A Note on The Effect of Television Viewing and Computer Use on Adult Obesity

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Abstract

This paper considers the effect of television viewing and computer use on obesity for adults as a whole and then by gender using NHANES 2003-2004 data. Using body mass index (BMI) as a measure of obesity, our results for the adult sample indicate that both television viewing and computer use are positively associated with obesity. However, television viewing is more significant and closely related with BMI than computer use. When we conducted the analysis by gender, results suggest that television viewing is statistically significant and has positive effects in both genders but computer use is not significant in female adults.

Key words: obesity, body mass index (BMI), television viewing, computer use

1. Introduction

Obesity is an increasing health risk to many Americans. Since the late 1970s, the number of obese adults in the United States has grown by over 50% (Chou et al, 2004). Obesity can affect some chronic diseases such as heart disease, high blood pressure, diabetes and some forms of cancer. According to a 1988 report on nutrition and health from the U.S. Surgeon General, one-fourth of adult Americans are overweight. The National Institute of Health (1985) also reported that obesity is one of the most significant health concerns facing Americans.

There are mainly two groups of researchers who can explain the growth of overweight problems. One group of researchers suggests that obesity growth is mainly due to higher intake of calories. The other group asserts that a lower expenditure of

calories in daily activities mainly causes the obesity. The common ground in both groups is that obesity results from a positive imbalance in the energy equation, which leads to fat accumulation in the body (Loureiro, 2005).

A common and accepted measure of obesity, Body Mass Index (BMI) is defined as weight in kilograms divided by height in meters squared. According to the World Health Organization (1997), recommended BMI levels are generally between a numerical value of 20 and 25. An individual with a BMI between 25 and 30 is considered to be overweight, while a BMI above 30 is considered obese.

Previous studies on obesity have focused on dietary habits and physical activity, but there is increasing interest in the effect of sedentary behaviors such as television viewing, computer use, and electronic games on obesity (Kaur, 2003). Since 1970, the mass media have profoundly altered American leisure. Television viewing has become a popular leisure activity that promotes a sedentary lifestyle by using available time for physical activity (Atherton, 2006). Television viewing is thought to displace physical activity and is also associated with increased snacking and consumption of nutritionally poorer diets (Kaur, 2003). For example, Tucker (1989, 1991) reported that during television viewing, time for exercise is reduced significantly so that the metabolic rate of the heart and other muscles in the body is slower and fewer calories are used. Therefore, the time for television viewing can yield a change in the time for physical activity and also a change in the quantity, quality and frequency of food consumption. As a result, this may have an influence on BMI.

A number of studies in the non-economics literature have found a positive relationship between the prolonged time of television viewing and overweight or obesity status (Robinson et al, 1998, Jeffery et al, 1998, Kaur, 2003, Proctor et al, 2003). Bowman (2006) observed that more than two hours of television viewing per day was associated with high mean BMI and was also associated with significantly higher energy intakes at dinner and from snacks than one hour of television viewing. Burke et al (2006) assessed the effect of the time Australian adolescents spent in television viewing and other sedentary behaviors in addition to the effect of their diet and fitness on their weight. They observed that fitness was negatively related with the odds of obesity in boys and girls, but television viewing was positively related for boys and negatively related for girls although the magnitude of the effect was small. Robinson

(1998) also reported that time spent in watching television was found to be directly associated with a prevalence of obesity among children and adolescents. Tucker (1991) found out that adult males who watched television more than three hours per day had twice the probability of being obese as those who watched less than one hour per day. Similarly, Dietz and Gortmaker (1986) showed that children's obesity increased substantially as television viewing increased. Crespo et al (2001) reported that television watching was more closely associated with BMI than physical activity.

While a number of the papers discussed above have focused on the effect of television viewing, no known economic study have analyzed the effect of both television viewing and computer use on adult obesity. In addition to the well known fact that Americans watch a lot of television, it is also common notion that computer use in the US is high and becoming an important part of everyday life.

The purpose of this study is to examine how television viewing and computer use are associated with BMI using NHANES (National Health and Nutrition Examination Survey) 2003-2004 data of adults over 20 years of age. Specifically, we examine the relationship of these factors with BMI using the adult sample and then by gender.

2. Empirical model

Obesity is a function of an individual's energy balance, which is measured as the difference between caloric consumption and caloric expenditure in a given period. A behavioral model of obesity has to define the determinants of energy consumption and expenditure (Chou et al, 2004). In addition to this energy balance, socio-demographic factors such as gender, age, ethnicity, education, and household income influence the process by which energy balances are translated into changes in BMI. In this paper, we model the body mass index (BMI) as a function of our variables of interest (e.g., television viewing and computer use) as well as control variables that include physical activity, total energy consumption and other socio-demographic characteristics as depicted in equation (1) below.

$$BMI = f(TV, COM, \textit{calorie, activity,} E, D, I) \qquad (1)$$

where TV represents television viewing, COM is computer use, *calorie* represents total energy intake, *activity* represents the index for physical activity, E is education status, D represents demographics and I is income.

The regression models for adults and male or female adults have the following form (2) and (3):

$$\text{BMI (adults)} = \alpha_{0t} + \alpha_1 \text{female} + \alpha_2 \text{age} + \alpha_3 \text{age2} + \alpha_4 \text{black} + \alpha_5 \text{hispanic} + \alpha_6 \text{hsch} + \alpha_7 \text{mhsch} + \alpha_8 \text{midinc} + \alpha_9 \text{highinc} + \alpha_{10} \text{single} + \alpha_{11} \text{act1} + \alpha_{12} \text{act2} + \alpha_{13} \text{act3} + \alpha_{14} \text{act4} + \alpha_{15} \text{act5} + \alpha_{16} \text{TV2} + \alpha_{17} \text{TV3} + \alpha_{18} \text{calorie} + \alpha_{19} \text{COM2} + \alpha_{20} \text{COM3} + u \quad (2)$$

$$\text{BMI (male or female)} = \alpha_{0t} + \alpha_1 \text{age} + \alpha_2 \text{age2} + \alpha_3 \text{black} + \alpha_4 \text{hispanic} + \alpha_5 \text{hsch} + \alpha_6 \text{mhsch} + \alpha_7 \text{midinc} + \alpha_8 \text{highinc} + \alpha_9 \text{single} + \alpha_{10} \text{act1} + \alpha_{11} \text{act2} + \alpha_{12} \text{act3} + \alpha_{13} \text{act4} + \alpha_{14} \text{act5} + \alpha_{15} \text{TV2} + \alpha_{16} \text{TV3} + \alpha_{17} \text{calorie} + \alpha_{18} \text{COM2} + \alpha_{19} \text{COM3} + u \quad (3)$$

The description of the dependent and independent variables is summarized in Table 1. All independent variables except for age, age2 (age square) and energy use are dummy variables. Female represents gender, and black and hispanic represent race/ethnicity. Hsch and mhsch indicate educational status, and midinc and highinc stand for household income. Single represents marital status and act1~act4 are for physical activity. TV2 and TV3 represent the time spent for television viewing. Calorie is total energy consumption, measured in Kcal.

3. Data

The data set used in this study is from the National Health and Nutrition Examination Survey (NHANES 2003-2004). A total of 5041 adults, over 20 years old, participated in this survey. Due to incomplete data in some of the variables, 4647 observations for adults were used and among them, 2410 and 2237 observations were used for the female and male samples, respectively, in the analysis. In the data, television viewing and computer use are measured using three categories based on time spent on the activity per day over the past 30 days. For television viewing, the first group (TV1) represents those watching television less than one hour, the second group

(TV2) represents those watching television greater than or equal to one hour and less than four hours, and the third group (TV3) represents those watching television greater than or equal to four hours. In the same way, for computer use, COM1 represents computer use of less than one hour, COM2 represents two and three hours of computer use and COM3 represents more than three hours of computer use.

Crespo et al (2001) noticed that the individual questions pertaining to physical activity in the NHANES may not be sensitive enough to measure physical activity accurately. Consequently, we used four detailed questionnaires for physical activity. Act1 describes general information about daily activities. Act2 means moderately active tasks, act 3 means vigorous activities and act 4 means muscle strengthening activities. These four questions make up four physical activity variables.

The dietary intake data are used to estimate total energy intake (total calorie consumption). The National Center for Health Statistics (NCHS) in the United States estimated this total by using the release of two days of the dietary intake data for each participant. Data on the first day were collected by the Mobile Examination Center (MEC) and data on the second day were collected by telephone from three to ten days later. Most of the MEC participants (87%) have two days of complete intakes. To assess diets in US adults, we used the average of the two days of data (NHANES data, 2003-2004, Documentation of dietary intake).

BMI data comes from actual heights and weights measured from physical examinations. This is important since many studies on obesity use self-reported weight and height, which can provide biased BMI measures. According to Chou et al (2004), self -reported variables related to human body measurement can include errors because obese people tend to underreport their weight.

The descriptive statistics are shown in Table 2. Both males and females participated almost evenly in this survey. Among the 4647 participants, 2206 participants are more than 50 years old (the average age is 50.4, SD=19.5). Approximately 53% of the participants are White, 45% of the participants have a level of education higher than high school, 44% of the participants fall in the range of mid income ($20,000~$45,000) and 60% of the participants are married. Sixty percent of the participants watch television between 1 hour and 4 hours and more than 70% of the participants use computers for less than one hour. Total energy intake per day is 2062

Kcal on average and is higher among males than females (for female, 1806 Kcal; for male, 2348 Kcal respectively).

4. Result

As previously discussed, we model BMI as a function of television viewing, computer use and control variables that include physical activity, energy consumption, age, race/ethnicity, income and other socio-demographic variables.

Since we used cross sectional data, the presence of heteroskedasticity is a common issue. In our data, we also found a heteroskedasticity problem and corrected it using heteroskedasticity-consistent standard errors of the OLS estimators proposed by White (Baltagi, 2002). The parameter estimates of the equations are presented in Table 3. While not uncommon in cross-sectional analyses, the three regressions in Table 3 have relatively low explanatory power, with R^2 ranging from 3 % to 8%. Chou et al (2004) explained that one of the reasons for typical low R^2 is that BMI and obesity have large genetic components.

4.1. The Effects of Television Viewing and Computer Use

4.1.1. All Adults

In all adults, the results suggest that both television viewing and computer use are positively related to BMI. Specifically, adults who spend at least one hour on television viewing have BMIs that are 1.135 (TV2) and 2.093 (TV3) higher than adults who spend less than one hour on television viewing, *ceteris paribus*. As for computer use, results also indicate that those who spend at least one hour on computer use have BMIs that are 0.541 (COM2) and 0.858 (COM3) higher than those who spend less than one hour on computer use.

4.1.2. By Gender

In both genders, television viewing is positively associated with BMI. However, the effect of television viewing on BMI is stronger in females than in males. Specifically, among females, those who watch television between one and four hours per day (more than four hours per day) have BMIs that are 1.24 (2.21) higher than those who watch less than one hour of television per day. Among males, those who watch

television between one and four hours per day (more than four hours per day) have BMIs that are 0.88 (1.81) higher than those who watch less than one hour of television per day.

In the female group, the relationship between computer use and BMI is not statistically significant while in the male group, only COM2 shows significantly positive effects. This result suggests that among males, those who have one to three hours of computer use per day have higher BMIs than those who have less than one hour of computer use per day.

Overall, the magnitude of the effects imply that television viewing tend to have greater association with BMI than computer use and that these associations are greater in females than in males.

4.2. The Effects of Control Variables

4.2.1. All Adults

Of the control variables in the adult model, the variables age, female, black, Hispanic, Kcal and Act2 show positive significant effects on BMI, and the variables age2 and other physical activity variables except for Act2 show negative significant effects on BMI.

As for gender, female adults have a 0.823 higher BMI than male adults. When considering ethnicity, Blacks and Hispanics have higher BMI than Whites. Blacks have 2.319 higher BMI than Whites, ceteris paribus. Hispanics, on the other hand, have 0.662 higher BMI than Whites. Considering age and age2, the age variable has a positive effect on BMI but age2 has a negative effect on BMI. This reflects the nonlinearity of the effects of age on BMI. As expected, most physical activity variables (Act1, Act3, Act4) show a negative effect on BMI and total energy intake is positively related to BMI.

4.2.2. By Gender

In the female group, Hispanics and Blacks have BMIs that are 0.928 and 3.41 more than Whites, respectively. However, in the male group, only Blacks are positively significant and have 0.729 higher BMI than Whites. Therefore, ethnicity effects are

more prevalent among females. In both genders, age variables are positively related with BMI.

Among females, those who have high income (more than $45,000) have BMIs which are1.215 lower than those who have low income (less than $20,000). Among males, those who have high income have BMIs which are 0.698 higher than those who have low income. In females, those who have education level higher than high school have BMIs that are 0.696 lower than those who have less than high school education but in males, educational status is not statistically significant. Marital status is not significantly associated with BMI in both males and females. As expected, act 1,3, and 4 show a negative association with BMI but act 2 is positively related with BMI. In males, act 1 and act 3 are negatively related with BMI but also act 2 is positively related with BMI. Total energy consumption shows a significantly positive effect among females.

We planned to address the possible endogeneity problem between BMI and physical activity and energy consumption, even though these were included only as control variables. However, we could not find suitable or valid instruments to address this issue. Park and Davis (2001) also noted the significant challenges in finding appropriate instruments in cross sectional data dealing with health issues. A possible alternative is the use of the Lewbel procedure. Lewbel developed a procedure for creating instruments when no other data are available (Lewbel, 1997). However, in many studies, the Lewbel instruments proved to be rather weak and many have questioned their usefulness (Park and Davis, 2001). Nakamura and Nakamura (1998) also recommended that OLS results would be preferred when the instruments are weak and that the Hausman tests are only for the existence of OLS bias, not its severity.

5. Conclusion

The focus of this paper is to assess the effect of television viewing and computer use on obesity among adults. Using 2003-2004 NHANES, our results generally indicate that television viewing is positively related to BMI among adults and this is evident for both males and females. Computer use is also positively related to BMI although this effect is not as strong as television viewing. We also separately conducted the analysis by gender. Results suggest that television viewing is positively related to

BMI in both males and females but the magnitude of its effect is greater among females than males. In contrast, the effect of computer use on BMI is more evident in males than females.

Our findings have important public health policy implications since they reflect the significance of the *ceteris paribus* effects of amount of time devoted to television viewing and computer use on obesity. These findings can be used as a guide in designing public health outreach programs that would educate the public of the detrimental effects of television viewing and computer use on BMI.

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Table 1. The Description of Dependent and Independent variables

Variable name		Frequency (%)
	Dependent variable	
BMI	Body Mass Index(kg/m2)	
	Independent variables	
	(Gender)	
Female	1= female, 0= male	52 %
	(Ethnicity)	
WHITE	1= white, 0= otherwise	53 %
BLACK	1= black, 0= otherwise	20 %
HISPANIC	1= hispanic, 0= otherwise	27 %
	(Education)	
LHSCH	1= less than high school, 0= otherwise	29 %
HSCH	1= high school, 0= otherwise	25 %
MHSCH	1= more than high school, 0= otherwise	45 %
	(Household income)	
LOWINC	1= low income ($0~$20,000), 0= otherwise	26 %
MIDINC	1= mid income ($20,000~$45,000), 0= otherwise	44 %
HIGHINC	1= high income (more than $45,000), 0= otherwise	30 %
	(Marital status)	
Single	1= if single (unmarried, widowed or divorced) 0= otherwise (married or living with a partner)	40 %
	(Physical activity)	
Act1	Over the past 30 days, {have/has} {you/SP} walked or bicycled as part of getting to and from work, or school, or to do errands? 1=Yes 0= No	23%
Act2	Over the past 30 days, did {you/SP} do any tasks in or around {your/his/her} home or yard for at least 10 minutes that required moderate or greater physical effort? By moderate physical effort I mean, tasks that caused light sweating or a slight to moderate increase in {your/his/her} heart rate or breathing. 1=Yes 0= No	58%
Act3	Over the past 30 days, did {you/SP} do any vigorous activities for at least 10 minutes that caused heavy sweating, or large increases in breathing or heart rate? Some examples are running, lap swimming, aerobics classes or fast bicycling. 1=Yes 0= No	25%
Act4	Over the past 30 days, did {you/SP} do any physical activities specifically designed to strengthen {your/his/her} muscles such as lifting weights, push-ups or sit-ups? Include	24%

	all such activities even if you have mentioned them before. Adults 1=Yes 0= No	
	(Food consumption)	
Kcal	Total energy intake (Kcal)	
	(Television viewing)	
TV1	1= watching TV or videos (outside of work) for less than one hour per day over the past 30 days 0= otherwise	14 %
TV2	1= watching TV or videos (outside of work) for more than or equal to one hour and less than four hours per day 0= otherwise	60 %
TV3	1= watching TV or videos (outside of work) for more than four hours per day 0= otherwise	26 %
	(Computer use)	
Com 1	1= use computer or play computer games (outside of work) for less than one hour per day over the past 30 days 0= otherwise	77 %
Com 2	1= use computer or play computer games (outside of work) for more than or equal to one hour and less than three hours per day over the past 30 days 0= otherwise	17 %
Com 3	1= use computer or play computer games (outside of work) for more than three hours per day over the past 30 days 0= otherwise	6 %

Table 2. Descriptive Statistics

	adult (n=4647)		female (n= 2410)		male (n=2237)		range	
Variables	Mean	SD.	Mean	SD.	Mean	SD.	Min	Max
BMI	28.41	6.29	28.84	6.96	27.94	5.44	14.7	64.97
FEMALE	0.52	0.50	.	.	.	.	0	1
AGE	50.35	19.50	50.07	19.63	50.64	19.36	20	85
WHITE	0.53	0.50	0.53	0.50	0.53	0.50	0	1
BLACK	0.20	0.40	0.20	0.40	0.19	0.39	0	1
HISPANIC	0.27	0.45	0.27	0.44	0.28	0.45	0	1
LHSCH	0.29	0.46	0.29	0.45	0.30	0.46	0	1
HSCH	0.25	0.43	0.25	0.43	0.25	0.43	0	1
MHSCH	0.45	0.50	0.46	0.50	0.45	0.50	0	1
LOWINC	0.26	0.44	0.28	0.45	0.23	0.42	0	1
MIDINC	0.44	0.50	0.42	0.49	0.46	0.50	0	1
HIGHINC	0.30	0.46	0.29	0.45	0.31	0.46	0	1
MARRIED	0.60	0.49	0.55	0.50	0.67	0.47	0	1
SINGLE	0.40	0.49	0.45	0.50	0.33	0.47	0	1
ACT1	0.23	0.42	0.21	0.41	0.25	0.43	0	1
ACT2	0.58	0.49	0.55	0.50	0.61	0.48	0	1
ACT3	0.25	0.43	0.22	0.41	0.29	0.46	0	1
ACT4	0.24	0.43	0.21	0.41	0.28	0.45	0	1
TV1	0.14	0.35	0.15	0.35	0.13	0.34	0	1
TV2	0.60	0.49	0.60	0.49	0.61	0.49	0	1
TV3	0.26	0.44	0.25	0.43	0.26	0.44	0	1
KCAL	2062	814	1806	681	2347	854	302	5475
COM1	0.77	0.42	0.79	0.41	0.75	0.43	0	1
COM2	0.17	0.37	0.16	0.37	0.17	0.38	0	1
COM3	0.06	0.24	0.05	0.22	0.07	0.26	0	1

Notes: SD means Standard Deviation.

Table 3. OLS regressions for three groups

Variables	adults		female		male	
	coefficients	St. error	coefficients	St. error	coefficients	St. error
FEMALE	0.82323***	0.2182				
AGE	0.28362***	3.37E-02	0.33702***	4.97E-02	0.22993***	4.35E-02
AGE2	-2.84E-03***	3.10E-04	-3.41E-03***	4.64E-04	-2.31E-03***	3.94E-04
BLACK	2.3187***	0.3108	3.407***	0.4549	0.72859*	0.4102
HISPANIC	0.66229***	0.2509	0.92837***	0.3854	0.16118	0.3099
HSCH	-1.87E-02	0.2914	-0.5045	0.4265	0.48488	0.3813
MHSCH	-0.29461	0.2897	-0.69632*	0.421	9.91E-02	0.3856
MIDINC	-0.22858	0.265	-0.57757*	0.3845	0.42011	0.3487
HIGHINC	-0.36168	0.3122	-1.215***	0.4613	0.69809*	0.4007
SINGLE	0.19439	0.2286	0.40499	0.339	-0.35374	0.3077
ACT1	-0.88416***	0.2325	-1.0707***	0.353	-0.67752**	0.2925
ACT2	0.97549***	0.2177	1.1499***	0.3268	0.83267***	0.2784
ACT3	-1.0726***	0.2538	-1.1789***	0.4188	-0.74759***	0.2961
ACT5	-0.73324***	0.2456	-1.6591***	0.3971	0.2978	0.2925
TV2	1.1346***	0.2813	1.2383***	0.4063	0.88421***	0.3708
TV3	2.0927***	0.3419	2.2088***	0.4889	1.8054***	0.4616
KCAL	2.27E-04*	1.52E-04	4.08E-04*	2.65E-04	-1.08E-04	1.76E-04
COM2	0.54056**	0.2821	0.41701	0.4313	0.62644*	0.3534
COM3	0.85846*	0.4557	0.87426	0.6989	0.89183	0.6021
CONSTANT	20.017***	1.048	19.905***	1.476	21.473***	1.36
R^2	0.0844		0.1233		0.0620	
N	4647		2410		2237	

Notes: St.error means standard error.
* Significant at 10 % significance level
** Significant at 5 % significance level
*** Significant at 1 % significance level