programs to help shape their interventions to be more gamified or integrate video games to keep their attention.

One gap in literature that should be addressed is the conflicting results in regards to the intensity levels of the games, specifically if they are intense enough to substitute for regular exercise, as well as the balancing of entertainment and education for nutrition video games. Especially with exercise games, the most concerning aspect about the research done on it is that there are so many different opinions on the intensity of these exergames and how it relates to their viability as an alternative to regular exercise. The fact that the answer still isn’t clear shows that there needs to be either more work to try and come to a better understanding or a clear and defined set of criteria to determine if an exergame is considered “intense enough”.

To help further illustrate some of these points, I decided to interview my friend Andrew, whose exercise habits consist almost entirely of playing video games. In his words he believes that exercise is “boring, time-consuming, and very tiring and painful”. When asking him afterwards about why he prefers to exercise with video games instead, he says that all of the
above reasons are why he prefers video games instead, but also the fact that when playing exercise video games like Wii Sports and Wii Fit, “winning feels like good and rewarding”, which reflects the notion that interventions that are the most effective should be appealing and entertaining. He also talks about certain skills he obtained while playing these games as well such as reaction time and reflexes, memorization, and critical thinking. This mirrors some of the skills that were mentioned in the DeVary article (2008). Then, when asked about competition and cooperation in video games and their possible role in these types of games, he said that even without the presence of other players to invoke competition, “you [the player] still face competition from the game itself”. This can be in the form of computer-based opponents and scores from both the game itself and real-life players. He then elaborates by saying that one of the reasons why he and others prefer video games is because “[Y]ou want the game to tell you that you are doing good”. All this relates to what was found in the literature about competition helping with energy expenditure in exercise video games as well as reinforces the idea of satisfaction playing such a huge part of why video game-based interventions are successful.

With this, I will use all of this information to propose possible solutions to make the most effective video game intervention.

**How Do We Make the Most Effective Games?**

Continuing on with the interview, I asked Andrew why he keeps playing and enjoying these games. He said that the reasons why he comes back to certain types of games mostly depends on a case-by-case basis, where it depended on both his personal enjoyment and his goals for said game. For example, he references games from Wii Fit such as Rhythm Kung-Fu and Step games were ones that he noted he keeps playing out of his personal preference and enjoyment, but ones with goal, records, and achievements to complete and compete for push him
to keep playing until he meets his personal goals. This would mean that there should be a variety of games that span over many different genres and settings in order to have a sort of educational game that appeals to many people. This can help cater to personal preferences of all children.

His thoughts about his enjoyment of exercise video games very much mirrors the results that we see overall regarding the evaluation of both nutrition and exercise video games, where one of the main criticisms is that most interventions need to keep children engaged. Some notable examples of this in my literature search were the studies by Harris and colleagues (2012) and London and colleagues (2011) have effective programs in the Let’s Move Salad Bars to School and Let’s Move programs respectively, but they lack ways of keeping children engaged, which is what video games have shown the ability to tackle that challenge.

To conclude, I asked him about what kinds of improvements can be made to these games to make them more effective. One of the first things he said was that the game Ring Fit Adventure is as good as it gets when it comes to exercise games. He mentions that the best parts of the game are that it teaches you how to perform practical exercises as a game mechanic in order to “fight” enemies in the game. In terms of what he thought could be improved even more, he said that making a game similar to Ring Fit, but focusing purely on the idea of fighting big “boss characters”. What this does is that focuses purely on the gamified exercise aspect that is the most enjoyable. Then have the game be based on a “boss rush” game where you only fight these big boss enemies through exercising. The point of this is because it would be a more focused and intense game that is still entertaining to keep children interested. Another benefit of this would be that there can also be the incentives for speedrunning the game which encourage personal goals and competition. Lastly, he mentioned that there should be other modes like co-op mode and party mode in order to encourage social interaction with gameplay. With this, I also
want to discuss possible solutions to make these games more effective as well, using the basis of Andrew’s proposed game idea.

The main way I thought about making these types of games more effective is through making them involve social interaction through hub worlds where you can interact with and encourage other players who are also doing these exercises. This can lead to games that have “raid bosses” or even larger enemies that can only be beaten by teaming up with people. It can also host other events such as tournaments that can also establish another source of competition as well.

The other way I thought about making these games more effective by tackling the issue of intensity is by pushing for consistency instead. Examples of this lack of consistency in the intensity levels are from Barkley and colleagues (2009) that showed that exercise games were intense enough to substitute for regular exercise versus results like the one from Rizzo and colleagues (2009) who found that exercise games weren’t intense enough to substitute regular exercise with. As shown by these examples, many of these studies talk about intensity being an issue with these games, but none of them really talked about the idea of consistency in exercise games, which is something that should be encouraged in the game and keep children engaged. One example of this was how Barkley and colleagues (2009) performed only 4 10-minute exercise sessions, which doesn’t account for the idea of long-term exercise patterns. What I would propose would be having some sort of “daily missions” that can keep children going back to the game to at least exercise for a short amount of time. They can be incentivized to come back and play every day in order to meet personal goals or beat other players and their high scores, drawing from the proposal of social-networking components from the Foodbot Factory study (2020).
Concluding Thoughts

We have taken a look at how children learn about nutrition and exercise and found that much of their learning is done through their social environment and influences. We also analyzed many different interventions that have been created to help teach and maintain these behaviors in children, looking at their strengths and weaknesses. What we found was that the most successful interventions were those that involved education and access to resources as well as those that focused on a child’s social relationships and environment. One of the biggest things that hindered the effectiveness of these interventions was the child’s interest and enjoyment, which led to the idea that video games were an effective type of intervention.

From the research that was done on video games and video game interventions, they found that the effectiveness of these interventions was in the entertainment and enjoyment of the game keeping them interested in participating and playing them. Another benefit that was common was the ability to consider social factors through multiplayer games helping children stay engaged. The main drawbacks of these interventions, however, are the fact that there needs to be a balance between entertainment and education, specifically for nutritional education games, the lack of intensity of certain exercise games, and overall costs associated with video gaming and technical issues that can arise from development of these games.

In conclusion, nutrition and exercise video games can be viable interventions because it takes into consideration most of the benefits of regular interventions as well as tackles the issues of engagement and enjoyment that aren't present in other types of interventions, but it still comes with its own set of problems such as being too entertainment heavy or not intense enough as well as technical issues and cost effectiveness. This shows that with some improvements in
technology and how they are developed, these games can be refined to become the most effective types of health interventions.
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