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A Multinomial Logistic Regression Examination of TV Time and Two Different Measures of Obesity in U.S. Adults

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Abstract **Background**: Physical inactivity and sedentary behavior are known factors related to the growing obesity rates in US adults. However, most population-based physical activity research primarily use a single measure of obesity. Therefore, the purpose of this study was to examine the relationship between television (TV) time and two different measures of obesity in US adults. **Methods**: This study used data from adults 20+ years of age participating in the 2015-2016 National Health and Nutrition Examination Survey (NHANES). Using body mass index (BMI), participants were categorized as obese if their values were 30 kg/m^2 or greater. Using waist circumference (WC), participants were categorized as obese if their values were greater than 88 (females) or 102 cm (males). TV time was assessed from a survey question and adults were categorized into one of four different groups. Multinomial logistic regression was used to model the relationship between TV time and three different obese status categories. **Results**: In fully adjusted models, odds of being BMI obese (OR=1.98; 95% CI: 1.32-2.98) and WC obese (OR=2.76; 95% CI: 1.88-4.05) were significantly greater in adults with 5+ hours of TV time as compared to those with < 1 hour. In fully adjusted multinomial models, odds of being BMI or WC obese (OR=2.18; 95% CI: 1.43-3.34) and BMI and WC obese (OR=2.80; 95% CI: 1.68-4.65) were significantly greater in adults with 5+ hours of TV time as compared to those with < 1 hour. **Conclusion**: Results from this study indicate that TV time is clearly related to both overall and abdominal obesity in US adults. Furthermore, this relationship remains in light of MVPA and appears stronger for adults with both types of obesity.

Keywords: *physical inactivity, obesity, sedentary behavior, epidemiology*

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1. Introduction

Obesity is a growing concern both in the US and world-wide and is receiving much attention from national public health organizations [1,2,3,4]. Obesity is defined as an abnormal accumulation of more than twenty-five percent (males) or thirty-five percent (females) body fat [5]. Additionally, abdominal obesity is considered a major concern due to its links with increased visceral fat and in consequence its links with lipotoxicity [6]. Despite these definitions of obesity, most epidemiological and population-based research use body mass index (BMI) as a proxy for obesity [7].

Physical activity is a known correlate of obesity in US adults [8,9,10,11]. Moreover, health education efforts to combat obesity have focused on physical activity and energy balance intervention [12,13,14]. Screen time (combined use of technology devices with screens) is a measure of sedentary behavior that is also related to obesity in adults [15,16,17]. Given this background, few studies have inspected the relationship between specific forms of screen time and obesity measured using multiple assessments. Therefore, the purpose of this study was to examine the relationship between television (TV) time and two different measures of obesity in US adults.

2. Methods

2.1. Study Design

Data for this research came from the 2015-2016 National Health and Nutrition Examination Survey (NHANES) [18]. The sample consisted of participants who were 20+ years of age and had complete physical activity and body composition data.

2.2. Variables Utilized

The main independent variable was TV time. The two main dependent variables were obesity status measured by body mass index (BMI) and obesity status measured by waist circumference (WC). Covariates were moderate-to-vigorous physical activity (MVPA), age, sex, race, income.

2.3. Assessment of TV Time and MVPA

TV time was assessed from a survey question asking participants how many hours per day they sat and watched TV or videos during the past 30 days [19]. For this study, four discrete TV time groups were formed: (1) < 1 hour, (2) 1-3 hours, (3) 4 hours, and (4) 5+ hours.

A physical activity control variable was computed from constructed variables of minutes of moderate physical activity (MPA) per week and minutes of vigorous physical activity (VPA) per week [19]. VPA was assessed from the responses to two questions. The first question asked respondents how many days they participated in vigorous intensity sports, fitness, or recreational activities. The second question asked respondents how much time they spend doing vigorous-intensity activity on a typical day. Multiplying days with minutes yielded VPA measured per week. The same two questions were asked regarding moderate-intensity activities to assess MPA per week. These two physical activity variables were then used to compute minutes of MVPA per week.

2.4. Assessment of Obesity

Using BMI, participants were categorized as obese if their values were 30 kg/m^2 or greater. Using WC, participants were categorized as obese if their values were greater than 88 (females) or 102 cm (males) [20]. For the multinomial analyses, a three-level obesity outcome variable was constructed; consisting of 1) non-obese, 2) BMI or WC obese, and 3) BMI and WC obese. Measurements for both BMI (height and weight) and WC were collected by trained NHANES health professionals during a medical examination.

2.5. Statistical Analyses

Prevalence estimates, 95% confidence intervals (95% CI), and Rao-Scott chi-square tests of independence were used to describe BMI categories (Non-Obese, BMI or WC Obese, BMI and WC Obese) across demographic characteristics. The general linear model was used to form analysis of covariance models (ANCOVA) to test for adjusted mean BMI and WC differences across TV time groups. Logistic regression was used to calculate the adjusted odds ratios (ORs) and 95% CIs of being obese as opposed to being non-obese for each TV time group, while adjusting for age, race, gender, income, and MVPA. Multinomial logistic regression models were run modeling the probability of being BMI or WC obese only and being BMI and WC obese simultaneously, with non-obese as the reference. All analyses were performed using the complex samples module of SPSS version 24 [21,22,23]. All p-values are reported as 2-sided and statistical significance was defined as p-values < 0.05.

3. Results

Table 1. Prevalence of BMI- and WC-determined obese classification by demographic characteristic, US adults 20+ years of age 2015-16

	Obese Classification						
	Non-Obese		BMI or WC Obese		BMI and WC Obese		
Characteristic	%	95% CI	%	95% CI	%	95% CI	*p*
Overall	39.3	34.6-44.1	22.5	20.0-25.2	38.2	34.9-41.6	<.001
Gender							<.001
Male	49.5	43.5-55.6	15.7	13.2-18.5	34.8	30.3-39.5	
Female	29.6	25.6-34.1	28.9	25.7-32.4	41.4	38.2-44.8	
Age Group (yr)							<.001
18-24	61.6	55.3-67.5	11.4	8.0-15.8	27.0	21.3-33.6	
25-34	50.6	44.2-57.0	15.9	12.9-19.5	33.5	29.0-38.3	
35-44	37.3	31.8-43.2	21.3	16.8-26.7	41.3	34.3-48.7	
45-54	36.9	30.3-44.0	23.7	20.2-27.7	39.4	33.3-45.8	
55-64	33.1	27.3-39.5	22.7	17.0-29.6	44.2	35.9-52.7	
65+	27.7	22.6-33.3	33.6	29.2-38.2	38.8	34.5-43.3	
Race/Ethnicity							<.001
Hispanic	36.5	32.2-41.0	19.8	17.0-22.9	43.7	39.8-47.6	
Black	38.8	34.4-43.5	16.6	14.9-18.4	44.6	39.8-49.5	
White	37.4	32.2-42.9	25.0	21.7-28.7	37.5	33.8-41.4	
Asian	72.3	68.7-75.6	16.1	13.5-19.0	11.6	9.1-14.7	
Other	33.4	24.4-43.9	17.3	10.5-27.2	49.3	43.1-55.4	
Monthly Income ($)							.488
0-1249	40.1	34.1-46.4	21.6	18.0-25.7	38.3	32.8-44.2	
1250-2099	39.6	32.9-46.8	23.2	19.0-28.1	37.1	32.4-42.2	
2100-3749	40.3	36.1-44.6	20.4	17.1-24.1	39.4	34.9-44.0	
3750-5399	36.7	29.5-44.4	23.5	18.6-29.1	39.9	32.5-47.8	
5400-8399	34.1	28.0-40.8	23.3	18.8-28.5	42.6	37.4-47.9	
8400+	42.8	32.0-54.2	23.0	16.6-31.0	34.2	26.7-42.6	
General Health							<.001
Excellent	64.5	55.7-72.5	21.4	15.9-28.2	14.0	10.2-18.9	
Very Good	46.0	40.6-51.4	24.4	21.3-27.8	29.6	26.1-33.4	
Good	32.6	27.7-37.9	22.6	19.3-26.2	44.8	40.2-49.5	
Fair	26.6	21.4-32.5	18.7	15.9-21.8	54.7	48.4-60.9	
Poor	30.3	18.5-45.3	17.8	12.0-25.6	51.9	41.9-61.7	

Note. *p*-values are testing independence by Rao-Scott chi-square. Non-obese group represents adults with a BMI < 18.5 kg/m^2 and WC <= 88 cm (women) or <= 102 cm (men). BMI or WC obese group represents adults with either a BMI >= 30 kg/m^2 or a WC > 88 cm (women) or > 102 cm (men). BMI and WC obese group represents adults with both a BMI >= 30 kg/m^2 and a WC > 88 cm (women) or > 102 cm (men).

Table 1 contains prevalence estimates for the three obese status groups. A total of N=5,107 adult participants were included with 39.3.6% (95% CI: 34.6-44.1) classified as non-obese, 22.5% (95% CI: 20.0-25.2) as BMI or WC obese, and 38.2% (95% CI: 34.9-41.6) as BMI and WC obese (p < .001). All other demographic variables were significantly related to obese status (ps < .05).

Table 2 contains results from two sets of logistic regression analyses. In the fully adjusted BMI model, odds of being BMI obese were significantly greater for 4 hours (OR=1.92; 95% CI: 1.28-2.88) and 5+ hours (OR=1.98; 95% CI: 1.32-2.98) of TV time, as compared to < 1 hour. In the fully adjusted WC model, odds of being WC obese were significantly greater for 1-3 hours (OR=1.38; 95% CI: 1.03-1.84), 4 hours (OR=2.46; 95% CI: 1.48-4.09) and 5+ hours (OR=2.76; 95% CI: 1.88-4.05) of TV time, as compared to < 1 hour. Both sets of models showed a significant linear trend in probability of being obese and TV time (ps < .05).

Table 3 contains results from the multinomial logistic regression analyses. In fully adjusted models, adults in the highest TV time group were more likely (OR=2.18; 95% CI: 1.43-3.34) to be BMI or WC obese (vs. non-obese) than those in the lowest TV time group. Furthermore, adults in the highest TV time group were more likely (OR=2.80; 95% CI: 1.68-4.65) to be BMI and WC obese (vs. non-obese) than those in the lowest TV time group. Similar to the previous analysis, both sets of models showed a significant linear trend in probability of being obese and TV time (ps < .05).

Figure 1 displays age-adjusted and sex-specific mean BMI across TV time groups. Both male and female adults had significantly different mean BMI across TV time groups (ps < .05). Additionally, both male and female adjusted mean BMI showed a significant linear trend (ps < .001) across increasing TV time groups. Figure 2 displays age-adjusted and sex-specific mean WV across TV time groups. Similarly, both male and female adults had significantly different mean WC across TV time groups (ps < .05). Additionally, both male and female adjusted mean WC showed a significant linear trend (ps < .001) across increasing TV time groups.

Table 2. Odds of being BMI and WC obese relative to the least TV time group, US adults 20+ years of age 2015-16

	BMI Obese				WC Obese			
TV Time Group	OR	95% CI		*p* for Trend	OR	95% CI		*p* for Trend
Unadjusted				<.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	**1.34**	1.07	1.69		**1.44**	1.14	1.83	
4 hr	**2.01**	1.42	2.84		**2.61**	1.66	4.11	
5+ hr	**2.31**	1.57	3.39		**3.15**	2.12	4.67	
Adjusted				<.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	**1.37**	1.04	1.80		**1.42**	1.06	1.91	
4 hr	**2.09**	1.33	3.26		**2.56**	1.59	4.11	
5+ hr	**2.24**	1.43	3.52		**2.90**	1.85	4.55	
Fully Adjusted				.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	1.28	0.98	1.67		**1.38**	1.03	1.84	
4 hr	**1.92**	1.28	2.88		**2.46**	1.48	4.09	
5+ hr	**1.98**	1.32	2.98		**2.76**	1.88	4.05	

Note. Adjusted multinomial logistic regression models are adjusted for age, race, income, and gender. Fully adjusted models additionally adjust for MVPA. Bold ORs are significant at .05 significance. BMI obese represents adults with a BMI >= 30 kg/m^2. WC obese represents adults with a WC > 88 cm (women) or > 102 cm (men). *p* for trend is test for linear trend in TV time effects.

Table 3. Odds of being obese relative to the least TV time group, US adults 20+ years of age 2015-16

	BMI or WC Obese vs. Non-Obese				BMI and WC Obese vs. Non-Obese			
TV Time Group	OR	95% CI		*p* for Trend	OR	95% CI		*p* for Trend
Unadjusted				<.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	**1.41**	1.08	1.83		**1.45**	1.12	1.89	
4 hr	**2.06**	1.28	3.30		**2.80**	1.75	4.49	
5+ hr	**2.56**	1.79	3.67		**3.43**	2.12	5.53	
Adjusted				<.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	1.37	0.99	1.88		**1.47**	1.06	2.03	
4 hr	**1.92**	1.27	2.89		**2.81**	1.64	4.84	
5+ hr	**2.19**	1.43	3.36		**3.18**	1.83	5.52	
Fully Adjusted				<.001				<.001
< 1 hr	1.00	-	-		1.00	-	-	
1-3 hr	1.36	0.98	1.89		1.37	1.00	1.87	
4 hr	**1.92**	1.26	2.93		**2.56**	1.55	4.24	
5+ hr	**2.18**	1.43	3.34		**2.80**	1.68	4.65	

Note. Adjusted multinomial logistic regression models are adjusted for age, race, income, and gender. Fully adjusted models additionally adjust for MVPA. Bold ORs are significant at .05 significance. Non-obese group represents adults with a BMI < 18.5 kg/m^2 and WC <= 88 cm (women) or <= 102 cm (men). BMI or WC obese group represents adults with either a BMI >= 30 kg/m^2 or a WC > 88 cm (women) or > 102 cm (men). BMI and WC obese group represents adults with both a BMI >= 30 kg/m^2 and a WC > 88 cm (women) or > 102 cm (men). *p* for trend is test for linear trend in TV time effects.

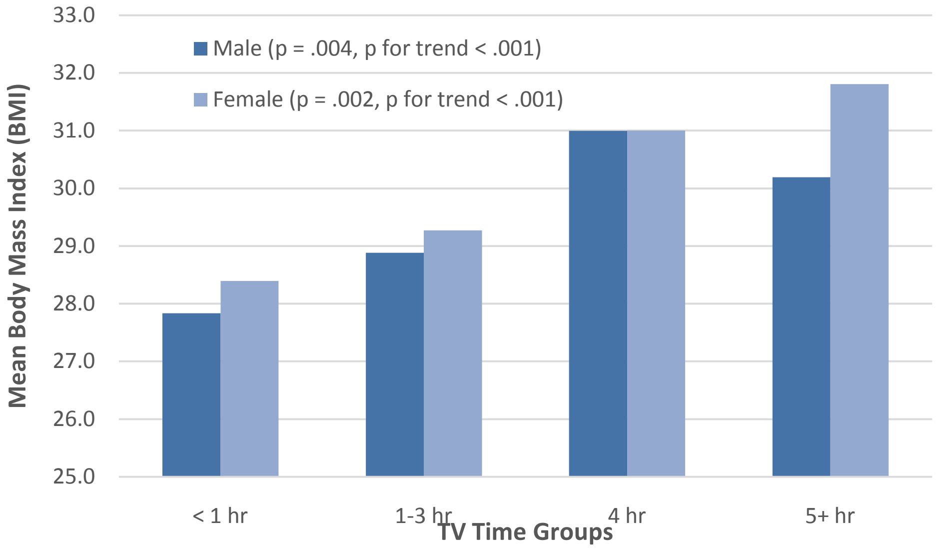

Figure 1. Age adjusted mean BMI difference across TV time groups (*Note*. Mean BMI are ANCOVA adjusted for age)

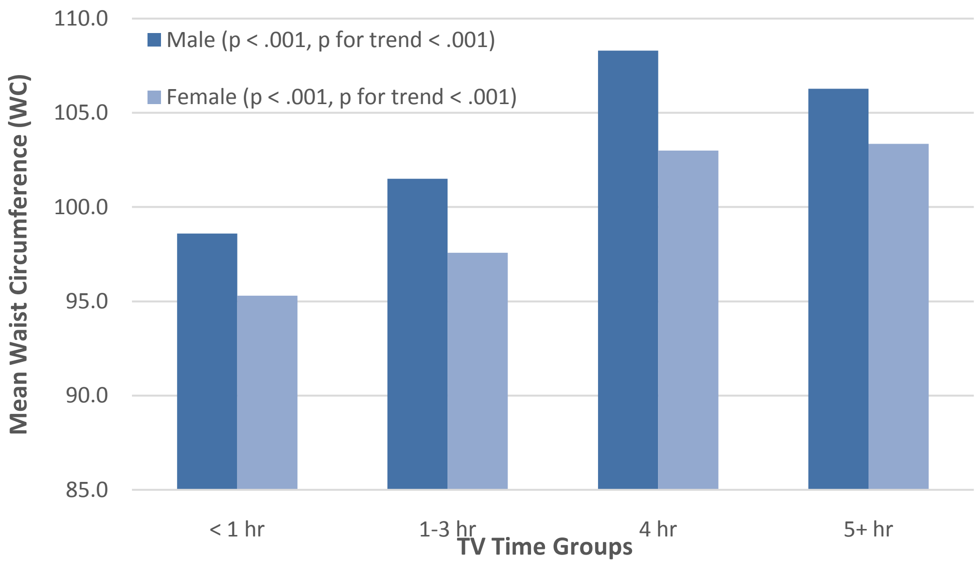

Figure 2. Age adjusted mean WC difference across TV time groups (*Note*. Mean WC are ANCOVA adjusted for age)

4. Discussion

The purpose of this study was to examine the relationship between TV time and two different measures of obesity in US adults. As expected, both BMI and WC models showed an increasing odds of being obese as TV time increased. Similar findings relating sedentary behavior with obesity have been shown using both subjective and objective measures of sedentary behavior in adults [24,25,26,27]. A novel finding from this study, however, was the increasing greater odds of being both BMI and WC obese with ascending TV times. Specifically, adults with 5+ hours of TV time were approximately three times more likely to be BMI and WC obese, as compared to adults with < 1 hour per day. A similar 2009 study examined the association between screen time and BMI-defined and WC-defined obesity in separate analyses [28]. Results showed a positive relationship between screen time and both measures of obesity. However, this study did not examine the relationship between screen time and both measures of obesity simultaneously.

This study should be interpreted along with its limitations. One limitation is its cross-sectional properties which limits these findings to correlational generalizations as opposed to cause-and-effect inferences. However, the test of linear trend in this study, which also tests for dose-response effects, is a valuable attribute that aids in cross-sectional generalizations. Another limitation of this study was the use of self-reporting of TV time. Therefore, estimating TV time in this study may include un-accounted for measurement error.

5. Conclusions

Results from this study indicate that TV time, a measure of sedentary behavior, is related to obesity in US adults. Furthermore, the evidence supports a dose-response relationship between amounts of TV time and likelihood of being obese. This relationship remains in light of MVPA and appears stronger for adults with both overall and abdominal obesity. Health promotion programs should target the reduction of TV time as a possible means for reducing obesity in adults.

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