An Examination of the Effect of Sleep Quality and TV/Computer Usage on Stress: Based on National Health and Nutrition Examination Survey Data

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Abstract: This study examines the effect of TV/computer usage and sleep quality on stress on a large population with comprehensive demographic characteristics. It also aimed to identify the difference of treatment effect between the female group and the male group. This study includes 5092 participants in the National Health Nutrition Examination Survey (NHANES). These participants were asked to answer questionnaires regarding TV/computer usage, sleep quality, and mental health. We applied a binary logistic regression and a Poisson regression. TV usage, computer usage, and sleep quality were positively associated with both the odds of experiencing stress-related symptom and the frequency of stress-related symptoms. No difference of treatment effect was found between the female group and the male group for sleep quality. The female group was found to be less affected by TV usage. Effect of computer usage was detected on the male group, but not on the female group. A reduction in TV/computer usage and an improvement of sleep quality can be performed to reduce the frequency and the odds of experiencing stress-related symptoms. Future study with comprehensive population groups and standardized measurement for sleep quality is needed to reduce bias.

1 INTRODUCTION

Anxiety is an emotion characterized by feelings of tension, worried thoughts and physical changes like increased blood pressure (Kazdin 2000). Study has also shown that anxiety can be spread in social networking sites (Seabrook 2016). Many of us have experience stress and anxiety during COVID-19 pandemic (Ahmed 2020). It is a serious matter since anxiety is shown to be related to the risk of cardiovascular disease (Tully 2016). There has been research shown that TV/computer viewing has positive correspondence to anxiety-related problems (Maras 2015, Werneck 2021, Yu 2019). On the other hands, sleep quality is also highly associated to anxiety (Al-Khani 2019, Ghrouz 2019). However, they either targeted specific population group, or considered a single factor that leads to anxiety. In this research, we want to examine the effect of both non-regular sleeping and time of computer/TV use on mental health, and the population in this study have comprehensive demographic characteristics. We will be using binary logistic regression and Poisson regression; and the factors we considered are TV usage, computer usage, how often overly sleepy during day, ever reported trouble sleeping, and sleep time (details listed in Table 1). We aim to determine the effect of those factors on the occurrence and frequency of stress-related symptoms, and we hope that with the large sample size, this study can give us a more accurate result compares to previous studies.

2 METHODS

2.1 Study Design and Participants

The data used in this study came from the National Health and Nutrition Examination (Centers for Disease Control and Prevention 2015-2016). The National Health and Nutrition Examination Survey (NHANES) is a program of studies designed to assess the health and nutritional status of adults and children in the United States. The survey is unique in that it combines interviews and physical examinations. NHANES is a major program of the National Center for Health Statistics (NCHS). NCHS is part of the Centers for Disease Control and Prevention (CDC)

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and has the responsibility for producing vital and health statistics for the Nation.

The NHANES program began in the early 1960s and has been conducted as a series of surveys focusing on different population groups or health topics. In 1999, the survey became a continuous program that has a changing focus on a variety of health and nutrition measurements to meet emerging needs. The survey examines a nationally representative sample of about 5,000 persons each year. These persons are located in counties across the country, 15 of which are visited each year.

The NHANES interview includes demographic, socioeconomic, dietary, and health-related questions. The examination component consists of medical, dental, and physiological measurements, as well as laboratory tests administered by highly trained medical personnel.

Findings from this survey will be used to determine the prevalence of major diseases and risk factors for diseases. Information will be used to assess nutritional status and its association with health promotion and disease prevention. NHANES findings are also the basis for national standards for such measurements as height, weight, and blood pressure. Data from this survey will be used in epidemiological studies and health sciences research, which help develop sound public health policy, direct and design health programs and services, and expand the health knowledge for the Nation. The present study includes participants who were 18-year-old and older at the baseline measurement (N = 5735). A total of 643 participants who had missing data (599) or answered, "I don't know/choose not to say" (44) are excluded (N = 5092). The demographic characteristic of the 5092 participants is listed in Table 1.

2.2 Predictors

The predictors included in this study is listed in the last 5 rows in Table 1. The first 3 predictors (TV usage, computer usage, how often overly sleepy during day) are set to be continuous variables. The last 2 predictors (ever reported trouble sleeping, sleep time) are set to be binary categorical variables. Interactions are also introduced to capture the interplay between each variable.

2.3 The Scale of Stress Level (Response)

In the original data from NHANES, the codebook for Mental Health – Depression Scanner has 10 categories: 1. "Having little interest in doing things", 2. "Feeling down, depressed, or hopeless", 3. "Trouble sleeping or sleeping too much", 4. "Feeling tired or having little energy", 5. "Poor appetite or overeating", 6. "Feeling bad about yourself", 7. "Trouble concentrating on things", 8. "Moving or speaking slowly or too fast", 9. "Thought you would be better off dead", 10. "Difficulty these problems have caused". Each category has 4 levels: 0. Not at all, 1. Several days, 2. More than half the days, 3. Nearly every day.

In order to transform the codebook for mental health into a response variable, we sum up the levels of each category (except the 10th category, because of too many missing values) and create a response ranging from 0 to 27, details in row 5, Table 1. To reduce outliers, we collapse all response with 10 or more into 10.

A binary response is set to be whether participants have experienced any stress-related symptoms, which is either 0 or 1. A count response is set to be the scale of stress level (i.e., the frequency of stress-related symptoms), which ranges from 0 to 10.

2.4 Statistical Analysis

The Statistics Analysis Tool R (R Core Team 2020) and the package glmnet (Friedman 2010) were used for data analysis. Binary logistic regression analysis was performed for the association between the predictors (computer and TV times, whether overly sleepy, ever reported trouble sleeping, normal or abnormal sleep time) and the binary response (whether having stressed or not), which determines whether a participant is having stress-related symptoms or not. Poisson regression was also performed for the association between the predictors and stress level for those participants with stress, whichdetermine how stress a participant is for those who are determined to be having stress-related symptoms. A Fixed significance level of $p \leq 0.05$ was used for the analysis. The package xtable (Dahl 2019) was used to produce coefficient table.

Table 1: Demographic characteristics of the study population.

CHARACTERISTICS		MEAN ± SD / FREQUENCY (%)
AGE (YEARS)		48.2 ± 18.5
GENDER	Male	2486 (48.8%)
	Female	2606 (51.2%)
RACE	Mexican American	924 (18.1%)
	Other Hispanic	652 (12.8%)
	Non-Hispanic White	1700 (33.4%)
	Non-Hispanic Black	1081 (21.2%)
	Non-Hispanic Asian	540 (10.6%)
	Other Race and Multi-Racial	195 (3.8%)
EDUCATION LEVEL	Less than 9th grade	535 (10.5%)
	9-12th grade	659 (12.9%)
	High school graduate/GED or equivalent	1176 (23.1%)
	College or AA degree	1512 (27.0%)
	College graduate or above	1209 (23.7%)
	Don't know	1 (0.01%)
STRESS LEVEL (FROM 0 TO 10)	None (0)	1562 (30.7%)
	Slightly Stressed (1-5)	2521 (49.5%)
	Stressed (6-9)	602 (11.8%)
	Highly Stressed (>=10)	407 (8.0%)
TV USAGE (HOUR)	Light use (0-1)	778 (27.9%)
	Average use (2-4)	2922 (45.9%)
	Heavy use (5+)	1392 (10.8%)
COMPUTER USAGE (HOUR)	Light use (0-1)	2756 (54.1%)
	Average use (2-4)	1786 (35.1%)
	Heavy use (5+)	550 (10.8%)
HOW OFTEN OVERLY SLEEPY DURING DAY	Never (0 times)	904 (17.8%)
	Rarely (1 time a month)	1176 (23.1%)
	Sometimes (2-4 times a month)	1677 (32.9%)
	Often (5-15 times a month)	914 (17.9%)
	Almost always (16-30 times a month)	421 (8.3%)
EVER REPORTED TROUBLE SLEEPING	Yes	1383 (27.2%)
	No	3709 (72.8%)
SLEEP TIME (HOUR)	Normal (7-10)	3754 (73.7%)
	Abnormal (<7 or >10)	1338 (26.2%)

3 RESULTS

3.1 Association between Predictors and Binary Response of Stress

A detailed summary of the binary logistic regression is listed in Table 2. Notice that all predictors except the interactions are positively associated with the binary response of stress. For each unit increase in TV usage, the odds of having stress symptoms is increased by 10.71% (95% CI, 4.61%−17.2%). The usage of PC also leads to an increase in the odds ratio by 14.35% (95% CI, 4.96%−24.73%). Feeling overly sleepy during day leads to a more significant increase in the odds ratio of 73.19% (95% CI, 62.07%−85.26%). The odds ratio of sleep time is increased by 17.33% (95% CI, -2.38%−41.25%),

which means that having an abnormal sleep time (less than 7 hours or greater than 10 hours) would result in an increasing chance of experiencing anxiety-related symptoms. For those who reported trouble sleeping, they have an increase of 213.77% (95% CI, 149.71%−297.5%) to the odds ratio than those who did not. Furthermore, the interaction between TV usage and PC usage leads to a slight decrease in the odds ratio of 2.46% (95% CI, 0.36%−4.52%). A more significant decrease is related to the interaction between sleep time and report trouble sleeping, which leads to 37.39% (95% CI, 4.7%−58.57%).

Table 2: Binary Regression Analysis: coefficients and etc..

	EXP(B)	LOWER CI	UPPER CI	P-VALUE
INTERCEPT	0.4747	0.3762	0.5982	0.0000
TV USAGE (TV)	1.1071	1.0461	1.1720	0.0004
PC USAGE (PC)	1.1435	1.0496	1.2473	0.0023
OVERLY SLEEPY (OS)	1.7319	1.6207	1.8526	0.0000
SLEEP TIME (ST)	1.1733	0.9762	1.4125	0.0899
REPORT TROUBLE SLEEPING (RTS)	3.1377	2.4971	3.9750	0.0000
TV * PC	0.9754	0.9548	0.9964	0.0223
ST * RT	0.6261	0.4143	0.9530	0.0274

3.2 Association between Predictors and Scale of Stress

A detailed summary of the Poisson regression is listed in Table 3. Notice that similar to the binary logistic regression, all predictors except the interactions are positively associated with the binary response of stress. For each hour increase in TV usage, there is a 6.47% (95% CI, 4.93%−8.04%) increase on the scale of stress. The usage of PC also leads to a slight increase in the scale of stress by 2.28% (95% CI, 0.02%−4.58%). Feeling overly sleepy during day leads to a more significant increase on the scale by 31.05% (95% CI, 28.97%−33.16%). The increase on scale of stress of sleep time is increased by 12.38% (95% CI, 6.51%−18.53%), which means that having an abnormal sleep time would result in an increasing chance of experiencing anxiety-related symptoms. For those who reported trouble sleeping, they have an increase of 75.03% (95% CI, 67.27%−83.15%) on the scale than those who did not.

Furthermore, both interaction terms included in the Poisson model have slightly or insignificant decrease on the scale of stress. The interaction between TV usage and PC usage leads to a slight decrease on the scale by 0.82% (95% CI, 0.3%−1.34%). A slight decrease is related to the interaction between sleep time and report trouble sleeping, which leads to 6.57% (95% CI, -1.14%−13.69%).

Table 3: Poisson Regression Analysis: coefficients and etc.

	EXP(B)	LOWER CI	UPPER CI	P-VALUE
INTERCEPT	1.0959	1.0250	1.1712	0.0071
TV USAGE (TV)	1.0647	1.0493	1.0804	0.0000
PC USAGE (PC)	1.0228	1.0002	1.0458	0.0469
OVERLY SLEEPY (OS)	1.3105	1.2897	1.3316	0.0000
SLEEP TIME (ST)	1.1238	1.0651	1.1853	0.0000
REPORT TROUBLE SLEEPING (RTS)	1.7503	1.6727	1.8315	0.0000
TV * PC	0.9918	0.9866	0.9970	0.0022
ST * RT	0.9343	0.8631	1.0114	0.0930

3.3 Sub-group Analysis

A sub-group analysis stratified by gender is performed and the result is listed in Table 4. Interestingly, the female group seems to be less affected by the usage of computer. Both binary logistic and Poisson regressions shows insignificancy (p-value is relatively large). The female group is also less affected by the usage of TV compares to the male group in the binary regression (female's 4.72% increase in odds ratio compares to male's 11.7%

Table 4: Subgroup Analysis (Stratified by Gender): Exp(β)

	MALE BINARY	MALE POISSON	FEMALE BINARY	FEMALE POISSON
INTERCEPT	0.3731	0.9967	0.6816	1.2740
TV USAGE (TV)	1.1170	1.0508	1.0472	1.0512
PC USAGE (PC)	1.2573	1.0461	1.0108	0.9989
OVERLY SLEEPY (OS)	1.7005	1.3070	1.7427	1.2899
SLEEP TIME (ST)	1.2898	1.2054	1.2723	1.1597
REPORT TROUBLE SLEEPING (RTS)	2.9304	1.8637	3.1398	1.7268
TV * PC	0.9562	0.9889	1.0097	0.9982
ST * RT	0.6609	0.8570	0.6715	0.9498

4 DISCUSSION

Positive association has been found for all the predictors in both binary logistic regression and Poisson regression, though there has been a slight negative association for the interaction terms. Comparing to another study (Ghrouz 2019), the increase in both the odds ratio and on the scale of stress for sleep time is lower (39% increase from Ghrouz compares to 12.38% increase in this study). This difference can be explained by the difference definition of sleep quality between Ghrouz and this study. In Ghrouz, the use of Pittsburgh Sleep Quality Index (PSQI) allows the sleep quality predictor to include different aspects such as sleep quality, sleep latency, sleep duration, disturbance, etc. However, in this study, the factor sleep time is only one aspect of sleep quality, and it is more generalized. Having an average of 7-10 hours of sleep does not guarantee of having a high-quality sleep, and thus some participants with normal sleep time would still experience stress-related symptoms. The more influential factors are report trouble sleeping and overly sleepy during day. Participants who report trouble sleeping to doctor has a 213.77% increase in odds ratio and 75.03% increase on scale of stress than those who did not. Report trouble sleeping can be interpreted as another factor of sleep quality. Only those who had severe trouble on sleeping would consider seeking medical help, hence they are more likely to have stress-related symptoms. While on the other hand, overly sleepy during day is a sign of poor quality of sleeping in the night. This factor is similar to the sleep quality factor in Ghrouz's study, and the result of 31.05% increase in the chance of having anxiety in this study is relatively similar to Ghrouz's 39%. The effect of TV usage in this study is 10.71% increase in odds ratio and 6.47% increase on the scale of stress for each unit increase. Comparing to the effect of TV usage in another study (Yu 2019), this study's result is relatively lower. It may be contributed by the different characteristics of the study population, that Yu's study targeted participants in China. It is also possible that the difference in TV programs led to a difference between the two studies. Yet, comparing to a Brazilian study (Werneck 2020), their result of 30.0% increase in anxiety by TV (4 or more hours usage) and 38.5% increase by PC (4 or more hours usage) is closer to the present study. It is possible that individuals who choose to do unhealthy movement (watching TV or using computer) has the same effect on mental health compare to individuals who are forced to do unhealthy movement due to quarantine. A further study is needed to confirm this hypothesis.

The sub-group analysis stratified by gender is performed and listed in Table 4. Both the male group and the female group seems to be equally affected by sleep quality, and no significant difference was found in the three factors of sleep quality. Yet, the usage of

computer is found to have insignificant effect in the female group, while the usage of TV has less effect on female (4.72%) than male (11.7%). This finding resembles to another Werneck's study (Werneck 2021), where boys have higher odds ratio (1.24) than girls' odds ratio (1.09). It is possible that male is more common to use computer to play games, but female is not; hence, the purpose of using computer for male is more likely to be entertainment, but the purpose for female is more likely to be browsing internet, doing work, or doing online shopping. A further study is needed to test the effect of using computer on mental health stratified by the purpose of using computer.

Strengths of the present study include containing a variety of participants with different race, education level, and gender. This study also shows results resemble to previous studies with smaller sample size, where male's mental health is more affected by the usage of TV than female.

Limitations of the present study include not using the Pittsburgh Sleep Quality Index (PSQI) to produce a standardized measurement for sleep quality, hence the comparison of the effect of sleep quality to other studies may not be accurate. Furthermore, the lack of including the last category ("Difficulty these problems have caused") on the depression scanner questionnaire may introduce biasness to the result. Lastly, an exclusion to 643 missing or refused responses in the dataset contributed to a 11.21% reduction in the sample size, and hence the result may be even more biased.

5 CONCLUSIONS

TV/computer usage and sleep quality are found to be positively correlated to the probability of experiencing stress-related symptoms. These factors are also positively correlated to the frequency of stress-related symptoms. Hence, a reduction in TV/computer usage and an improvement of sleep quality can be performed to reduce the frequency and the odds of experiencing stress-related symptoms.

This study provides a more accurate view of the effect of sleep quality and TV/computer usage on stress by containing a large and diverse population. It confirms results from previous studies and detect a phenomenon, where men are more susceptible to stress-related symptoms as the usage of TV or computer increases. However, since the data from NHANES does not incorporate PSQI to measure sleep quality, this study lacks the use of standardized measurement compares to other studies. Hence, a future study with comprehensive population groups and standardized measurement for sleep quality is needed to reduce bias. Moreover, another future study is needed to investigate why TV and computer usages have more impact on the stressfulness of males than females.

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