

The Effect of Screen Time on Childhood Obesity

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Abstract

One in five children in the U.S. is overweight. With a child not being considered a “rational consumer” the way they chose to allocate their time is done so without knowing the opportunity cost of investing in their own health as a form of human capital. If children choose sedentary activities such as watching television, playing video/ computer games will this affect the obesity rates in children? This paper uses data from the Child Development Study to test the hypothesis that screen time and obesity in children is correlated using a cross-sectional linear regression. There is a relationship between time spent watching television and obesity in children, however the R^2 indicates that the variables are poor predictors of obesity.

1. INTRODUCTION

“At a basic level, weight gain and obesity are the result of individual choices. Consequently, economics, as a discipline that studies how individuals use limited resources to attain alternative ends, can provide unique insight into the actions and forces that cause individuals to gain excessive weight (Philipson et al).”

If children choose to allocate their time towards watching television, or playing video games, or computer usage, are they doing so at the expense of the investment in their own health as a form of human capital? Does screen time affect the obesity rate in children?

The Family Economics and Nutrition Review (1999) noted that about one in five children in the United States is now overweight, and that being overweight during childhood is associated with being overweight in adulthood. If an obese child grows into an obese adult employment could be affected, as found by the 2003 Decennial Health Survey collected by the French National Institute for Statistics and Economic Studies. This study found that a percentage of time spent unemployed (during working years) is significantly higher for each kg/m^2 deviation from the mean Body Mass Index (BMI) attained at age twenty; also mentioned was that the probability of being reemployed after a long span of unemployment is lower (Paraponaris et al. 2005).

According to Dietz and Gortmaker (1985) watching television requires no energy in excess of resting metabolic rates, and it may reduce time spent on more energy expending activities, which could contribute to child obesity. The cost of allocating time in this manner is the reduction in healthy years of life due to obesity related health effects: high blood pressure, high cholesterol, heart failure, liver problems, bone & joint problems in lower limbs, growth abnormalities, and rashes or fungal infections (Kulkarni et al.). Where as another consequence of television viewing is that the food most heavily advertised on children’s television, and more

likely to be consumed by children watching increased amounts of television, are calorically dense foods (Dietz and Gortmaker).

In an article written by John Cawley (2006) he points to the operation of the markets as contributing to the recent increase in overweight children in three ways: First, the real price of food has fallen; in particular, those foods that contain fats and sugars have become relatively cheaper than fresh fruits and vegetables. Second, the rising wages have increased the opportunity costs of food preparation, encouraging less time to be spent on preparing meals (Cawley). Third, changes in technology have provided an incentive to the consumer to utilize prepackaged foods instead of preparing the food themselves (Cawley).

Hernandez et al. (1999) states “Plausible, although unproven, mechanisms by which TV viewing may increase the risk of obesity include a reduction in time dedicated to physical activity, and increases in dietary intake while eating food while watching TV, and a reduction in RMR [Resting Metabolic Rates] while watching TV/video.”

2. LITERATURE REVIEW

The following studies attempt to address the overall research question of this paper: Is there a correlation between the amount of screen time a child is exposed to and the obesity rate among children? Screen time includes television viewing, video games, and computer usage.

According to Robinson (1998), the extrapolation of Nielsen Media Research, Written Communication, February 1997 data revealed that US children, between the ages of 2 and 17 years, spend an average of three years of their lives watching television (this time does not include time spent watching videos, playing video games, or using a computer). Also cited was the Anderson et al. portion of the National Health and Nutrition Examination Survey III, from 1988 through 1994, where 80% of the children reported three or more episodes of vigorous

physical activity per week (Robinson). Despite this high percentage of physical activity reported, 26% of the sample also reported watching four or more hours of television on the previous day; with children who had greater BMIs and trunk skinfolds being more likely to report watching more television on the previous day (Robinson). Robinson (1998) also states that there are two primary mechanisms that have been proposed to link television viewing and body fatness: reduced energy expenditure from displacement of physical activity, and increased dietary intake, either during viewing or in response to advertisements for food.

Dietz and Gortmaker (1985) examined data from the National Health Examination Survey (NHES) cycle II and III. They used two cross-sectional samples and one longitudinal sample of US adolescents and children to see if television viewing and child obesity were associated (controlling for other variables known to influence childhood obesity). They found that those who watched more television daily were significantly more obese than their counterparts who watched less television and that the probability of a child being obese increased 1.2% to 2.9% for each additional hour of television watched per day. This study would support the statement made by Robinson (1998) that television is linked to body fatness, because as the child increases the hours of television watched they are reducing the amount of calories (energy) expended. This is due to the child allocating their time towards a sedentary activity rather than being physically active.

A study conducted by Hancox, Milne, and Poulton (2004) assessed approximately 1,000 unselected individuals born in New Zealand, in 1972-1973, at regular intervals up to age 26; they found that average weeknight viewing between ages 5 and 15 was associated with higher body-mass indices.

A study conducted among children in Mexico City found that the odds ratios of obesity were 12% higher for each hour of television program viewing per day (Hernandez et al.).

Wake, Hesketh, and Waters (2003) conducted a large epidemiological study of the health of school children in Victoria, Australia that was part of the 1997 Health of Young Victorians Study (HOYVS). They used a stratified two-staged sample design to sample school children representative of the population by age and school education sector. Wake et al. found that the mean BMI z-scores were 0.60 for boys and 0.42 for girls (SD 1.07 and 1.06 respectively) and increased in a stepwise fashion with increasing hours of television viewing and video game/computer use. A one way ANOVA confirmed significant relationships between mean BMI z-scores and the four television viewing categories for the whole sample and for boys and girls separately, however, there was no significant relationship between BMI and the four categories of video game/computer use overall (Wake et al.). Yet, when hours of television viewed and video game/computer use were combined into an average of “sedentariness,” the results were almost identical to those reported for television alone (Wake et al.).

Proctor et al. (2003) conducted a longitudinal study, known as The Framingham Children’s Study, of 106 children from preschool years (mean age 4) to adolescence (mean age 11.1). In this study the children’s parents completed a questionnaire about the child’s television and viewing habits and each child’s BMI, triceps skinfolds, and sum of five skinfolds being recorded yearly (Procter et al.). Results from The Framingham Children’s Study indicated that by the time of early adolescence, BMI was highest for those children who watched the most television and that BMI was the lowest for children who watched the least. This study separated television viewing hours into three categories less than 1.75 hours, 1.75 hours to less than 3 hours, and greater than 3 hours (Procter et al.). At the end of their follow up (at age eleven) they

found that those children who watched 3 hours or more of television per day had a higher mean sum of skinfolds compared with the mean of skinfolds for those watching between 1.75 to less than 3 hours of television per day and the mean of skinfolds for children watching less than 1.75 hours per day (Procter et al.). In all cases, those children that watched more than 3 hours of television per day had a statistically significant higher BMI, triceps, and sum of five skinfolds than children who watched less than 1.75 hours per day (Procter et al.).

Stettler, Signer, and Suter (2004) conducted a cross-sectional study, concerning the relationship between obesity and electronic games, that found: obesity was independently associated with time spent playing electronic games, the time spent watching television was inversely related with physical activity, and that the association of electronic game use with obesity was significant, with a 2-fold increase risk of obesity by hour per day spent playing electronic games. In this study it was expected that there would be a positive association between television viewing and childhood obesity, this association was also significant. For each additional hour of television per day there was a two- to three fold increased risk (Stettler et al.). These studies show that an increase in overall sedentary activities, such as television viewing, playing computer games, and/ or playing video games have an impact on the weight of children. This is the result of children allocating their time towards a non-energy expending activity as opposed to an energy expending activity. Since children are not considered “rational consumers” they are allocating their time without knowing the opportunity costs of investing in their own health, costs such as low wages as shown in the Cawley study below.

Cawley (2004) conducted a study where he utilized panel data from the National Longitudinal Survey of Youth (NLSY) from 1981-2000 to investigate the effect of body weight on a person’s wage. Controlling for factors that may cause a person to have lower wages as well

as a higher body weight he found that increased body weight lowers wages for White females and that no wage effects were found for other gender and ethnic groups (Cawley). According to The Economics and Nutrition Review (1999) being overweight in childhood is associated with being overweight in adulthood; so a child who is a White female and obese could potentially face low wages in the future (adulthood). Also, a child with these particular characteristics is not investing in their health, which in adulthood could cause externalities to occur in health insurance pools as the Bhattacharya and Sood (2004) study indicates below.

Bhattacharya and Sood (2004) developed a model of weight loss and health insurance under two alternative regimes: regime 1 allows for underwriting on weight, and premiums are a function of weight and regime 2 does not allow underwriting on weight, and premiums are not based on weight. Bhattacharya and Sood (2004) then analyze welfare under each regime and they also estimate the change in prevalence of overweight and obesity when regime 2 changes to regime 1. They found that with full insurance coverage there is no incentive for weight loss when underwriting is allowed, however, if allowed consumers benefit because weight loss decreases their own premium and that changes in co-payments also provide an incentive for weight loss. Bhattacharya and Sood (2004) then noted that obese and overweight people, due to their higher risk of chronic diseases, with health insurance impose significantly higher costs on healthy-weight people in the same insurance pool causing an “externality” to arise because weight-based underwriting of health insurance premiums is not practiced. However, when the authors estimated welfare loss they ran a simulation model under both regimes; the results indicated that a modest co-payment could limit these external effects (Bhattacharya and Sood).

These studies indicate that sedentary activities such as television viewing, playing computer/video games are associated with increased weight, BMI, and/or trunk skinfolds; these

activities can individually have an effect on childhood obesity or can have an effect on childhood obesity lumped together as an average of “sedentariness.”

3. METHODS

Data was obtained from the Panel Study of Income Dynamics (PSID) Child Development Study's (CDS) Time Diaries. The PSID website allows the user to select variables from the CDS that pertain to the user's interest and download them along with a codebook. Variables chosen from the CDS were: gender of child, date of birth, BMI, height, weight, and weekday time spent watching TV, playing video games (referred to in the CDS as electronic games-e.g. Nintendo), and playing computer games, and weekend data for TV, computer games, and video games was also obtained. To determine whether the child was obese I compared the BMI given by the CDS to two different growth charts provided by the Center for Disease Control (see Appendix A); one growth chart for girls and one for boys. By doing this a limitation in my research occurs, I base whether or not the child is obese by “eyeballing” the cut-off point for non-obese BMIs; I estimate based on where I think the 95th percentile line intercepts weight in pounds for each age (2-20). A child is considered obese if their current weight is greater than or equal to the 95th percentile, or the weight that was estimated. For example: according to the CDC growth chart, boys age five weighing greater than or equal to 52 pounds (estimated) would be considered obese, by weighing greater than 52 pounds (estimated) the child's weight falls above the 95th percentile line. A cross-sectional linear regression will be run using the data provided by the CDS; however, confounding presents a problem. According to Hancox et al. (2004) several childhood behaviors can explain the association between television viewing and health. Stating that the most obvious of these behaviors are physical activity and diet, while these are potential confounding influences, they could also be in the causal pathway (Hancox et

al.). In the Procter et al. (2003) study they controlled for body fat of both mothers and fathers to address the issue of predisposition of weight gain due to genetic factors. Family effects were also controlled for in the Dietz and Gortmaker (1985) study. According to Robinson (1998) cross-sectional studies cannot eliminate the possibility that the “causal arrow” is backwards, i.e. if the amount of television viewing is measured at the same time or after body fatness is measured, watching more television could be the consequence of being overweight. However, for television watching to be a risk factor for childhood obesity, there must be a precedent established, with a greater amount of television viewing preceding the development of overweight (Robinson). The regression will be run on the 905 children who are considered obese according to the CDC growth charts with regressors: time spent watching television per week (TV/wk), time spent playing video games per week (vg/wk), and time spent playing computer games per week (cg/wk) (referred to as X variables). All X variables are measured in seconds. The second linear regression will be run only on the children who are not obese (N=1400), and a third linear regression will be run on all children obese and not obese (N=2306), with the same aforementioned regressors. The Y variable will change for each regression run: BMI_{obese}; BMI_{non-obese}; and BMI_{obese & non-obese} respectively. Prior to these regressions being run, children were eliminated from the data set that had no information recorded for height, weight, BMI, and the three activities.

4. RESULTS

Regression output can be found in Appendix B

The first regression run was for obese children:

$$\text{BMI}_{\text{obese}} = \beta_0 + \beta_1[\text{cg/wk}]_1 + \beta_2[\text{vg/wk}]_2 + \beta_3[\text{TV/wk}]_3$$

This regression yielded an R² of 0.018 indicating that the X variables are poor predictors of the Y variable. Approximately 1.8% of the variation in BMI for obese children is explained

by the variation in all of the X variables. The only variable that was statistically significant, when tested at the 5% level, was TV/wk. This implies that there is a relationship between television and BMIs that indicate obesity in children holding all of the other X variables constant. Therefore a one hour increase (3600 seconds) in television watched yields a 0.295 unit increase in BMI in obese children holding all other X variables constant.

The second regression that was run was for non-obese children only:

$$\text{BMI}_{\text{non-obese}} = \beta_0 + \beta_1[\text{cg/wk}]_1 + \beta_2[\text{vg/wk}]_2 + \beta_3[\text{TV/wk}]_3;$$

yielded a R^2 that was .005 indicating once again that the X variables are poor predictors of the BMI in non-obese children with approximately 0.5% of the variation in Y being explained by the variation in all of the X variables. Again the only variable that was statistically significant was TV/wk, where a one hour (3600 second) increase in television watched per week increases BMI for non-obese children by 8.476524^{-3} units holding all other X variables constant.

The third regression that was run was on both obese and non-obese children:

$$\text{BMI}_{\text{obese \& non-obese}} = \beta_0 + \beta_1[\text{cg/wk}]_1 + \beta_2[\text{vg/wk}]_2 + \beta_3[\text{TV/wk}]_3;$$

yielded a R^2 of .013 which also indicates that the X variables are poor predictors of the BMI in both obese and non-obese children with approximately 1.3% of the variation in the Y variable being explained by the variation in the X variables. However, in this regression both the variables TV/wk and vg/wk were statistically significant indicating a relationship between BMI in both obese and non-obese children and time spent watching TV, holding all other variables constant, and time spent playing video games, holding all other variables constant. A one hour (3600 second) increase in television watched per week increases BMI for both obese and non-obese children by 0.209 units holding all other variables constant. While a one hour (3600

second) increase in playing video games per week increases BMI by 0.124 units, holding all other X variables constant.

5. DISCUSSION

According to the regressions run there is a relationship between time spent watching television, and time spent playing video games in both obese and non-obese children to BMI. However, the latter activity was not found to be statistically significant in the regressions run on obese children only and non-obese children only. In all three regressions there was a relationship between BMI and time spent watching television, however, the X variables were determined to be poor predictors of BMI as indicated by the low R^2 values for all three regressions. These findings imply that there is a relationship between time spent watching television and BMI in both obese and non-obese children; and that there is a relationship to time spent watching television and obesity in children according to the results of the regression that was run on obese children only. In the health related studies mentioned in the literature review they found the same relationship between television and obesity in children. In the Dietz and Gortmaker (1985) study they found that those who watched more television daily were significantly more obese than their counterparts, who watched less television. The study conducted by Hancox, Milne, and Poulton (2004) found that television viewing, in particular weeknight viewing, was associated with higher BMIs in children. However, there is not a relationship between time spent playing video games and time spent playing computer games and obesity in children. This finding is different than what the study conducted by Stettler, Signer, and Suter (2004) found. Stettler et al. (2004) found that the association of electronic game use with obesity was significant. In this study the relationship between obesity and time spent playing video games is not significant.

“A bodybuilder with a large muscle mass and a low percent body fat may have the same BMI as a person who has more body fat because BMI is calculated using weight and height only (CDC)”

BMI is not an accurate measure of measure obesity or being overweight. For example there could be two individuals same height, same weight, and their BMI indicates that they are both obese, however their body composition could be different, meaning that they have different percentages of body fat. Another important limitation is that of precedent and whether or not obesity or being overweight followed that of television viewing, video/computer game usage, or if the child was already obese or overweight prior to these activities being performed. Another limitation is genetics and/or family effects as controlled for in the Dietz and Gortmaker (1985) study. Essentially one would need to control for the effects of the nature vs. nurture conundrum. A child could be genetically predisposed to obesity and these activities would not have an effect on the child’s BMI. Also, a child could be exposed to a certain family environment that could effect whether or not the child is obese. Perhaps a study could be conducted on types of family environments that are conducive of obesity in children. For example, the parents may prefer sedentary activities over being active or participating in energy-expending activities and this behavior, or this choice, is being mimicked by the child or poor nutritional and exercise habits are being taught to the child. A future study could be conducted on the technological effects on the eating patterns of dual-income families (both parents working with children). Due to the poverty of time created with both parents working and how advancements in technology have provided an incentive to the consumer to utilize prepackaged foods instead of preparing the food themselves (Cawley), this could lead to the parent choosing prepackaged food, or “fast-food” for their child causing potential weight gain in their child that could lead to obesity. With both parents working, parents will have less time to spend with their child, leading to less parental

involvement in monitoring healthy food choices. Also this lack of time spent with the kids could lead parents to feel guilty and to make up for this lack of time spent with their kids, they buy their child whatever they want, including food items that are calorically-dense like those advertised on children's television programs. If parents are unable to teach the child how to live a healthy lifestyle, whether it be due to poverty of time or that the parents themselves do not lead a healthy lifestyle, policies could be created to increase school funding to provide for the teaching of healthy diets and exercise via physical education programs and nutrition programs.

6. CONCLUSION

In conclusion the regression run on obese children indicates that there is a relationship between obesity in children and time spent watching television, however there is no relationship between the other two variables. In all three regressions that were run there was a relationship between television viewing and a child's BMI whether the child is considered obese or not. Limitations arise from this study including, estimation of the cut-off point for being considered not obese, confounding, BMI not being an accurate measure of obesity, and lack of precedent established. While a majority of the studies reviewed support the findings of this study, i.e. television has an effect on obesity in children, the Stettler et al. study found that the association of electronic game use with obesity was significant while this study did not. If healthy diet and exercise choices are not promoted by parents in the home, perhaps policy could be written to increase school funding to provide for physical education and nutrition programs to teach healthy diet and exercise choices to children in order to reduce the prevalence of overweight children as noted by the Family Economics and Nutrition Review (1999).

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