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Rise Of Exergaming

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THE RISE OF EXER-GAMING

by

Badrinarayanan Ramakrishnan

B.Tech., Sathyabama University, 2008

A Research Paper
Submitted in Partial Fulfillment of the Requirements for the
Master of Science

Department of Mass Communication & Media Arts
in the Graduate School
Southern Illinois University Carbondale
May, 2011
THE RISE OF EXER-GAMING

By

Badrinarayanan Ramakrishnan

A Research Paper Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science.

Approved by:

Dr. John Hochheimer, Chair
Graduate School
Southern Illinois University Carbondale
May, 2011
This paper looks at childhood obesity in the United States of America, its causes, and various intervention methods as well as videogames that have been employed in the fight against obesity through the emergence of physically engaging games. While childhood obesity is spreading fast, its effects are devastating. Illnesses and other conditions previously seen only in adults are now occurring more frequently in children. Though the Center for Disease Control has made recommendations and tried to educate children about a healthy diet and regular physical activity, obesity remains a threat to health. Though a combination of diet and physical activity are the recommended intervention criteria, the importance of physical activity has been realized in many studies. But, even here many studies only reached near significant changes in their interventions due to adherence issues. Videogames games help in burning calories and also in increasing physical activity levels in children, since these games engage players physically. Adherence issues are solved using the help of “exergames”, as they hide exercise behind a layer of fun. These exergames are seen as a genre of
videogames rather than a novel way to play (i.e. a replacement of the traditional videogame controller) and need to expand from only one kind of videogame title.
DEDICATION

I dedicate this work of mine to my parents – Shri. H. Ramakrishnan & Smt. Vasantha Ramakrishnan who have been most supportive in everything I do. Thank you Appa and Amma.
ACKNOWLEDGMENTS

I record my sincere gratitude to Dr. John Hochheimer, for the personal attention he bestowed, right from the beginning and at every stage of my Masters project. His encouragement has been a very great source of inspiration to me.

I will be failing in my duty if I do not place on record my gratitude to all the members of the faculty, MCMA, SIUC.

I finally thank all my family and friends for the constant support they have rendered to me throughout.
This paper presents the role that Exergames play, as an important part in an effort to change the behavior of many individuals. It shows how the videogame industry has moved to a stage where it has many beneficial uses for its technology. Children should not be robbed of their childhood by the excess physical weight and the consequences of which are cardiac problems, type-two diabetes, and more. Obese children's life condition may be improved through an understanding of the mechanics of the physical activity aspect in intervention methods and the application of the exergames to fight childhood obesity. This paper aims to better arm educators, who play a very pivotal role in the growth and development of the youth. An understanding of physical activity, as one of the basic factors that play an important role in intervention, will help them provide for better means of meeting the complex needs of school children when it comes to prevention of obesity.

My grateful acknowledgment to Dr. John Hochheimer, without whom this work would not have reached its present form.
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CHAPTER 1

Thesis Statement

With the rising levels of childhood obesity in developed countries such as the United States of America, a lifestyle intervention that is both motivating and effective is needed. The electronic gaming industry has the answer with exer-games i.e. a combination of video games and physical exercise.

Priorities for Action

While childhood obesity has quadrupled in the U.S.A alone in the last decade, other developed countries in the Middle East, and Australia have reported an increase in the occurrence of obesity. Obesity leads to various other problems that are life threatening, such diseases, which were previously seen only in adults, are now seen in children as well. There is a dire need for a mass medium that can improve the fitness levels primarily of children which does not present adherence issues.

Aim

The aim of this report is to establish beyond a doubt, that exergames can be employed as an intervention method to reduce the prevalence of obesity among children.

Objectives

To gauge market reception to novel video game controllers used in exergames.
• To stress upon the importance of physical activities in any intervention to prevent or treat childhood obesity.
• To analyze “Traditional Physical Activity Intervention” in obese children and seek out improvements.
• To establish exergaming as an effective tool in interventions.
• To suggest effective ways of marketing exergames to public health officials and schools.

Definitions

• Physical activity - According to the Department of Health and Human Services' Physical Activity for Americans (2008), physical activity generally refers to bodily movement that enhances health.
• Overweight and obesity are both labels for ranges of weight that are greater than what is generally considered healthy for a given height. The terms also identify ranges of weight that have been shown to increase the likelihood of certain diseases and other health problems (Center for Disease Control, 2011).
• “Exer-gaming” can be defined as employing a video game in a physical exercise routine.
CHAPTER 2 - THE COST OF OBESITY

Obesity is defined as an excess accumulation of fat in the adipose tissue of a person’s body by the WHO. But the consequences of having an obese population are not as simple as the definition. Obesity leads to physical and psychological health challenges, damaged public health outcomes, and increased health costs (Lawrence et al., 2010). Physically, the cost of obesity often has chronic health complications, of which many were seen previously only in adults (Cecil-Karb & Grogan-Kaylor, 2009), one of which being type 2 diabetes (Hannon, Rao, & Aslanian, 2005). By 1994, unhealthy weight gain due to poor diet and lack of exercise was responsible for 300,000 deaths each year and cost nearly 100 million dollars per year for medical care (Wilmore, 1994). The cost of obesity to U.S. business in 1994 was estimated to total $12.7 billion, including $2.6 billion as a result of mild obesity and $10.1 billion due to moderate to severe obesity. Health insurance expenditures constituted $7.7 billion of the total amount, representing 43 per cent of all spending by U.S. business on coronary heart disease, hypertension, type 2 diabetes, hypercholesterolemia, stroke, gallbladder disease, osteoarthritis of the knee, and endometrial cancer (Thompson, D., J. Edelsberg, KL Kinsey, and G. Oster, 1998).

Those under the age of 18 years currently accounting for more than half of all new diagnoses in some subgroups (Fagot-Campagna et al., 2000). Obesity also increases the risk of cancer (Deslypere, 1995; Weisburger,
and also tends to lead to poor cardiovascular health (Freeman, Dietz, Srinivasan, & Berenson, 1999). Thus, there is an urgent need to address the issue of childhood obesity. More than diet, physical exercise is given importance in this report. This is due to the fact that childhood obesity may carry over into adulthood (DeMattia & Denney, 2008) we will see more case studies that look at this particular aspect later in this chapter. Statistics below (fig1.1) show the prevalence of obesity among children and adolescents in the United States over the period of time from 1963-2008. In the past 10 years, among the heaviest boys, a significant increase in obesity has been observed, with the heaviest getting even heavier, according to the CDC’s morbidity and mortality report (2011). The CDC also identifies more cardiovascular risks such as hypertension, high cholesterol and abnormal glucose tolerance levels. It has also been reported that an estimated 15 percent of new diabetes cases are among children and adolescents are type 2 diabetes, even though its occurrence is low in teens (Freedman, D., Kahn, H., Mei, Z., Grummer-Strawn, L., Dietz, W., Srinivasan, S., & Berenson, G., 2007). The health consequences of an overweight childhood include metabolic disturbances, type 2 diabetes, abnormal sleep patterns, impaired mobility, increased blood pressure (Freedman DS et.al, 1999). Also, there is a tremendous risk of hypertension, high cholesterol, and increased risk of coronary heart disease in adulthood (Daniels, 2006). There are also psychological consequences to childhood obesity such as decreased self-esteem and quality of life, social alienation (Doak CM, Visscher TLS, Renders
Poor academic performance, as well as increased risk behaviors such as premature sexual activity and alcohol use discrimination, depression is also some psychological consequences of childhood obesity (Miller JW, Naimi TS, Brewer RD, and Jones SE, 2007).

This graph clearly shows the steep climb in the occurrence of childhood obesity. In the year 1971, the obesity figures for 6-11 year olds was at 5.2 per cent, and for 12-19 year olds at 4.7 percent. By 1994, 12 per cent of 6-11 year olds were obese while it may be noted that the rate of increase is higher among the age groups of 6-11 year olds and in 12-19 year olds though there is significant increase in 2-5 year old children as well.

What is required to treat obesity is a healthy food intake (diet) and regular physical exercise; this is accepted more widely than any other
methods such as surgical removal of fat tissue as the healthiest means. In 1990, obesity expenditures were estimated at 8 percent of all health care costs, a cost of $69 billion (Wolf & Colditz, 1994). They only rose higher in 2002 when national medical expenditures associated with overweight and obesity were an estimated $92.6 billion, or approximately 9 percent of all medical expenditures (CDC, 2010). At this rate, there will be dire costs both financial and otherwise in the future. Successful intervention and prevention measures must take into account the need to increase physical activity.

The excess weight (literal and figurative) that obesity adds, leads to arthritis and loss of interpersonal skills in the morbidly obese. The medical expenses that were related to obesity were at 9 per cent which amounted to $147 billion in 2008 (Finkelstein, 2009). So, not only is there great personal cost but also a large economic cost to a high prevalence of obesity. And the trend is seen in developing countries as they become more industrialized. Obesity “related” expenses also refer to diseases such as type 2 diabetes which are caused by obesity.
CHAPTER 3 - CAUSES OF OBESITY

In this chapter, we will look at the many causes of obesity, including in adults. We consider the causes of obesity and weight gain in adults since childhood obesity also carries into adulthood. Although the primary causes of obesity are high calorie intake and physical inactivity or sedentary lifestyles, there are several other factors.

Environmental Causes

The two main components of childhood obesity are physical inactivity and improper nutrition, and it is becoming increasingly evident that the built environment can determine the level of exposure to these risk factors (Rahman, Tamanna; Cushing, Rachel A.; Jackson, Richard J. Mount Sinai, 2011). The built environment theory implies that there has to be some overhauling of zoning policies in order to accommodate the needs of children who require open spaces to engage in sports and other physical activities. Increased availability of food, especially calorie-dense foods, coupled with marketing pressures, suboptimal eating habits and sedentary lifestyles significantly contribute to the rise in overweight and obesity that we are seeing in the United States and around the world (Hensrud, 2002).

Genetic Causes

A small number of confirmed major genes for human obesity have been identified by molecular genetic studies; mutations of these have a strong
influence on the development of excessive body weight. However, the underlying mutations are rare and do not explain the current obesity epidemic (Hebebrand et al, 2010). But in general, heredity doesn't mean that a person is destined to be fat. Genes can make a person more susceptible to weight gain. They also affect the rate at which the body accumulates fat and where that fat is stored. Heredity may make it more difficult for a person to lose weight than someone whose ancestors were not obese. But just as genes don't guarantee cancer or diabetes, they don't decide that a person must be overweight either. No matter what the genes say, it is ultimately the choices in nutrition and activity that will determine a person’s weight (Hensrud, 2002).

Cigarette Smoking

Smokers who quit gain an average of 6 to 8 pounds of weight. This is due to a change in metabolic rate that has been slowed down due to the lack of nicotine. Nicotine actually increases metabolic rate. Former smokers often gain weight because they eat more after they quit since their food tastes and smells better.

Energy Imbalance

In this concept, it is believed that obesity is due to a positive energy imbalance in which energy intake exceeds energy expenditure (Epstein, Coleman, Myers, 1996). Meaning that those who consume more calories than they need to perform everyday activities are more prone to becoming obese. This concept suggests that in the industrialized world, elevators and escalators are used instead of stairs; cars are used in commuting to and from
work instead of walking or using bicycles but the calorie consumption stays the same, thus leading to obesity. A study by Chiu, Bell, Herman, Hill, Stewart, Cohen, Liau, Steg, and Bhatt (2010) that compared Chinese living in China and Chinese living in North America strengthened this theory. It was found that Chinese in China actually consumed more calories than those in North America but were not obese. Those who lived in North America were consuming fewer calories but were also leading a more sedentary lifestyle and therefore were overweight. As developing nations become more industrialized, there will be more of an energy imbalance and a rise in the obese population seems imminent.

Though there are varying causes for obesity, as much of the literature suggests, there are two main underlying causes. 1) A poor diet which has more calories than needed to perform daily tasks. 2) A lack of physical activity that burns calories and keeps body weight in check. It is the latter factor that we shall consider tackling in this paper. By employing new entertainment technology, particularly, exergames (a combination of videogames and physical exercise), that burn calories and encourage children to be physically active; bodyweight of the youth can be kept in check.
CHAPTER 4 - KNOWN METHODS OF DEALING WITH CHILDHOOD OBESITY

The Surgeon General recommends that children get 60 minutes of moderate level exercise each day (U.S. Department of Health and Human Services, 2005). The American Academy of Paediatrics stated that paediatricians should recognize children at risk for obesity calculate and plot BMI to identify weight gain and monitor obesity.

Also, the strategy was to encourage breastfeeding, encourage healthy eating habits and promote physical activity as well as limitation of TV viewing (AAP, 2003). The majority of adults in industrialized countries do not meet recommended physical activity requirements as of 2008 (Maximova et al, 2009). This means that children who have not been habituated to a healthy lifestyle (diet and physical exercise), are prone to carry obesity or overweight into adulthood. Below is a graph that tracks Body Mass Index (BMI) for age from birth to 18 years Percent Overweight Children Who Are Obese at Age 25.
In the above figure, it can be seen that childhood obesity carries into adulthood. Those children who had lesser BMI than what is considered obese and those who are at the high range of normal BMI became obese when they reached adulthood. This is inferred from the table where children who are 4 years old are at 36% rate of obesity and in later stages they reach a higher percentage. These were children who were thought to be in the normal BMI range but their BMI increased to greater than the 95th percentile. This is a reason why obesity in children should not be judged by the Body Mass Index method. Objective criteria for obesity are more accurate than a BMI chart as we will see later in this report.

Much has been attempted to treat or prevent childhood obesity in the United States of America in the form of calorie conscious diet changes, regimen of physical exercises, and even other invasive methods such as surgical removal of fat tissue have been attempted. This chapter will discuss...
various intervention methods, their follow ups (if any), their effectiveness and their recommendations and results.

Although a combination of calorie conscious diet and physical exercise is the most widely accepted method of intervention in obese subjects, the importance of physical activity in interventions is paramount. The following is a discussion of a study conducted by Epstein, Coleman, and Myers (1996) whose method was to cross examine 13 studies in which obese children and adolescents were placed on exercise programs and/or calorie-conscious diet for the purpose of weight loss. Studies included for review met two criteria: 1) children or adolescents were defined as obese using objective criteria for obesity, and 2) obese children or adolescents were provided either different types of exercise programs or an exercise program compared with a no-exercise control condition. The following table shows the 13 studies that qualified (in tabulated form) which had an exercise intervention and a control group. This shows that studies involving interventions in either physical activity alone, or a combination of physical activity and dietary intervention yield positive results. As opposed to studies in which only dietary changes are introduced. This also strengthens the energy imbalance concept discussed earlier.
Table 1 Source: Epstein et al, 1996.

<table>
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<tr>
<th>Authors</th>
<th>Age</th>
<th>N</th>
<th>Groups</th>
<th>Exercise</th>
<th>Diet</th>
<th>Rx FU Months</th>
<th>Results</th>
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<tr>
<td>Becque et al.</td>
<td>12-13</td>
<td>11</td>
<td>Diet + Ex</td>
<td>3 x · wk⁻¹; 50-min supervised aerobic activity</td>
<td>Loss of 1-2 lb · wk⁻¹</td>
<td>5</td>
<td>%BF; BW; Diet + EX = Diet = Con</td>
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<td>Blomquist et al.</td>
<td>8-9</td>
<td>22</td>
<td>Ex Control</td>
<td>2 extra gym classes · wk⁻¹</td>
<td>None</td>
<td>4</td>
<td>OW; SF; Ex = Con</td>
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<tr>
<td>Epstein et al.</td>
<td>8-12</td>
<td>55</td>
<td>Diet + Ex</td>
<td>45-min intensive activity</td>
<td>900-1200 kcal</td>
<td>4-12</td>
<td>%OW, %RF; Ex, Sed &gt; Ex</td>
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<td></td>
<td></td>
<td></td>
<td>Diet + Sed</td>
<td>Reinforced for activity</td>
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<td></td>
<td>%OW, %RF; Fu, Sed &gt; Ex, Com</td>
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<td></td>
<td></td>
<td></td>
<td>Diet + Com</td>
<td>Combined ex + sed</td>
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<td></td>
<td>Fitness; Rx, FU; NS</td>
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<td></td>
<td>Diet + LS</td>
<td>Lifestyle exercise</td>
<td></td>
<td></td>
<td>Fitness; Ex, NS; FU; Ex &gt; Diet</td>
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<tr>
<td>Epstein et al.</td>
<td>8-12</td>
<td>23</td>
<td>Diet + Ex</td>
<td>3-mile walk 3 x · wk⁻¹</td>
<td>900-1200 kcal</td>
<td>2-12</td>
<td>%OW, BW; Diet &gt; Ex; Diet</td>
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<td></td>
<td></td>
<td></td>
<td>Diet</td>
<td></td>
<td></td>
<td></td>
<td>%OW, BW; Fu, Diet &gt; Cont</td>
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<td>18</td>
<td>Diet + Ex</td>
<td>Lifestyle exercise</td>
<td>900-1200 kcal</td>
<td>2-12</td>
<td>%OW, BW; Diet = Diet + Ex</td>
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<td></td>
<td>Diet</td>
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<td>Epstein et al.</td>
<td>8-12</td>
<td>8</td>
<td>Diet + Pro</td>
<td>Programmed aerobic exercise</td>
<td>900-1200 kcal</td>
<td>2-17</td>
<td>%OW, BMI, Ex, NS</td>
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<td></td>
<td></td>
<td>Diet + LS</td>
<td>Programmed aerobic exercise</td>
<td></td>
<td></td>
<td>%OW, BMI, Fu; all LS &gt; all Pro</td>
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<td></td>
<td></td>
<td>Diet + Pro</td>
<td>Programmed aerobic exercise</td>
<td></td>
<td></td>
<td>Fitness; Rx &gt; Pro &gt; LS</td>
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<tr>
<td>Hills and Parker</td>
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<td></td>
<td>Diet + Ex</td>
<td>Gymnastics 1 x · wk⁻¹</td>
<td>Nutrition</td>
<td>4</td>
<td>Diet + Ex &gt; Diet</td>
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<td>Pena et al.</td>
<td>10-15</td>
<td>20</td>
<td>Diet + Ex</td>
<td>20 min home aerobic</td>
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<td>3</td>
<td>Boys HIF &gt; Ex &gt; LoF for BW</td>
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<td></td>
<td></td>
<td>Diet + Ex</td>
<td>activity 9-4 x · wk⁻¹</td>
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<td></td>
<td>Girls HIF &gt; Ex &gt; HIF or LoF</td>
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<td></td>
<td></td>
<td></td>
<td>Diet + Ex</td>
<td>Cycling at 75% VO₂max</td>
<td>1000 kcal</td>
<td>1</td>
<td>BW; LoF &gt; Ex &gt; LoF for BW</td>
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<td></td>
<td></td>
<td></td>
<td>Diet + Ex</td>
<td>5 x/km (2 x · d⁻¹)</td>
<td>LoF = 3-6</td>
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<td></td>
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<td></td>
<td>Diet + Ex</td>
<td>Platform stepping</td>
<td>27 kcal · leg⁻¹</td>
<td>15 days</td>
<td>BW, BF, NS</td>
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<tr>
<td>Heybrock et al.</td>
<td>6-14</td>
<td>21</td>
<td>Diet + Ex</td>
<td>Walking for 2 h 7 x · wk⁻¹</td>
<td>800-1000 kcal</td>
<td>48</td>
<td>%BF; Ex &gt; Diet</td>
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<td>Roocini et al.</td>
<td>9-15</td>
<td>23</td>
<td>Diet + Ex</td>
<td>Daily aerobic exercise</td>
<td></td>
<td>5</td>
<td>BW, %BF; Diet &gt; Ex</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Diet + Ex</td>
<td>15-40 min at 70-75%</td>
<td></td>
<td></td>
<td>Diet or Ex &gt; Control</td>
</tr>
<tr>
<td>Shultz and Mayer</td>
<td>9-14</td>
<td>18</td>
<td>Diet + Ex</td>
<td>Three additional aerobic phys ed classes · wk⁻¹</td>
<td>None</td>
<td>5</td>
<td>BW, SF, Ex = Control</td>
</tr>
</tbody>
</table>

Rx = treatment period; FU = follow-up period; Ex = exercise; Con = Control; x · wk⁻¹ = times activity was performed per week; Sed = reinforced for decreasing sedentary behavior; Com = reinforced for decreasing sedentary and increasing active behaviors; Pro = programmed aerobic exercise; LS = lifestyle exercise; Cal = calisthenics; NS = no significant between group differences; %BF = percent body fat; %BW = body weight; OW = overweight defined by standard weight for height and age tables; SF = skinfold measurements; BMI = body mass index; prep = prepubertal; HIF/LoF = High/Lo fiber diet; BF = body fat.

All referenced information is used with permission.

Studies included for review met two criteria: 1) children or adolescents were defined as obese using objective criteria for obesity, and 2) obese children or adolescents were provided either different types of exercise programs or an exercise program compared with a no-exercise control.
condition. There are two studies in the above table that had only an exercise versus no exercise scenario (Blomquist, B., M. Borjeson, Y. Larsson, B. Persson, G. Sterky, 1965. Seltzer, C. C., and J. Mayer, 1970); these did not find significant effects of exercise on weight variables or fitness. The fact that both of these studies were school based interventions must be weighed against the rest of the studies in the table that had a combination of exercise as well as dietary information. The school based interventions took place only at school, whereas the other studies which had physical activity and dietary changes involved school and home environments. Some of the studies even had one hour sessions with the entire family and a nutritionist.

The five studies that compared diet versus a combination of diet and exercise differed in diet and exercise methods, but all showed positive changes in weight and fitness for diet plus exercise groups than diet only studies. Reybrouck et al. (1990) found that after 4 months a group expending 250 kcal in one session of exercise per day along with a low-calorie diet, showed a greater decrease in overweight percentage than the group with low-calorie diet only. In another study that spanned 4 months Hills and Parker (1988) showed that children who received nutritional information along with aerobic exercise three to four times a week had lower total skin fold measures than the group that only received nutritional information. Pena et al (1980) demonstrated significant changes in percent body fat for diet plus exercise than diet alone in a short treatment period of only 15 days. Epstein et al concluded that the most important component of exercise intervention
research, exercise adherence was neglected at the time. The studies in the table that showed negative exercise results may have been due to poor adherence in their exercise programs. Epstein et al (1996) recommended that exercise was an important adjunctive treatment for childhood and adolescent obesity. Additional research was needed on the best type of exercise program that promotes added weight loss beyond that of diet alone and which promote long-term changes in activity i.e. exercise where adherence was known to be at high levels.

K. S. Steinbeck’s review (2001) sought to stress on the importance of physical activity in the prevention of overweight and obesity in childhood by identifying certain risk times for the development of obesity in childhood. The author considers that increasing physical activity in children is an attractive and non-restrictive approach to obesity prevention. Considering the morbidity and mortality risks of childhood obesity (which we have lain out earlier), there is a strong case for having a lifestyle intervention in children since they can learn lifestyle behaviors from an early age and may be more flexible in their ability to change behaviors than adults. Community interventions designed to increase physical activity in children such as ‘Dance for Health’ (Flores, 1995) will need to be tailored to specific groups at the local level. This particular intervention used 3 sessions lasting 50 minutes each over a 12 week period as a cardio-vascular risk intervention in 10 – 13 year old girls. The review also discussed another intervention in school children where aerobic exercises were employed. Children in the treatment group took part in a 15-min walk
before the beginning of school and a 20-min dance session three times a week, after their afternoon sleep (Mo-Suwan et al, 1998). While there are many descriptive studies of community intervention, these tend to share common difficulties, including having no control group. Nevertheless the results did show near significant changes that led to a positive change in lifestyle at least for some time after the intervention. Even here exercise adherence issues are noted. The review concluded by stating that obesity is a socially engineered problem and that physiology is responding appropriately to the conditions of plentiful food supply and reduced activity by storing fat. If indeed obesity is a socially engineered problem, the factors to be considered would be consumption of high calorie foods and the lack of physical activity.

In another study (Owens, Gutin, Allison, Riggs, Ferguson, Litaker, Thompson, 1999), the effects of physical training on total and visceral fat in obese children were closely looked at. Before we continue to discuss this particular study, the difference between visceral fat and other adipose tissue will be made clear. Visceral adipose tissue or visceral fat is associated with risk factors for coronary artery disease, hypertension, and non-insulin-dependent diabetes mellitus. The other subcutaneous adipose tissue also affects the waist/hip circumference but is significantly less harmful. This is the reason why the Body Mass Index (BMI) method of classification is discouraged in children. Using objective criteria to identify obese children is the most accurate method of selection for study. A volunteer sample of eighty-one children underwent baseline testing, and was randomly assigned,
to the physical training or control groups. Before and after the 4-month intervention period, the subjects were tested for body composition, aerobic fitness, and daily physical activity. Apart from these specific measurements of cardiovascular fitness were also compared in both groups. The physical training regimen was specifically designed for maximum energy expenditure from the participants. A typical training session included 20 minutes of exercising on machines such as treadmill, stationary cycle, and trampoline and 20 minutes of playing games like basketball, dodge ball, and tag.

Each child wore a heart-rate (HR) monitor during every session. After each session, the min-by-min HR data were downloaded into a computer and displayed to the child. Children were paid $1 for each exercise session attended and earned points for maintenance of the target heart-rate as incentives. This particular aspect seems very similar to what can be found in arcade game parlors where points for playing games are exchanged for prizes. In the same way, the points earned by participants were exchanged for prizes. This study showed that in obese children, regular exercise, without dietary intervention, led to improved total body composition and cardiovascular fitness. In summary, this study showed that during physical training obese children were capable of participating in a substantial amount of high intensity physical training over a 4-month period. They also accumulated significantly less visceral fat tissue when compared with non-exercising controls. And, participants in the physical exercises experienced other beneficial changes in total and regional body composition.
Other community based or school-based interventions have also been attempted in obese children. Two authors (Brown & Summerbell 2009) reviewed thirty eight school-based interventions that focus on changing dietary intake and physical activity levels to prevent childhood obesity and gauged their effectiveness. Of the 38 studies that were selected for the review, 23 were already in the National Institute for Health and Clinical Excellence obesity guidance and 15 were new studies. The studies were at least 12 weeks long and were mostly randomized controlled trials. Only 17 of the studies were conducted in American schools while, 3 were in the UK, two were conducted in Australian schools, two in Germany, and the remaining 14 were in other European countries. Fifteen studies aimed to increase physical activity levels and were compared with a usual care control group. The studies had various kinds, durations and intensities of physical activity involved.

The mean age of participants in four of five studies that lasted 6 months or less was below 9 years. Among the studies was a 6 month intervention which aimed to encourage reduction in TV, videotape and video game usage (18 lessons of 30–50 min, self-monitoring and a 7 h TV use budget per week) in 9-year-olds. This resulted in a significant reduction in BMI, skin fold thickness, waist circumference and waist-to-hip ratio in intervention children compared with controls (Robinson, 1999).

Another physical activity intervention in low-income, minority school children (mean age 8 years) that lasted 12 weeks demonstrated significantly
more weight gain among controls and significant decreases in skin-fold thickness among intervention children (Stephens & Wentz, 1998). In other studies aerobic exercises, play, play and PE, physical activity to supplement PE were also employed. However, 10 of the 15 studies did not report improvement in mean BMI or percentage of overweight in the participating children. In some of the other studies, the effects of the intervention were not long term. Results for boys showed that the control group had significantly lower BMI at 6 and 12-months (P = 0.05), but not at 18-months (Sallis JF, McKenzie TL, Alcaraz JE, Kolody B, Hovell MF, Nader PR, 1993). All boys in all three groups increased their BMI over 2 years. Girls’ results showed the control group to have lower BMI at each time point and this reached significance at 18-months (Sallis JF, McKenzie TL, Alcaraz JE, Kolody B, Faucette N, Hovell MF, 1997). Walking did not help in the mean BMI in the Australian study by Schofield et al (2005) where the use of a pedometer was involved. This was done with hopes of seeing an increase the number of steps taken in day by the participating children. There were 20 studies that included changes in diet and physical activity in the interventions. Of these, 9 studies showed encouraging results in reducing the BMI of the participants when compared to the control groups. This review expanded and updated the evidence base of lifestyle interventions to prevent obesity in school children. It concluded that in the question of whether physical activity interventions or only diet interventions were better, the evidence was inconclusive. The recommendation was that a combination of both diet and physical exercises
may be the best option to use in intervention in obese children and in preventing obesity in children. Also, in most studies involving physical activity, adherence issues were noted.

Irwin CC, Irwin RL, Miller ME, Somes GW, Richey PA (2010) started an intervention that involved community, school, and home of obese children. It was called ‘Get Fit with the Grizzlies’, after the Memphis Grizzlies, the city’s basketball team. The program was a 6 week addition to curriculum at Memphis City Schools (MCS) for the fourth and fifth grades. It focused on both nutrition and physical activity. Out of 110 MCS elementary schools, 11 elementary school sites were randomly chosen for the “Get Fit” program evaluation, which accounted for approximately 1600 fourth and fifth graders. The difference between this program and others was that it involved parents (i.e., exercising with their child, discussing healthy foods, eating dinner together), and their signature was required on their child’s Get Fit activity/food log. Becoming more knowledgeable about health information and changing and/or maintaining personal health behaviors were the program’s overall program objectives. The Get Fit program was mainly influenced by the Social Cognitive Theory (Bandura, 1986) and the Social Learning Theory (Miller & Dollard, 1941) that differentiated learning as a socially driven process. Overall, the program was able to utilize Memphis City’s NBA franchise, the ‘Grizzlies’ star power to educate children in nutrition and physical activities. Analyses confirmed that there was significant health knowledge acquisition in
the participating children. The approach of looking at learning as a socially driven process might have increased the adherence level in the children.

Nemet, Barkan, Epstein, Friedland, Kowen, and Eliakim (2005) looked at the beneficial effects of a combined dietary, behavioral, and physical activity intervention in Israeli children. The prevalence of childhood obesity in Israel is among the highest, compared with European countries and the United States (Lissau, Overpeck, Ruan, Due, Holstein, Hediger, 2004).

Both short term and long term benefits were observed by Nemet et al after the study. The authors stated that only a minor fraction of obese children participate in weight reduction interventions, and the longer-term effects of these weight-reduction interventions among children have not been elucidated. In this randomized study, 24 obese subjects in a twice-weekly training program (1 hour per training session) conducted by professional coaches. The games were mainly endurance based and were intended to replicate the type and intensity of exercises regularly performed by school children. The physicians who worked in the program (former members of the Israeli national track and field team) participated regularly in the training sessions, to encourage the children and provide examples. A dietary intervention complimented these efforts after a nutritional assessment. This involved the whole family and consisted of 30 to 45 minute sessions which consisted of mainly nutritional education. The control group consisted of 22 obese participants and the gender percentage between the control group and the intervention group was the same. After the 3 month intervention, there
was significant loss of body weight and body fat percentage among the intervention participants. While the BMI of the control group remained the same, there was significant increase in body fat and total weight.

In the long term effects, where 20 participants from each group completed the one year follow up evaluation, there were significant decreases in BMI and body fat percentage among the intervention participants, compared with increases among the control subjects. Due to parental involvement in the intervention, dietary changes, nutritional education, changes in physical activity patterns, and behavioral modification were achieved in the long term.

The prevention of obesity through increasing physical activity was also suggested by the Council on Sports Medicine and Fitness and Council on School Health (2006). It was stated that children living in poverty, children with disabilities, children residing in apartments or public housing, and children living in neighborhoods where outdoor physical activity is restricted by climate, safety concerns, or lack of facilities were at increased risk of obesity. For these children who are at higher risk of obesity, physically active videogames are the right “fit”. These videogames are not played with traditional controllers, but employ the player’s whole body and encourage those who play these games to move and work up a sweat. As to how much these videogames physically engage players and how appropriate they are for children, we shall see later in this paper. But for now, suffice it to say that these videogames can encourage physical activity in children.
The importance and benefits of regular physical activity cannot be underestimated. Regular physical activity is important in weight reduction and improving insulin sensitivity in youth who have type two diabetes (American Diabetes Association, 2000). Aerobic exercise has been shown to reduce systolic and diastolic blood pressure over 8 months in a prospective randomized, controlled study of 64 children (9–11 years old) with hypertension (Hansen et al, 1991). Resistance training (e.g., weight lifting) after aerobic exercise seems to prevent the return of blood pressure to preintervention levels in hypertensive adolescents (Hagberg JM, Ehsani AA, Goldring D, Hernandez A, Sinacore DR, Holloszy JO, 1984). Regular physical activity is also beneficial psychologically for all youth regardless of weight. It is associated with an increase in self-esteem and self-concept and a decrease in anxiety and depression (Calfas & Taylor, 1994).
CHAPTER 5 - EMERGENCE OF PHYSICALLY ENGAGING VIDEOGAMES

The birth of the first generation video game was not a gala event; nor was it as thoroughly dissected by periodicals of today, and it certainly was not pursued so greatly by marketing efforts. It is a picture which is unthinkable for today’s game manufacturers as well as the consumers. Electronic games were the new wave that would capture the imaginations of many with simple red and green boxes and lines. The many hours spent by early gamers (perhaps carried to the next generation of gamers) led to the many studies about the consumption of time with regards to electronic gaming. Even when the games were not as in-depth and did not have such involving characters and storylines like today, games were ‘addictive’. There is no better term to describe the unnatural attraction these electronic brains have on human ones; the games create a whole new reality which excites and actively involves the gamer/reader unlike any other form of media.

The days of sitting in one place and interacting with the screen (regardless of its size) only with thumbs are over. Console games of today allow for more movement as the controllers are wireless and games are designed to get players off the couch and burn calories. It could be the answer to the expanding population of obese children in the United States of America. But the innovation of physically engaging videogames was made decades ago, but only now are world markets responding positively. In the year 1982, the videogame industry was at $3 billion and there was a slump in
1985 when there was a loss of interest in the products that were coming out, since they seemed redundant. The industry hit bottom at $100 million in 1985 and at that time, it was Nintendo that rekindled the interest in videogames with improved graphics and also a new controller. Gun-like wands, which use light pulses to control the action on the screen, became standard equipment, and Nintendo introduced an advanced version of the joystick, festooned with additional controls that included a button that allows players to put a game into slow-motion, to give them a fighting chance (Potts, 1987).

As we will see, the industry’s situation in 1985 and in 2005 are very much alike, in that consumers appeared bored and retailers were selling games and game accessories at bargain prices. Also, in both the time periods a boom and a slump followed by a healthy recovery can be seen. Though videogames are fun, they have not been very helpful in influencing active lifestyles. The age old concept of a healthy body leading to a healthy mind and vice versa did not ring true for videogames for a long time. In the year 2000, a group of psychological experts from the United Kingdom came together to discuss physical activity and its association to positive emotions. The group agreed on a summary of what is currently known, and this was published as a number of consensus statements (Biddle, S.J.H., Fox, K.R. & Boutcher, S.H., 2000; Grant, 2000). This work recognized that physical activity has been associated with positive effect, mood and psychological well-being while physical inactivity is associated with negative emotions and mood (Mutrie, 2002). Videogame, as mentioned earlier were fun for the mind
and were after all, still only entertainment. This situation changed, (although over a long period of time) with the advent of “exer-gaming”, a combination of exercise and videogames.

“Exer-gaming” can be defined as employing a video game in a physical exercise routine. It could be the answer to the expanding population of obese children in the United States of America. The days of sitting in one place and interacting with the screen (regardless of its size) only with thumbs are over. Console games of today allow for more movement as the controllers are wireless and games are designed to get players off the couch and burn calories. The early examples of this would be the Nintendo Wii and the Sony Playstation Eyetoy which are now seen as stepping stones to more advanced game consoles like the ‘Kinect’ for Microsoft’s Xbox 360 and Sony’s new ‘Move’ which entertain, engage and also help in promoting fitness activities. A whole new term has been coined for such games as even gyms and fitness clubs have adopted this new technology and employed it to make exercise more of a game; hence the term “exer-gaming”. Hiding exercise behind a layer of fun makes exercise less monotonous and this is the reason why physiotherapists are excited about the new uses of videogames (Fitzgerald et al, 2010). While it has been argued that exergames are not a replacement for regular exercise and that they are more ‘game’ than exercise, new game titles like “Jillian Michaels Fitness Ultimatum 2010” and “EA Sports Active 2” are stepping up the standard for exergames and are working out game players like never before (McGinn, 2010).
Games then proceeded to capture imaginations of many and also invaded popular culture in many ways. Whether it be a Las Vegas bar where authors read prose and poetry (things that usually clear the room) with titles like “Mario and the Punk Rock Hero”, or films created around game characters and plots; there are many examples of other mediums being invaded by videogames (Stanley, 2004). Games can be perceived as an art form, one that is interactive and involves a few unrealistic scenarios, but an art form nevertheless (Bissell, 2010). A French politician Renaud Donnedieu de Vabres once said in an interview “Call me the minister of video games if you want. I am proud of this” (Crampton, 2006). He went on to say that games are a form of artistic expression involving creation from script writers, designers and directors. The interview was about the issue of whether or not to give videogames credit as an art form and also award a tax break like those awarded to French films. Thankfully, this did not materialize, as it would have certainly spelt disaster for the videogame industry in Europe.

This report takes into consideration only the devices that are dedicated to gaming, but there are mentions of other devices like mobile phones, and personal computers using innovative technologies for gaming. The reason for this is that videogame platforms are made exclusively for the purpose of playing games and deliver better performance and have no nuances when compared to personal computers. Although personal computers are still used for playing electronic games, the game publishers
know that the real money is to be made in platform games since dedicated gamers prefer such devices since they are always coming up with new controllers, vibrating body sensors, body-movement-activated and voice-activated controllers, head-mounted visors, light-gun weapons and other gizmos to make the game experience more real (Burrill, 1997). There are also more advantages like the absence of viruses and the considerably lower piracy rate of game titles that set the game platforms apart. The exercise bike has arguably been the most suitable candidate for teaming with computer games; the Atari Puffer project from 1982 is an often mentioned early example [Atari 2007]. The exercise or ‘stationary’ bike has evolved to be integrated as a controller for games played on personal computers and on platforms such as the Sony Playstation and Microsoft’s XBOX series.

Today there is quite a wide range of exercise bikes designed to be used as controllers, such as the Cateye GameBikeTM- marketed as a gym bike, the Tacx Fortius Trainer - produced as a training aid for cyclists, and the Fisher Price Smart Cycle - aimed at children and offering educational games as well as exercise (Sinclair et al, 2007). The first commercially successful exer-game was a game published by Konami of Japan named Dance Dance Revolution (henceforth KDDR); the game had sold over 6.5 million units worldwide by 2003. The game consists of a pressure pad with buttons that need to be pressed by the player’s feet in sync with music and corresponding arrows presented on screen. This unit was primarily for the arcade but later it was made for the home entertainment sector. The next innovation was
surprisingly not the wireless controller or ‘wand’ that the Nintendo Wii uses, but a camera. The Sony Playstation 2 had a new add on by the year 2002, namely the EyeToy, which uses the camera to track actions performed by the game player. The EyeToy has had a solid commercial performance but has yet to have a blockbuster game release. To this end, the eye-toy perhaps inspired others to employ motion sensors in exer-game technologies (Sinclair et al, 2007).

Toy companies like Hasbro have released these kinds of toys and their research and development teams are onto something big. Perhaps even bigger than the exer-gaming toys of the time, this is apparent from the ‘Games for Health’ conventions held since 2004. Among the toys that were released, one of them employed the ION technology which was patented by Hasbro, and that the technology is much like the “Eyetoy” in Sony’s Playstation consoles. Another toy maker “Fisher- Price” making activity based toys are not new, they have been making toys for the longest as they celebrate their 75th anniversary, they released the “Lazy Town get up and Go” mat, which is much like an exercise pad, but is interactive along the lines of Konami’s DDR. Toys target kids from 3 to 14, the only disadvantage is that when the kids outgrow the toys, they may just outgrow the physical activity they had, provided that the toys were all the exercise they got (Facenda, 2005).

In all of these instances, the aim has been to make videogames more physically intense and not to adapt physical exercises to videogames. Games
have also been useful in helping rehabilitate individuals who have a need to re-establish their body’s motor functions. Physiotherapists claim that 70 per cent of their patients are non-compliant; it is not that patients are not doing the repetitive exercises, but that they are not doing them properly. A new company, Exer-gaming Solutions, uses computer games that oblige the wearer to repeat certain movements to improve their physical capacity and skill. The technology uses a band with a sensor worn on the leg or the arm linked to a computer game. To play the game, the patient is required to make specific movements. The sensory technology allows the physiotherapist to monitor how often the patient does the exercises and whether or not they are done correctly (Labanyi, 2009). As if in agreement, the sports fitness scientists and the sports medicine experts write that the movements could also be adapted for use as physiotherapy (Itzkovich, 2010). When the term “exergaming” gained attention in the early 2000s, many firms were still working on new approaches to consoles, personal computers and mobile phone platforms. Sony (in partnership with Ericsson) is perhaps at the forefront on multiple platforms with the release of their entry level mobile phone the F 305 in 2008. A mobile phone that has advanced motion sensors that allow users to play games on it by using movements like the flick of a wrist or the swing of an arm (Peters, 2008). To date, it is the only mobile phone with this capability, although previous phones from the same manufacturer featured the same technology that was employed for measuring the distance walked by the user. This is an example of how manufacturers of
electronics are employing new ideas to help fight obesity and inculcate more active lifestyles.

While childhood obesity has quadrupled in the last decade alone, fingers have been pointed at many different probable causes. The fast food chains, the grocery stores that present TV dinners and high calorie snacks better than they do vegetables, but mostly, the blame has been thrust on videogames, improper diet, and sedentary lifestyle. While videogames are thought to displace active behaviors and are independently associated with obesity, hiding the exercise routine behind a layer of fun seems to be the answer that the game manufacturers are profiting from. The gaming industry reached a peak of U.S. $9.5 billion in the year 2007 (ESA, 2008).

Recent trends in consumer behavior and in the toy industry show that exer-gaming is on the rise as a recreational activity. The “Entertainment Software Association” (henceforth ESA), places the average gamer at 35 years of age and reports that 65 per cent of American households play computer or videogames (ESA essential facts, 2008). Below is a table containing the top 20 selling games of 2008 by units sold:
As the table shows, games with novel controllers are gaining popularity with 7 out of the top 20 games being the ones with new types of controllers. Not only the games but even when it comes to game accessories, of the top-10-selling video-game items in June of 2007, seven were Wii software or accessories. "Guitar Hero 2" for PS2 and Wii ranked Nos. 6 and 7 respectively, selling almost 400,000 guitars (and software) at average prices of $80 to $90, according to NPD (Bulik, 2007). It is to be noted that these statistics are only for video game consoles and do not include games for personal computers. As far as the rating for the games go, it does suggest that the higher percentage of games sold are rated E for everyone. The table

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<tr>
<th>RANK</th>
<th>TITLE</th>
<th>PLATFORM</th>
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<tr>
<td>1</td>
<td>HALO 3*</td>
<td>Xbox 360</td>
<td>MATURE</td>
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<tr>
<td>2</td>
<td>WII PLAY WITH REMOTE</td>
<td>Wii</td>
<td>EVERYONE</td>
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<tr>
<td>3</td>
<td>CALL OF DUTY 4: MODERN WARFARE*</td>
<td>Xbox 360</td>
<td>MATURE</td>
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<tr>
<td>4</td>
<td>GUITAR HERO III: LEGENDS OF ROCK*</td>
<td>PlayStation 2</td>
<td>TEEN</td>
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<td>5</td>
<td>SUPER MARIO GALAXY</td>
<td>Wii</td>
<td>EVERYONE</td>
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<td>POKEMON DIAMOND VERSION</td>
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<td>GUITAR HERO 2*</td>
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<tr>
<td>9</td>
<td>ASSASSIN'S CREED*</td>
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<td>MARIO KART</td>
<td>Nintendo DS</td>
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*Includes Collector's, Limited, Legendary, Bundles (Guitar) Editions

Source: The NPD Group / Retail Tracking Service
below shows the annual sales figures for the entire electronic gaming industry from 1996 through 2007.

![U.S. Computer and Video Game Dollar Sales Growth](image)

Figure 4, Source: NPD group.

The above figure shows that the 7.0 billion U.S $ barrier was broken in 2003 but there was a lull in sales through 2005 and 2006. The increase in sales in 2007 can be attributed (at least partly) to the Nintendo Wii being released into the market.
Table 3, Source: NPD group.

Table 3 (above) shows that there are 6 games in the top 10 selling games in the USA are for the Nintendo Wii. The audience reception evidently proves that games with novel controllers are well received if not preferred.
Figure 5 shows the computer and video game dollar sales growth in billions since 1996 up until 2009.

Toy companies like Hasbro have released these kinds of toys and their research and development teams are onto something big. Perhaps even bigger than the exer-gaming toys of the time, this is apparent from the ‘Games for Health’ conventions held since 2004. Among the toys that were released, one of them employed the ION technology which was patented by Hasbro, and that the technology is much like the “Eyetoy” in Sony’s Playstation consoles. Another toy maker “Fisher-Price” making activity based toys are not new, they have been making toys for the longest as they celebrate their 75th anniversary, they released the “Lazy Town get up and Go” mat, which is much like an exercise pad, but is interactive along the lines of Konami’s DDR. Toys target kids from 3 to 14, the only disadvantage is that when the kids outgrow the toys, they may just outgrow the physical activity
they had, provided that the toys were all the exercise they got (Facenda, 2005).

This only shows that videogames have made the long awaited transition into maturity.
CHAPTER 6 -USING EXERGAMES IN INTERVENTIONS

There has been much literature on the effectiveness of video games and energy expenditure. A pilot study whose purpose was to determine if interactive video/arcade games, requiring physical activity to play, increase the energy expenditure (EE) and heart rate (HR) of young adults enough to elicit a training response. Participants could play any of the three games for 30 minutes while metabolic and HR data were collected. Exercise data were compared to baseline measures, and the 3 games were compared for EE. Caloric expenditure during the 30-minute exercise session (226.07 ± 48.68) is also within the American College of Sports Medicine (ACSM) recommendations for daily physical activity (Siegel et al, 2010).

In a study that observed leisure activity patterns and their relations to obesity, children in the age group of 11 to 18 years were studied closely. All of the leisure activities were included in each latent class. Classes were distinguished by their members’ average level of participation in each leisure activity that then yielded an individual profile of each class. There was no mean difference in the mean BMI and prevalence of overweight between non-participants, 11-12 year-olds participating in the 14 year olds’ and 17 year olds’ questionnaires, or 14-year-olds participating in the 17-year-olds’ questionnaire. It was inferred that studying leisure activities may also serve to identify more distal determinants of obesity and overweight (Lajunen et al, 2009). Exergames may be a leisure activity which has spawned from a
medium thought to inculcate sedentary lifestyles, but this is no longer the case as we will see.

The Sony PlayStation 2 with Eyetoy, Wii and Nintendo consoles and "dance carpets" - which require active interaction by the player - can get users out of their chairs. These devices have sensors that enable them to "play tennis," dance or be physically active in other ways. Such activity, which has been dubbed "exergaming," can be very beneficial, the sports medicine experts write. The movements could also be adapted for use as physiotherapy (Itzkovich, 2010). Specific design changes no matter how minute, lead to various benefits to users, as an example, a randomized controlled trial (Fitzgerald et al, 2010) that compared the effects of wobble board exercises with and without feedback provided through integrating the wobble board movement into a computer game system, by comparing changes in postural stability and motivation found some very positive results. Although the changes in balance tests were not very significant, the major stride forward was the motivation levels. The findings suggested that exercising with the therapeutic exergaming system showed similar improvements in dynamic postural stability and showed a greater level of interest and enjoyment when compared to a group doing similar balance training without the game system. This motivation level is the missing key in other physical rehabilitation programs or in interventions. The International Obesity Task Force and the UAE Ministry of Health (2009), claim that 45 per cent of people between 15 and 45 are overweight. Also, 26 per cent of
children are obese, and bringing that number down poses a great challenge to health officials in the region. The causes for the epidemic are, once again, the lack of exercise and improper diets. These unhealthy lifestyle factors are leading to increased obesity rates in the country. In Motion Club, targeting the primary age group of 6 to 17 years provides complete fitness facilities based on Exergames and Exertainment, in a child-friendly environment.

In Idaho, Wittman (2010) collected data to determine if participating in exergames was an effective way to be physically active for youth ages 9-12 years of age. The Nintendo Wii was introduced into a 4-H after-school program as a pilot program since the state has an obesity rate of 10 per cent for children between the ages of 10 and 17 years. This study gives us a direct comparison between traditional games and exergames. Youth participated in two out of the three different Wii activities or game titles (Tennis, Boxing, and Dance Dance Revolution [KDDR]). These activities were selected by the amount of movement needed to play each game. The participants played each game for 20 minutes. Their heart rate was recorded both before and after each activity. Pedometers were also worn by participants during the activity, and the number of steps taken during each activity was noted. Youth then participated in two different traditional sports activities: capture the flag and kick ball. A youth committee comprised of three after-school participants determined the traditional activities that would be played. These activities were played for 20 minutes, and heart rate and pedometer recordings were recorded the same as for the Wii activities. Each
activity was played on a different day so the children’s heart rates would not already be high due to any previous exertion. The age range for these individuals was 9-12 years of age, and of the 25 participants 16 were male while the remaining 9 were female. The research reported that the majority of children had increased heart rates and had average pedometer readings of 600.

Table 4, Wittman, 2010.

<table>
<thead>
<tr>
<th>Scale</th>
<th>DDR</th>
<th>Tennis/Boxing</th>
<th>Capture the Flag</th>
<th>Kick Ball</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 or above</td>
<td>80%</td>
<td>84%</td>
<td>68%</td>
<td>63%</td>
</tr>
<tr>
<td>8 or above</td>
<td>36%</td>
<td>60%</td>
<td>64%</td>
<td>32%</td>
</tr>
</tbody>
</table>

The above table shows the results of children rating their perceived exertion levels on a scale of 1 to 10. Where 1 is the least amount of exertion and 10 is the highest amount of exertion. As we can see, the ‘perceived’ exertion levels in the Wii games range between almost equal to higher than traditional play.

Apart from exertion, enjoyment is an important factor since it reduces adherence issues. Participants should enjoy the activities if they are to adhere to any physical activity regimen.
The above table shows the level of enjoyment in activities that the children participated in during the study. These results were obtained after reviewing the feedback forms from children which had a 4 point scale where 1 was the least enjoyed activity and meant that the child would not play, 2 being activity was alright, 3 being activity was good, and 4 being activity was fun and would definitely play. The children's enjoyment rating indicated that using exergames is engaging and an effective method for increasing physical activity in youth. The author concluded that, given the popularity of the Wii, exergaming is an avenue for Extension educators and health professionals to incorporate physically and mentally stimulating activity into their programs.

In a study that evaluated the effects of exergaming on physical activity among 4 inactive children in a physical education (PE) classroom, Fogel et al (2010), showed that exergaming produced substantially more minutes of physical activity and more minutes of opportunity to engage in physical activity than did the standard PE program. In addition to this, exergaming was also socially acceptable to both the students and the PE teacher. The

<table>
<thead>
<tr>
<th>Activity</th>
<th>Enjoyment (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDR</td>
<td>72%</td>
</tr>
<tr>
<td>Tennis/Boxing</td>
<td>76%</td>
</tr>
<tr>
<td>Capture the Flag</td>
<td>79%</td>
</tr>
<tr>
<td>Kick Ball</td>
<td>26%</td>
</tr>
</tbody>
</table>

Table 5, Wittman, 2010.
exergames titles that were employed in the study and a short description of each game are as follows. Electronic Sports Dog Fighter Simulator is a form of a virtual bike that resembles a traditional bike and allows children to control all on-screen actions, including steering, speed, turns, firing mechanisms, and other strategies. The faster the player pedals, the faster the objects on the screen move. Cateye Virtual Bike with Sony Play Station was used in which the title ‘Dirt Biking’, which is another form of a virtual bike that functions like the Dog Fighter, was played. Nintendo Wii Sports Baseball is an exergames which is a virtual sport that allows children to participate in a baseball game inside a virtual world. After a swing or a throw, the screen provides a replay of the play; however, the player may choose to skip this option. iTech Fitness XrBoard is a game that uses a balance board simulator that allows children to snowboard down a mountain or practice complicated skateboarding tricks. Also used were two other Nintendo sports titles namely, Nintendo Wii Boxing, and Nintendo Wii Sports Tennis. On the scoring survey, the PE teacher reported a 30 per cent reduction in time spent dealing with behavior problems, a 30 per cent increase in students following directions, and a 50 per cent increase in time spent having students practice a PE skill or activity per session. The potential that exergames have in dealing with adherence issues is clearly demonstrated in this study.

We have established that exergames are an effective means of increasing physical activity in children and that they even minimize adherence
issues. Below is a table that shows most of the exergames titles available in the market today and their target audiences.

Table 6 Ratings by Entertainment Software Rating Board.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Type</th>
<th>Title</th>
<th>ESRB Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Konami</td>
<td>Dance Pad. Wii, PlayStation, PC, XBOX 360.</td>
<td>Dance Dance Revolution 2</td>
<td>E (Everyone)</td>
</tr>
<tr>
<td>Nintendo</td>
<td>Wii wand game, Wii Fit Games</td>
<td></td>
<td>E (Everyone)</td>
</tr>
<tr>
<td>Cybex</td>
<td>Standalone. With bike, pressure pad, camera.</td>
<td>Tazer games</td>
<td>Not available.</td>
</tr>
<tr>
<td>Nintendo International</td>
<td>Wii wand and bike, punchak pad, camera.</td>
<td>Wii Sports</td>
<td>E (Everyone)</td>
</tr>
<tr>
<td>Electronic Arts</td>
<td>Wii and Xbox 360</td>
<td>EA sports Sonic the active hedgehog</td>
<td>E (Everyone)</td>
</tr>
<tr>
<td>Majesco Entertainment</td>
<td>Full size exercise bike interfacing with games via Wii, XBOX 360</td>
<td>Everbike Pro Zumba Fitness Party</td>
<td>E (Everyone)</td>
</tr>
<tr>
<td></td>
<td>pedal speed and steering.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Konami</td>
<td>Dance Pad. Wii, PC, Sony Playstation</td>
<td>Dance Dance Revolution 2</td>
<td>E 10+ (Everyone 10+)</td>
</tr>
</tbody>
</table>
Companies like 'Cybex' who are primarily fitness equipment manufacturers are also branching out to make exergames. As we can see from the above table, there are several games that are appropriate for players of all ages. Unfortunately, there is a lot of doubt about the effectiveness of exergames to inculcate an active lifestyle. This is due to the marketing of the exergames titles. As seen in a commercial (Microsoft Kinect, 2010), the entire family is seen having fun together with the exergames and a positive tone is seen throughout the advertisement. Also the advertisement for the Wii in the USA showed several game titles and also the target audience was represented (Nintendo Wii, 2006) there were also some elements of other Nintendo game titles in the commercial outside of the in- advertisement screen space. Even the newer products from Nintendo for the Wii console, aimed at fitness (Wii fit, 2008) had the commercial showing exercise as easy. In all of these commercials, and most of the other exergames commercials in general, show people having fun gaming where usually, the entire family is present in the advertisements playing effortlessly. There is a need for exergames to shed the image of “more game than exercise”. And this can only be accomplished by showing real exertion and sweat in advertisements that are run on television or in online videos.
CHAPTER 7 - CONCLUSION

As we have seen, exergames are a force to be reckoned with, when it comes to prevention or treatment of childhood obesity. A mass medium that was thought to be part of a sedentary lifestyle is now leading the way in helping children to have a more active lifestyle. Where traditional physical activity interventions had adherence issues, interventions that used exergames have been enjoyable.

Exergames alone, meet the requirements to be deemed as exercise, but are not enough to get truly fit. They are only a platform through which active lifestyles are encouraged. That being said, exergames are the better choice compared to electronic games with traditional controllers or joysticks as they help to burn calories and hide the boring exercise routine behind a layer of fun. The games offered on all of the previously mentioned devices have been more game than exercise. But that is changing with the world’s largest electronic games publisher Electronic Arts taking exer-gaming seriously with their release of “NFL Training Camp”. The game is available on the Nintendo Wii, and features strenuous workouts which are effective and employ the Wii’s remote control, resistance bands, and an arm band sensor that doubles as a heart rate monitor. With the arm band monitoring heart rate, the game is more accurate in calculating calories burned during sessions. There is more motivation in this game than others as it is targeted specifically at football fans and has an online functionality where players can choose their favorite team. After which, they are paired with that team’s stats and the
points they earn by burning calories are added to the teams points. This offers hardcore fans a chance to do more for their team as well as for themselves (IGN, 2010). There are more game titles that feature actual trainers that motivate players to work out like “Your Shape Fitness Evolved”, developed by Montreal-based Ubisoft, “Jillian Michaels Fitness Ultimatum 2010” and “EA Sports Active 2” both promise to get users to work up a sweat. These new titles will get videogame players fitter and will help ‘Exer-gaming’ live up to its potential and help exergames to shed their reputation as child’s play (McGinn, 2010). There are other exergames, whose controllers are actual fitness equipment like exercise bikes. These fitness products can be connected to game consoles and personal computers and are compatible with most games. As we have seen, video games have taken a turn towards maturity by employing new technologies and are well on the way to eliminating controller devices. But, exergames are treated as a genre by itself rather than a novel way to play videogames. Most titles available in new controllers are in the sports genre; this is something that must change.

The factors that are most significant in developing future exergames that deal specifically with childhood obesity are the need to create games that are not so obviously exergames, i.e., the market has been flooded with sports titles and other fantasy genre titles that consumers can judge to be as exergames by just looking at the box art. Game publishers should be able to utilize the technology that manufacturers have developed, and use it to forward the game experience. The technology must be used to help in
forwarding the narrative elements in games and titles of all genres and must have a way to get players to exert themselves physically while enjoying the art form that is the videogame. Future works should try to incorporate all of the above elements with accurate marketing that help exergames shed the image of more game than exercise. Exergame packages should also have a shorter learning curve and just like the current trend, should be appropriate for all ages. When considered as an intervention method, a reduction of childhood sedentary activities should be promoted. Such an intervention should require a family and school alliance, and parental commitment to behavioral change and provision of alternative leisure activities, such as exergaming, is much needed. This intervention could also be incorporated into positive parenting strategies and early childhood education since childhood is the best time to teach positive habits. Schools should promote physical activity and the learning of skills that allow lifelong physical activity. Though exergames qualify as exercise, they should not replace traditional physical activities. Exergames are a platform through which youth are encouraged to be more physically active and can be employed to help children at high risk of becoming obese (children in urban areas, children who cannot play outside due to weather or safety concerns etc.,).
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   The Rise of Exer-Gaming

Major Professor: Dr. John Hochheimer