Investigation of the Correlation between Screen Time, Social Media Status, and BMI Status among Mason College Students.

A Thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at George Mason University

by

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DEDICATION

This work is a fruit of countless and arduous sacrifice. I dedicate this work to those who inspired me through my entire journey. This is dedicated to my loving wife Samar, my parents, and my friend Zaid.

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I would like to express my special thanks and gratitude to my loving wife, Samar, and my parents who have made this happen. I would like also to extend my thanks to my friend Zaid who supported me through my journey. Finally, thanks go out to Dr. Sapna and Dr. De Jong who helped me a lot in my research and bore all my questions.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

INVESTIGATION OF THE CORRELATION BETWEEN SCREEN TIME, SOCIAL MEDIA STATUS, AND BMI STATUS AMONG MASON COLLEGE STUDENTS.

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People's lives have become increasingly reliant on technology, especially with the emergence of social media. Research has shown that high technology usage has a detrimental impact on health and is linked to rising rates of overweight individuals and obesity worldwide (*Chau et al., 2014*; Liu et al., 2021; Melton et al., 2014). There is a surge in the number of college students who use technology. Previous research examined the effect of technology on BMI in children and adolescents (Alotaibi et al., 2020; Rosen et al., 2014; Shen et al., 2021), but to date, there has been limited research conducted on young adults ages between 18 -24. Increased technology usage is one of the main culprits that lead to poor dietary choices and sedentary lifestyles, both of which have been linked to an increase in BMI (*Chau et al., 2014*; Liu et al., 2021; Melton et al., 2014). This study aims to examine the relationship between screen time usage and an increase in body mass index (BMI) among George Mason University college students. The data was abstracted from the Health Starts Here Study and included 131 first year students from George Mason

University. Technology usage, BMI, diet, physical activity, and sleep were obtained through various questionnaires and anthropometric measurements. These variables were analyzed using different statistical tests: Person's correlation, independent t-tests, and stepwise regression analysis. The results showed that there is a non-significant correlation between using social media, BMI, and dietary choices. Person's correlation result revealed that the correlation between social media and BMI was r (129) =.072 *p*=.416 while the correlation between BMI and diet was r (129) =.09 *p*=.30. T-test result showed on average low-tech usages (M=23.24, SD=5.09) had lower BMI scores than high-tech usage (M=24.71, SD=6.81). This study concludes that the amount of time of using social media has no impact on increasing BMI.

Keywords: BMI, diet, sleep, cellphone, physical activity, screen time, technology, social media

CHAPTER ONE: INTRODUCTION OF THE STUDY

Statement of the Problem

Overweight and obesity are classified globally as major health crises (Hu et al., 2020a). In 2015, a total of 603.7 million adults worldwide were categorized as obese (The GBD 2015 Obesity Collaborators, 2017). Additional statistics in 2016 reported that 1.9 billion adults were overweight and more than 650 million adults were obese (*World Health Organization*, 2021). In 2015, 4 million people died in relation to having a high body mass index (BMI) (The GBD 2015 Obesity Collaborators, 2017). If current trends continue, by 2030, half of the adult population worldwide will be overweight or obese (Tremmel et al., 2017). Overweight and obesity are defined as an abnormal accumulation of the fat stores in the body by more than 20% of the ideal body weight that may impose harm to one's health (Agha & Agha, 2017; Hales, 2020). In clinical practices, overweight and obesity are measured by calculating the BMI among adults (men & women) which is weight in kilogram divided by height in meters squared (kg/m^2) (CDC, 2021). A BMI range from 25 to 29.9 (kg/m^2) is considered overweight while a BMI above 30 (kg/m^2) is classified as obese (CDC, 2021). In addition, the BMI equation is used for the adult population only rather than utilizing the growth chart which is for children and teens (CDC, 2021). Our participants' ages ranged from 18 - 24 years and they were considered adults. The age of 18 - 20 is deemed an adult in many studies and they use the adult version of BMI equation

as the best to assess their body weight (Liu et al., 2021; Melton et al., 2014; Penglee et al., 2019; Qiu et al., 2021).

Overweight and obesity pose difficult health challenges for society due to their association with several chronic diseases and economic burden. Overweight and obesity increase an individual's risk of developing type 2 diabetes, cardiovascular diseases, polycystic ovary syndrome (PCOS), dyslipidemia, arthritis, chronic kidney disease, some types of cancers, sleep apnea, steatohepatitis, gastroesophageal reflux, hypertension, infertility, and may lead eventually to increased mortality (Abdelaal et al., 2017; Piché et al., 2020). The health care deficit in the economy increased from $147 billion in 2008 to $427.8 billion in 2014, demonstrating an escalation in the number of obese people, which is anticipated to continue (CDC, 2021; Chen et al., 2019). As overweight and obesity pose potential serious health issues, obesity was categorized formally in 1990 as a disease with the code (ICD-10 E66.0) (Agha & Agha, 2017; ICD-10-CM Code E66.0 - Obesity Due to Excess Calories, n.d.).

In the United States between 2017-2018, the National Health and Nutrition Examination Survey (NHANES) illustrated that 31.1% of American adults were overweight and 42.5% were obese (Table 1) (Ogden et al., 2020). The NHANES data elucidated that the obesity level among both genders was mostly the same (Hales, 2020). The obesity level between the ages 20–39 years was 40.3 percent for men and 39.7 percent for women, 46.4 percent of males and 43.3 percent of females were obese between the ages 40-59 years, and 42.2 percent for men and 43.3 percent for women ≥60 years (Hales, 2020).

In relation to race/ethnicity, Hispanic black adults had the highest obesity levels while non-Hispanic Asian adults had the lowest rate at 17.5% compared to other races (non-Hispanic white adults, non-Hispanic black adults, and Hispanic adults which they had 42.2 percent, 49.6 percent, 44.7 percent respectively (Table 1) (Hales, 2020). Moreover, the obesity rates for male adults were the following: non-Hispanic Asians had the lowest obesity rate by 17.5%, while the other groups non-Hispanic whites were 44.7%, non-Hispanic blacks were 41.1%, and Hispanics were 45.7% which did not differ considerably (Table 1) (Hales, 2020). On the contrary, there was a significant variance in obesity levels between women as follows: non-Hispanic black women were the highest at 56.9 percent, Hispanic females were at 43.7 percent, non-Hispanic white females were 39.8 percent, and non-Hispanic Asian women were the lowest by 17.2 percent (Table 1) (Hales, 2020).

In 2010, the state of Virginia had an estimated population of 8,001,024 people, with 60.4 percent of adults being overweight and 26.0 percent being obese (Virginia-State-Profile.Pdf, n.d.). The CDC's 2011 Behavioral Risk Factor Surveillance System (BRFSS) published statistics for adults who are overweight and obese in Fairfax County which were as follows: 34.2% overweight, and 29.2% obese (Healthy Eating | Live Healthy, n.d.).

Table 1: The overweight and obesity levels in the U.S. (for age, gender, and race/ethnicity) according to the National Health and Nutrition Examination Survey (NHANES) 2017-2018.

Characteristic	%
Body Weight	
Overweight	31.1%
Obesity	42.5%
Ages & genders	
Men: 20-39 years old	40.3%
Men: 40-59 years old	46.4%
Men: ≥60 years old	42.2%
Women: 20-39 years old	39.7%
Women: 40-59 years old	43.3%
Women: ≥60 years old	43.3%
Race/Ethnicity	
Non-Hispanic Black adults	17.5%
Non-Hispanic White adults	42.2%
Non-Hispanic Black adults	49.6%
Hispanic adults	44.7%
Non-Hispanic Asian (male)	17.5%
Non-Hispanic white (male)	44.7%
Non-Hispanic black (male)	41.1%
Hispanic (male)	45.7%
Non-Hispanic black (women)	56.9%
Hispanic (women)	43.7%
Non-Hispanic white (women)	39.8%
Non-Hispanic Asian (women)	17.2%

Overweight and obesity rates have been increasing among college students (Jackson, 2020). Based on self-reported height and weight, the National College Health Assessment reveals that 30% of college students are overweight or obese (Karabulut et al., 2018). Sedentary life patterns, poor food choices, unaffordability of healthy food, accessibility, lack of time, and motivation in food preparation were the factors that were named as contributors to overweight and obesity among college students (Sogari et al., 2018). College students have busy lifestyles occupied by newly available college-related activities (Watanabe-Ito et al., 2020). Time constraints are the main obstacle for college students to prepare healthy food owing to the critical stage of college life that requires a transition from living with family to living alone that enhancing to gain more weight (Sogari et al., 2018). Technology and college students are inextricably linked, and it has become an intrinsic part of their identity (Roberts et al., 2014) The majority (60%) of college students in the U.S admitted to being addicted to their electronic devices, by spending an average of 7.65 hours/day for males students and ten hours/day for females students on their devices (Roberts et al., 2014). College students usually spend an hour and 57 minutes messaging, 48.4 minutes sending emails, 34.4 minutes browsing the internet, 26.9 minutes listening to their iPod, and 38.6 minutes on Facebook (Roberts et al., 2014).

Increased calorie consumption, poor dietary choices, low fruit, and vegetable intake, and being physically inactive are all factors that lead to overweight and obesity (CDC, 2021). A calorie deficit needs to be created to lose weight, calories in should be less than calories out (Howell & Kones, 2017). Adults who are overweight or obese, consume

more calories than the body burns, therefore, the body stores the extra calories as fat (Webb, 2021).

Effort have been exerted to combat overweight and obesity worldwide and especially in the U.S. The Centers for Disease Control and Prevention (CDC) developed many initiatives and strategies to confront this epidemic in the U.S., such as ways to increase fruit and vegetable consumption, guidelines to promote physical activity, and use of MyPlate for educating people about how to create a healthy meal (Prevention Strategies & Guidelines | Overweight & Obesity | CDC, 2019). Additionally, the CDC developed strategies for communities to reduce obesity, such as improving the provision and selection of affordable healthy foods and beverages, improving the accessibility of supermarkets in underserved areas, and encouraging retailers to offer healthier food and beverages choices in those areas, prohibiting unhealthy food and beverages should be implemented in public settings, etc. (CDC, 2009). College students' actions such as low physical activity, poor dietary intake that lack of fruits and vegetables all-cause putting them in jeopardy of gaining weight. In addition, it has been reported that more than 50% of college students drink alcohol and 65% of them consume less than two servings/day of fruits and vegetables (Stephens et al., 2017).

The COVID-19 pandemic put the world in unprecedented difficulties and obstacles in relation to the economy, society, and the healthcare system (Wosik et al., 2020). In the U.S, healthcare services were modified to reduce staff exposure to sick individuals (CDC, 2020). Being obese and contracting COVID-19 may necessitate hospitalization, intensive care, and the use of a ventilator to aid breathing, or potentially death. (*CDC*, 2020). One of

the main culprits that increase mortality rates is obesity (Lockhart & O'Rahilly, 2020). The lockdown that occurred during the pandemic radically changed people's lifestyles in terms of diet, physical activity, and sleep (Curtis et al., 2021). In connection with college students, a study reported that the pandemic increased the stress, anxiety, depression, low concentration, and sleep as a result of fearing of their academic performance, and social distance (Son et al., 2020).

In this era, the number of Americans using technology has increased and it became an integral part of American's life (Roberts et al., 2014). According to the Pew Research Center, 97% of Americans own a cellphone, 85% own a smartphone, three-quarters of adults own desktop or laptop computer and 93% of the college student have a smartphone (NW et al., n.d.). In the rapidly growing field of technology such as television, computers, cell phones, and smartphones, etc., overweight and obesity were linked to the amount of time a person spend using technology (Melton et al., 2014). As mentioned earlier, the amount of time that college students stay on their smartphones is high. A study showed that spending more than five hours/day on the phone increases the risk of obesity by 43% (Roberts et al., 2014). One study revealed that individuals who are obese usually spend around seven hours/week which is an hour a day on technology, while normal weight individuals spend 20 minutes/day, which is around 2 hours /week on technology (Melton et al., 2014).

Screen time plays a role in affecting physical activity level, and it may induce sedentary behaviors among college students (Melton et al., 2014; Liu et al., 2021). Besides, according to the World Health Organization (WHO) only 48.7% of college students in the

U.S. who meet the physical activity recommendations (at least 150 min of moderate-intensity physical activity throughout the week, or at least 75 min of vigorous-intensity physical activity throughout the week, or an equivalent combination of moderate and vigorous-intensity activity) (Penglee et al., 2019). Despite the low levels of physical activity among college students, several studies indicated that screen time has no direct effect on physically activity among college students (Liu et al., 2021; Melton et al., 2014; Penglee et al., 2019). It has been revealed that only 5% of college students met the recommendations of consuming five serving/day of fruits and vegetables (Melton et al., 2014).

Purpose of the Study

1- The primary endpoint of this study is to gain an understanding of the correlation of screen time usage and risk factors for weight gain among George Mason college students during the COVID 19 pandemic.

2- The secondary endpoint is to examine the relationship between screen time usage with dietary habits and physical activity.

Objectives/Specific Aims/Research Questions

The objectives of the study are as follows:

1. Analyzing BMI, dietary intake and screen time usage among first-time freshmen at George Mason University entered from the Health Start Here data in 2020
2. Analyzing the correlation between physical activity, sleep, BMI, diet with screen time.

3. Examining how the BMI status and screen time usage differ by gender, age, and ethnicity.

Research question

Is there a correlation between screen time usage and BMI status and dietary habits?

Hypothesis

Primary end point

H_0: College students who spend a greater amount of time on their electronic devices do not have increased risk factors for overweight and obesity.

H_1: College students who spend a greater amount of time on their electronic devices will have increased risk factors for overweight and obesity.

Secondary end point

H_0: Screen time usage has no negative effects on dietary habits and physical activity among college students who spend a greater amount of time on their electronic devices.

H_1: Screen time usage has negative effects on dietary habits and physical activity among college students who spend a greater amount of time on their electronic devices.

Significance

Overweight and obesity are critical health concerns, and the rates are predicted to increase in the U.S in the following years (Hales et al., 2018). Immediate actions are required to prevent and manage the elevated rates of obesity because of the potential consequences to health and financial ramifications (Hu et al., 2020). The medical cost of obesity and pre-obese individuals are upwards of one trillion dollars (De Lorenzo et al.,

2020). In 2030, one in two adults will be diagnosed as obese and one in four adults is expected to have severe obesity (Ward et al., 2019). The time period of young adulthood acts as a foundation for the rest of their life's behaviors because during this period many lifestyle habits may be maintained throughout adult years periods (Sogari et al., 2018). This period of time is critical for college students' life in general and food selection specifically is important (Sogari et al., 2018). The proportions of intake of healthy foods, such as fruits and vegetables, nuts, and seeds are low in comparison to the increased consumption of processed foods, sugary foods, and high-fat products, the concept of eating fruits and vegetables still requires more effort to be adopted by the American people (Blondin et al., 2015).

Young people are easily enticed by technology based on the data of the time consumed using their devices (Roberts et al., 2014). This study will help to determine the factors that contribute to gain more weight and lead to unhealthy food choices among the Mason community. Additional evidence such as the present study is needed to draw a conclusion of the risks of the long-time spending on social media on overweight and obesity. Besides, the COVID 19 pandemic made the world to move completely to online classes which may have increased the prevalence of sedentary life and lead to weight gain. There has been a lot of research conducted on screen time and BMI among children and adolescents. However, little research has been conducted on young adults between 18-25 years old. Therefore, this study would assist to fill the gap in the previous research in the area of technology usage and overweight and obesity among Mason college students.

CHAPTER 2: LITERATURE REVIEW

This chapter presents a comprehensive detail of the current literature concerning the effect of use social media on BMI and dietary choices. The purpose of this literature review is to investigate the research that has been conducted to date (May 2022) concerning the correlation of screen time (cell phone, smartphone, computer, etc.) and BMI among adults. In this chapter, the first section covers the background of increasing body weight and BMI. The second section is descriptive evidence of what the previous studies found.

Background

The incidence of overweight individuals and obesity consists of 1.9 billion adults worldwide (Obesity and Overweight, n.d.). The World Health Organization defines overweight and obese as "abnormal or excessive fat accumulation that may impair health" and can be recognized by Body Mass Index (BMI) equation (Obesity, n.d.). Body Mass Index (BMI) is a tool used in clinical practices that that serves as an indicator for the amount of fat in person's body assumed from weight and height, so to identify overweight and obesity, weight in kilogram divided by the square height in meters (kg/m^2) (Calculate Your BMI - Metric BMI Calculator, n.d.). If the number lies between 25 to 30 kg/m^2 individuals are considered overweight, but if the number is $\geq$ 30 kg/m^2 an individual is deemed obese (CDC, 2021b). BMI is a useful tool for measuring body weight. However, there are some limitations of using BMI as follows: BMI measures the body weight rather than the body fat; the BMI is unable to discern whether the rise is due to muscle or excessive fat; BMI cannot determine the fat distribution in the body; and the relationship

between BMI and body fat can be influenced by age, sex, ethnicity, and muscle mass (Body Mass Index: Considerations for Practitioners, n.d.).

According to the National Health and Nutrition Examination Survey (NHANES) between 2017-2018, there were a total of 42.5% of American adults that were obese and 31.1% were overweight across the U.S. (Ogden et al., 2020). Obesity rates among men between ages 20-59 years ranged from 40.3% - 46.4%, which is similar to women within the same age group at 39.7%-43.3% (Hales, 2020). In regards to race and obesity, Hispanic black adults have the highest rates at 49.6%, compared to non-Hispanic Asian adults at 17.5%, which is the lowest incidence compared to others groups (non-Hispanic white adults 42.2%, non-Hispanic black adults 49.6%, and Hispanic adults 44.8%) (Hales, 2020).

Virginia had an estimated population of 8,001,024 persons in 2010, with 60.4 percent of adults overweight and 26.0 percent obese (Virginia-State-Profile.Pdf, n.d.). There were 34.2% of adults that were overweight, and 29.2% of adults were obese in Fairfax County based on the CDC's 2011 Behavioral Risk Factor Surveillance System (Healthy Eating | Live Healthy, n.d.).

Overweight and obesity are associated to with a number of health challenges. Due to this, excessive weight has become a serious public health concern due to the link to many chronic diseases and the economic burden (Hu et al., 2020). Overweight and obesity may contribute to many chronic diseases, such as type 2 diabetes, cardiovascular disease, hypertension, dyslipidemia, chronic kidney disease, some types of cancers, sleep apnea and may lead to increased mortality (Piché et al., 2020; The GBD 2015 Obesity Collaborators,

2017). In 2014, the economic burden for obesity and treatment for obesity reached to $427.8 billion in the United States (Chen et al., 2019).

College students are especially vulnerable to experiencing overweight and obesity for a number of reasons. Sedentary lifestyles, poor food choices, the high cost of healthy food, food accessibility, time constraints, and lack of motivation in meal preparation were all components as contributing causes to the high prevalence of overweight and obesity among college students (Sogari et al., 2018). College students do not meet the recommendations of five serving/day of fruits and vegetables consumptions, and only 5 percent of them who follow that (Melton et al., 2014). Furthermore, only 48.7% of college students in the United States fulfill the physical activity recommendations (at least 150 minutes of moderate-intensity physical activity per week, or an equivalent combination of moderate and vigorous-intensity activity per week), according to the World Health Organization (WHO) (Penglee et al., 2019). Time restrictions are the primary barrier for college students to prepare healthy food due to the critical stage of college life that requires a transition from living with family to living alone that enhancing to gain more weight (Sogari et al., 2018).

In the 21st century, technology has become an essential part of daily life for Americans, particularly college students (Roberts et al., 2014). However, there is a negative association that appears between health and technology according to a study that illustrated a significant difference ($P< 0.05$) between underweight, normal, overweight, and obese people with spending a greater amount of time on technology and social networks, which has an association with an increased BMI (Melton et al., 2014). A study conducted on

college students showed that male students spend 7.65 hours per day on their cell phone, while female students spend ten hours per day *(P*= 0.929). The same study showed that there were no significant gender disparities in the number of calls and messages made (*P*=0.384). There was a significant difference in the emails sent (*P*= 0.047) between genders (Roberts et al., 2014). College students usually spend an hour and 57 minutes messaging, 48.4 minutes writing emails, 34.4 minutes surfing the internet, 26.9 minutes listening to their iPod, and 38.6 minutes on Facebook on average (Roberts et al., 2014). Obese people use technology for an hour/day while normal weight individuals spend on average 20 minutes/day (Melton et al., 2014).

Description of Evidence

A Medline and PubMed search was conducted to find articles that were published from 2014 to 2022 utilizing the following search terms: diet, weight, college students, cell phone, technology, screen time and COVID-19. Additional search terms used included the following: for the diet, (diet or nutrition or food habit or eating habit or eating behavior or lifestyle or food); for the weight, (weight gain or obesity or overweight or weight increase or high body mass index); for the college students, (college students or university students or undergraduates); for cell phone, (cell phones or mobile phones or smart phones or mobile devices); for screen time, (screen-time or screen time or screen exposure or screen use); for COVID 19, (covid-19 or coronavirus or 2019-ncov or sars-cov-2 or cov-19). The exclusion criteria included children, adolescents, older adults, and studies prior to 2014.

The search generated a total of 16 articles. However, four were excluded for a variety of reasons such as dates which were prior 2014, and topics are not related. Thus, the result was 12 articles that were included in the review.

Table 2: Illustrates the similarities between the studies, methodology, and results.

Studies' Reference	Sample size & Ages	Gender & BMI "Mean"	Study design	Results
Bruening et al., 2016 Texas	304 & Mean age: 18.9	Majority female 62% & BMI: N/A	Pilot study - Longitudinal study	No result – still ongoing
Chau et al., 2014 Central Norway	48,882 & Adults: ≥20	Majority female (54.4%) & BMI= 0.6% were underweight, normal 32.1&, 44.4% overweight, and obese 23.0%	Prospective cohort study	The results showed that higher levels of total sitting TV viewing and leisure time computer use were significantly associated with poorer cardiometabolic risk profiles and healthy participants. Results showed that men and women in the highest total sitting category more than/equal 10 hours per day had significantly poorer BMI, (all $P > 0.00$). Total sitting time more than or equal to 10 hours/day was significantly associated with lower HDL cholesterol in men only and with higher total cholesterol in women only, (all $P > 0.00$). The highest level of TV viewing time more than/equal 4 hours per day was significantly associated

				with poorer BMI, (all $P >$ 0.00). TV viewing more than or equal 4 hours per day was associated with poorer BMI.
Deliens et al., 2014 Belgium	35 & Adults :18-26 years	Majority 21 female (60%) and 14 males & 22.8 kg/m^2	Qualitative study	Five focus group discussions have been conducted. Students reported to be influenced by individual factors (e.g. taste preferences, self-discipline, time and convenience), their social networks (e.g. (lack of) parental control, friends and peers), physical environment (e.g. availability and accessibility, appeal and prices of food products), and macro environment (e.g. media and advertising).
Gonzales et al., 2016 New England	80 & Adults: 18-20 years	Majority female 52 (65%) and 28 males (35%) & BMI: (23.5), (23), 22.8 kg/m^2 for three groups	Cross sectional design	There was a significant correlation between total appetitive responsiveness score and percentage of total fat (r = 0.34, p = .002), but not total added sugars (r = 0.01, p = .92) or added sugars from showed that after controlling for total appetitive responsiveness score (p = .002),

Johnson et al., 2019 Canada	754 & Adults: ≥18	Majority males (89.1%) BMI= 18.2% were normal, 39.4% overweight, and obese 42.4%	Retrospecti ve cohort study	Screen time was not significantly associated with weight change outcomes. roughly half (51.7%) of participants reported not meeting the recommended 7 h of sleep per night. Nightly sleep duration was not significantly associated with weight or BMI change. long sleepers (> 9 h/night) gained significantly more weight per year (5.1 kg) compared with average (1.2 kg) and short sleepers (1.3 kg). Inmates who reported sleeping > 120 min during the day also gained more weight (9.6 kg) compared to those who reported not sleeping (5.6 kg) or sleeping ≤ 120 min (5.0 kg). Inmates who were inactive gained significantly more weight (8.3 kg) while who exercised at least 60 min per day gained 4.5 kg.
Liu et al., 2021 China	220 & Adults :18-25 years	Majority female (115) & BMI: N/A	Cross sectional design	Significant relationships were observed among BMI and sleep efficacy (r = – 0.19), and BMI and Sleep duration (r = –0.22). In detail, BMI was negatively correlated with sleep efficacy (p = 0.01) and sleep duration (p < 0.01). BMI was negatively correlated with SE (r = – 0.19) and sleep duration (r = – 0.23). MI were observed as predictors for sleep quality. Specifically, sedentary behavior (b = – 0.193, p =

				0.01), sleep duration (b = –0.299, p < 0.01), and BMI (b = –0.136, p < 0.01) negatively predicted sleep efficacy and accounted for 15% of the observed variance. BMI negatively predicted sleep duration (β = –0.222, p < 0.01), which explained 5% of variance.
Melton et al., 2014 Georgia	591 & Adults:	Majority female 325 (56.2%) and 253 (47.8%) males & 12.4% (N = 73) were underweight, 51.6% (N = 305) were a healthy weight, 18.3% (N = 108) were overweight, and 10.8% (N = 64) were obese.	Cross sectional design	Total social networking with participants spending on average 258.08 (SD = 26.89) minutes per week using social networking websites or Twitter. Participants average fruit intake was 1.28 (SD = 1.18) servings per day, average vegetables servings per day were 1.47 (SD =1.32). Television watching had the second highest usage with a reported average of 254.09 (SD = 17.37) minutes per week, followed by general internet surfing with an average of 202.66 (SD = 19.35) minutes per week. Participants with varying BMI classifications significantly used 2 technologies differently: social networking and TV watching (p < .05). Obese participants reported using twice the average minutes per week than the other BMI classifications.

				Obese participants spent on social networking, an average of 411.27 minutes per week as compared to 117.66 for underweight 202.33 for normal weight and 163.86 for overweight participants. In
Penglee et al., 2019 The US	242 & Adults: >18 years old	19.8% Male and 80.2% female & 25.0 kg/m^2	Cross sectional design	There was no significant difference in days per week of physical activity between the different categories of years of smartphone use, $X_2(2) = 2.01$, $p = 0.366$, and amount of time using a smartphone per day, $X2(3) = 2.39$, $p = 0.496$.
Qiu et al., 2021 China	2873 & Adults: 18-44 years	Majority female (75.5%) & BMI= 21.9 kg/m^2 female and 23.1 kg/m^2 male	Cross sectional design	We found no significant association between TV program viewing time and BMI ($P > 0.05$). High BMI had an association with short time using computers and mobile phones and the overall usage time of the three devices (all $P < 0.01$). People with obesity spent a short time using computers, No obesity 2.38 vs. obese 2.07, ($P < 0.05$). Obesity was found to be prevalent in 15.30 percent of the subjects, with males

				(18.5%) having more cases than females (11.8%) ($P < 0.01$). By contrast, we observed significant inverse associations between BMI and computer and mobile phone usage in the simple regression model (both $p < 0.05$). longer usage of computers and mobile phones was evident in males ($p < 0.05$) and participants with a high education level ($p < 0.01$).
Roberts., 2014 Texas	164 & Adults: 19-22 years old	Majority Male 84 (51%) and female 80. & BMI: N/A	Cross sectional design	College students spent nearly nine hours daily on their cellphones. the results show there was significant difference ($p < 0.05$) in terms of the number of e-mails sent. Findings reveal six activities that significantly ($p < .05$) affect cell-phone addiction in the full-sample. Females spent significantly ($p < .04$) more time texting compared with males (105 minutes daily versus 84 minutes, respectively)
Saxena et al., 2021 India	60 & Adults:18 - 24 years	30 men and 30 women & BMI = 23.06 kg/m^2	Cross sectional design	With an average screen time of 10.9 hrs., 38% of students were using the screen maximally during the night. Students' calorie intake was ten times the recommended daily requirement during the stay at home but was negatively related to screen-

				time, though non-significant *P*= 0.158.
Sogari et al., 2018 New York	35 & Adults: 18-25 years	Majority female (23) and 12 males & BMI= 23.2 kg/m^2	Qualitative study	Six focus group discussions were conducted until saturation of new information was reached. The majority of individuals felt themselves to be in healthy weight, and only a minority of them admitted to having current or previous eating disorders.

Description of Evidence

Population

Nine studies recruited a majority of women (54.4%-80%) (Bruening et al., 2016; Chau et al., 2014; Deliens et al., 2014; Gonzales et al., 2017; Liu et al., 2021; Melton et al., 2014; Penglee et al., 2019; Qiu et al., 2021; Sogari et al., 2018). Two studies (Johnson et al., 2019; Roberts et al., 2014) had males as the majority of their participants by 51%. Another study (Saxena et al., 2021) included an equal number of women and men by 30 people.

In concern to race/ethnicity of the participants, five studies (Johnson et al., 2019; Melton et al., 2014; Penglee et al., 2019; Roberts et al., 2014; Sogari et al., 2018) included Blacks/ African American, and they consisted between 2.9% to 25%, six studies (Gonzales et al., 2017; Johnson et al., 2019; Melton et al., 2014; Penglee et al., 2019; Roberts et al., 2014; Sogari et al., 2018) included White/Caucasian 62%-97.1%, two studies (Gonzales et

al., 2017; Roberts et al., 2014) included mixed race 6%-6.5%, three studies (Gonzales et al., 2017; Roberts et al., 2014; Sogari et al., 2018) included Asian 6%-11%, one study (Roberts et al., 2014) included Hispanic 6%, other three studies (Gonzales et al., 2017; Johnson et al., 2019; Melton et al., 2014) included other and not reported 2.5% to 11.7%. One study (Johnson et al., 2019) included 14% of Aboriginal.

Study design

Two of the studies (Deliens et al., 2014; Sogari et al., 2018) were qualitative studies in which participants were distributed to groups to discuss some questions. Seven studies (Gonzales et al., 2017; Liu et al., 2021; Melton et al., 2014; Penglee et al., 2019; Qiu et al., 2021; Roberts et al., 2014; Saxena et al., 2021) were cross-sectional study designs. Two studies were cohorts, but out of those, one was a prospective cohort (Chau et al., 2014) while the other retrospective (Johnson et al., 2019).

Outcomes Measured

One study had a primary end outcome being the association between technology usage on college students' overall health (Melton et al., 2014). Two studies had an outcome of the relationship between sleep behavior, sleep quality, diet and weight status among college students (Liu et al., 2021; Saxena et al., 2021). A study (Gonzales et al., 2017) had two outcomes the association between BMI and food intake and the influence of food intake on appetitive responsiveness influenced. Exploring smartphone usage and physical health for (Penglee et al., 2019) study and barriers and enablers of healthy eating for (Sogari et al., 2018) study. The use of cell phone addiction is the primary outcome of (Roberts et al., 2014) study. The study that conducted by (Deliens et al., 2014) focuses on factors that

impact eating behavior. One study (Chau et al., 2014) had to examine associations of total sitting time, TV viewing and leisure time computer use with cardiometabolic risk biomarkers in adults. A study (Qiu et al., 2021) had an outcome to evaluate the relationship between television (TV) viewing and computer and mobile phone usage duration with BMI and obesity. Last study (Johnson et al., 2019) primary outcome is to examine the weight change outcomes during incarceration were influenced by physical activity, screen time, and sleep.

Body Mass Index (BMI)

Four studies (Deliens et al., 2014; Gonzales et al., 2017; Penglee et al., 2019; Sogari et al., 2018) had a BMI range from 22.8 kg/m^2 to 25 kg/m^2 . Three studies (Bruening et al., 2016; Liu et al., 2021; Roberts et al., 2014) did not clarify the BMI status, and five studies (Chau et al., 2014; Johnson et al., 2019; Melton et al., 2014; Qiu et al., 2021; Saxena et al., 2021) included participants with different BMI statuses (underweight, normal, overweight, and obese).

Studies intervention length

The total studies duration ranged from one month to five years.

CHAPTER 3: DESIGN AND METHODOLOGY

Study Design

The data for the current study was abstracted from the Health Starts Here study which is a longitudinal prospective cohort study of young adult college students at George Mason University in 2020. The goal of the study is to better recognize and improve university students' health and well-being. It concentrates on emotional and physical health of the students from the first year until graduation. The primary objective of the study is to investigate the role of health, health behavior, and mental health in college completion. College students are different in many aspects such as socioeconomic status, sexual orientation, ethnicity, culture, gender, and other demographic characteristics, so the study also aims to explore if emerging adulthood or accelerated adulthood ideas can be applied to them. In addition, the study investigates dietary and physical activity habits during the college years, which is a period of increasing adult autonomy. The study also examines how social media and social networks impact influence healthy and unhealthy behaviors. Another objective of the study is how socioeconomic class, sexual orientation, ethnicity, culture, gender, and other demographic characteristics affect the longitudinal connections between physical and psychological health factors. The study will also investigate the effects of social connectivity and trauma exposure on mental and physical health; how present and previous risky behaviors, sexual risk, gun ownership, and substance use affect health,

mental health, and college graduation; and to differentiate modifiable risk and protective factors so that new interventions might be developed to improve health and well-being.

Study Population and Data Collection

The study originally was targeting 300 freshman students annually who are between 18 and 24 years old and speak English proficiently during the 2020 year. Any individual who is over the age of 24 and does not speak English was excluded. The study recruited students through flyers outside of classrooms, brief in-class presentations and to select student organizations, online films, postcards delivered in class, and email were utilized to promote the study in specific courses that contain a large number of new students of students were selected. However, the recruitment process changed due to the COVID 19 pandemic. Invitation letters and emails, as well as video and material during first-year orientation sessions and messages to university social media followers, were used to reach new students. Professors who teach courses with a large number of freshmen students to show the recruitment video to the students was strongly encouraged.

Each fall and spring, researchers collect data and invite participants to complete online surveys, and each individual who agrees to participate will be monitored for four years. Blood samples are only taken in the first year and the fourth year, while saliva will be collected throughout the course of four years. Additionally, the participants will be asked to do an in-person physical exam in a research center, which includes biospecimen collection each fall. The data collected were online questionnaires, demographics and social determinants of health, migraine, health, nutrition, physical activity, sleep, and technology use and social media.

In concerning measuring health parameters and nutrition, measuring health was conducted by using self-rated health (SRH) questionnaire, which is measured with one item that asks, “Would you say your health is excellent, very good, good, fair, or poor?” Responses range from 1 (poor) to 5 (excellent). Measuring nutrition was done by the Dietary History Questionnaire (DHQ)-III, which is a dietary recall method used to assess diets based on a food frequency questionnaire (FFQ). The FFQ was used in the Health Starts Study for the past month with portion size designed to assess food and dietary supplement intakes. Respondents chose their consumption frequency from a number of categories, then indicated the portion size from an array of three choices. DHQ-III contains 135 items about foods and beverages, as well as 26 questions about dietary supplements. Some food and beverage items have their own embedded questions that allow determining a final assignment of an item in the nutrient and food group database leading to 263 foods/beverages listed in the database. The food/beverage list, supplement list, and serving amounts in the DHQ-III are based on analyses of combined data from 24-hour recalls reported in the National Health and Nutrition Examination Surveys (NHANES) 2007-08, 2009-10, 2011-12, and 2013-14. The NHANES food and beverage data gathered is categorized by cognitively and nutritionally similar foods to determine which foods to include in the questionnaire. The food groups selected for DHQ-III consist of many distinct individual foods recorded on recalls that are subsumed by the line items. This produced a value per portion size for each nutrient or food group. The nutrient and food group values from the Nutrient and Food Group Database for the DHQ III were used to analyze Mason: HSH dietary intake. NHANES groupings that are pre-

established and mutually exclusive were used to estimate the leading sources of sugar intake, refined grains, saturated fat, and sodium. Because grain products, milk products, and beverages were major sources, the food categories were further subdivided by type of milk, grain, and beverages to examine which food or beverage type contributed to most of the total added sugar, saturated fat, and sodium.

In the current study, participants who lacked height and weight information as well as those who consumed more than 5000 kcal per day and less than 500 kcal per day were excluded.

Statistical Analysis

The current study investigated several variables in the Health Starts Here research. Several covariates were considered as evaluating factors for the main variables (dietary habits, weight (BMI) status, physical activity level, and phone use) included gender, and race/ethnicity. The Body Mass Index was calculated by dividing person's weight in kilograms by the square of the person's height in meters (kg/m^2). BMI was categorized as follows: underweight <18.5 kg/m^2; 18.5 kg/m^2 – 24.59 kg/m^2 normal weight; 25 kg/m^2 – 29.99 kg/m^2 overweight, ≥ 30 kg/m^2 obese. In addition, the participants were categorized according to their race/ethnicity into six groups: White/Non-Hispanic or Latino, White/Hispanic or Latino, Black or African American/Non-Hispanic or Latino, Black or African American/Hispanic or Latino, Asian/Pacific Islander, and Multiple races. For the physical activity level, daily activity levels were divided into four categories: sedentary (typical daily living activities); low active (typical daily living activities plus 30–60 minutes of moderate activity); active (typical daily living activities plus 60 minutes of

moderate activity or 30 minutes vigorous activity); and very active (typical daily living activities plus 60 minutes of moderate activity plus an additional 60 minutes of vigorous activity, or a total of 120 minutes of moderate activity) (Rana et al., 2022, p. 3).

Participants' total usage time of social media was grouped with three levels: low usage, medium usage, and high usage. The division was taken based on the total participants divided into three groups from the lowest to the highest. Stepwise regression was used between technology level usage, BMI, sleep, energy, and total PA time. The study took the lowest and the highest groups to model variables using stepwise regression.

Frequencies, percentages, standard deviation, and mean were estimated for the categorical variables and numerical variables. The mean screen time contributed by Discussion Boards, Facebook, Instagram, Pin Boards, Snapchat, Tumblr, YouTube, Reddit, Twitter, and Others was calculated. Also, the mean total energy intake was estimated and each one of protein, fat, saturated fats, carbohydrate, sugar, added sugar, fiber, and sodium all contributed to the total energy intake. Pearson correlation was computed to assess the linear relationship between BMI, Diet, physical activity, sleep, and screen time at the significance level, $p<0.05$. T- test was used between BMI and screen time level usage. The low usage and high usage were compared with BMI.

CHAPTER 4: DATA ANALYSIS AND RESULTS

Data Analysis

The data was analyzed using the Statistical Package for the Social Sciences, version 22, (IBM SPSS Inc., Chicago, IL). BMI, dietary behaviors and screen time were compared correlations, t-test, and stepwise regressions. The significance level used was 5%.

Results

Of the 174 participants of the 2020 HSH study, 131 students (48 men and 83 women) had a full record of the data needed. The study included a higher number of females than males, and all participants were between the ages of 18 and 24 which represent 63.4% and 36.6% of the total participants respectively (Table 3). The overall aim of the study was to examine the relationship between screen time usage and an increase in body mass index (BMI) among Mason college students. The distribution of the body mass index illustrated that the number of females who were classified as overweight individuals or obese was 62.5% and 52.63% respectively while males had a lower rate than females at 37.5% and 47.36% respectively (Table 5) (Figure 1). In terms of race/ethnicity, White/non-Hispanic or Latino represents the highest race with 41.2%, and women had the highest percentage at 66.66%, while black or African American/Hispanic or Latino represents the lowest at .8%. In addition, the mean activity level was higher in males by 2.06 than in females by 1.99, and the number of females who were sedentary/day was higher than the number of males (Table 5). Concerning

screen time, the number of females who used high screen time was slightly higher than men (Figure 1).

Table 3: Anthropometric Characteristics of Mason HSH Cohort.

Characteristics	*Total Numbers*	*Male*	*Female*
		Mean ± SD	***Mean ± SD***
Height (inch)	65.90± 3.51	68.84±3.02	64.20±2.51
Weight (pound)	152.24± 40.77	170.75±47.64	141.54±31.91
BMI (kg/m2)	24.54±5.69	25.31±6.74	24.09± .4.98
Activity level (day)	2.02 ±.87	2.06 ±.95	1.99±.83
Total calories (kcal)	1552.09±823.52	1855.17±964.56	1376.81±676.06
Total number n (%)	131 (100)	48 (36.6)	83 (63.4)

Table 4:Demographic Characteristics of Mason HSH Cohort.

Characteristics	*Total Numbers (%)*	*Male*	*Female*
		n	***n***
Race			
Unidentified	1 (.8)	1	0
White/Non-Hispanic or Latino	54 (41.2)	18	36
White/Hispanic or Latino	11 (9.4)	4	7
Black or African American/Non-Hispanic or Latino	13 (9.9)	3	10

Black or African American/Hispanic or Latino	1 (.8)	1	0
Asian/Pacific Islander	36 (27.5)	15	21
Multiple races	14 (10.7)	6	8
Others	1 (.8)	0	1

Figure 1: Illustrates the difference between male and female students' amount spends on technology and their BMI

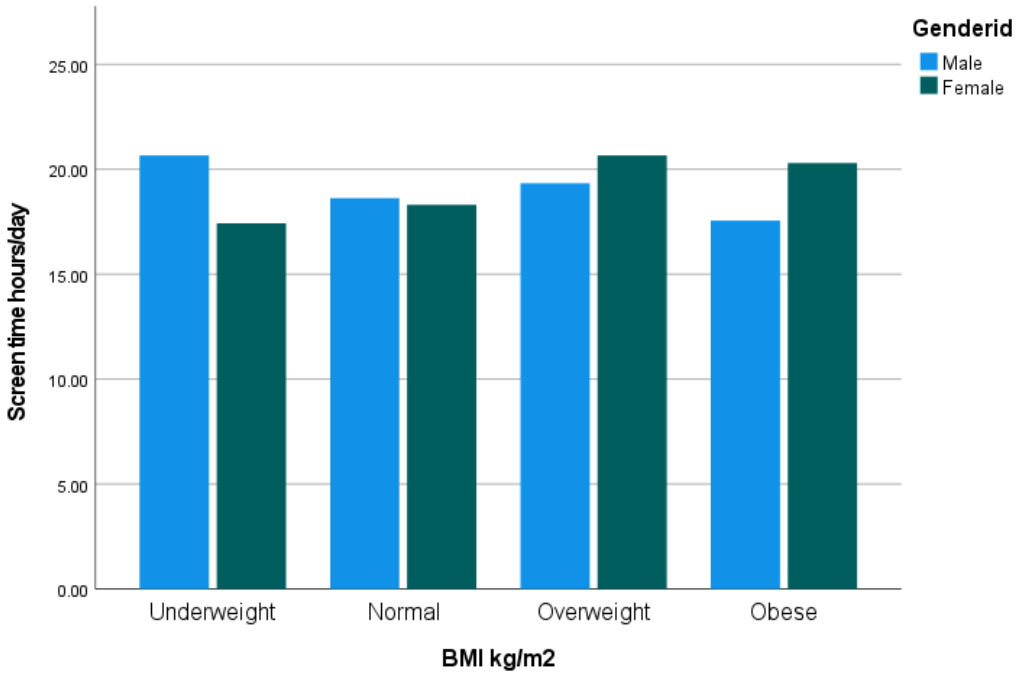

Table 5: Body Mass Index and activity level of Mason HSH Cohort participants

		BMI				***Physical activity level***				
		Under weight	*Normal*	*Over weight*	*Obese*	*Unidentified*	*Sedentary*	*Low active*	*Active*	*Very active*
Male		3	27	9	9	1	13	20	10	4
Female		7	51	15	10	2	20	41	17	3
Total number (%)		10 (7.6)	78 (59.5)	24 (18.3)	19 (14.5)	3 (2.3)	33 (25.2)	61 (46.6)	27 (20.6)	7 (5.3)

The results showed that male students had mean and SD for BMI of 25.3±6.74 kg/m^2, and the mean total of screen time was 18.68±4.17 hours/day (Table 6). Additionally, there were 20 students out of 48 who were classified as low active, and only 4 who were very active. Pearson correlation was performed between BMI and physical activity, and it showed that there was a significant positive correlation between the two variables, r (46) = .345 p=.016. Physical activity: is the sum of the total time spent/ (hour and minutes) on doing vigorous and moderate exercises among males only. For screen time and BMI, the correlation showed a negative relationship between the two

variables, when the amount of screen time increases, BMI increase. The study found a non-significant correlation between the two variables, r (46) = -.068 p=.645. Also, the study revealed that there was a non-significant correlation between BMI and sleep and the correlation showed r (46) = -.132 *p*=.370.

Table 6: The below table illustrates the correlation between BMI and technology usage, sleep, energy intake for Male only.

Correlations

		BMI (kg/m²)	**Screen Time (hour)**	**Total Physical activity time (hour)**	**Sleep Time (hour)**	**Total Energy intake (Kcal)**
BMI (kg/m²)	Pearson Correlation	1	-.068	.345*	-.132	.077
	Sig. (2-tailed)		.645	.016	.370	.603
Screen Time (hour)	Pearson Correlation	-.068	1	-.145	.016	.038
	Sig. (2-tailed)	.645		.327	.913	.796
Total Physical activity time (hour)	Pearson Correlation	.345*	-.145	1	-.072	-.006
	Sig. (2-tailed)	.016	.327		.629	.968
Sleep Time (hour)	Pearson Correlation	-.132	.016	-.072	1	-.130

Total Energy intake (Kcal)		
Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)
.603	.077	.370
.796	.038	.913
.968	-.006	.629
.379	-.130	
	1	.379

Note *. Correlation is significant at the 0.05 level (2-tailed).

In regard to diet, the mean total calories consumed was 1855.17 kcal/day. These calories were mainly from carbohydrates (mean = 239 g/day), followed by protein at 78 g/day and fat at 68 g/day (Table 9). The mean amount of sugar and added sugars were 122 g/day and 64 g/day respectively while the amount of saturated fat was 23 g/day, and 239 mg/day came from cholesterol. The mean sodium intake was 3190 mg/day.

For females, the mean and SD for BMI was 24.09±4.98 kg/m^2, and the mean total of screen time was 18.90±5.54 hours\day (Table 7). The number of female students who very active were 3, whereas 41 of them were low active. Pearson correlation was conducted between BMI and screen time, physical activity, and sleep, and had a positive correlation, but none of them had a significant statistical correlation. The correlation results were r (81) = .162 *p*=.143, r (81) = .054 *p*=.630, r (81) = .180 *p*=.104 respectively.

The average daily calorie intake was 1376.81 kcal. The majority of the calories came from carbohydrates (183 g/day on average), followed by protein (50 g/day) and fat

(51 g/day) (Table 9). Sugar consumption for males and females was 89 g/day and 45 g/day, respectively, whereas saturated fat consumption was 17 g/day, and cholesterol consumption was 194 mg/day. The average daily sodium intake was 2154 mg.

Table 7: The below table illustrates the correlation between BMI and technology usage, sleep, energy intake for female only

Correlations

		BMI (kg/m^2)	Screen Time (hour)	Total Physical activity time (hour)	Sleep Time (hour)	Total Energy intake (Kcal)
BMI (kg/m^2)	Pearson Correlation	1	.162	.054	.180	.051
	Sig. (2-tailed)		.143	.630	.104	.644
Screen Time (hour)	Pearson Correlation	.162	1	.016	.016	.048
	Sig. (2-tailed)	.143		.885	.888	.666
Total Physical activity time (hour)	Pearson Correlation	.054	.016	1	.318**	.090
	Sig. (2-tailed)	.630	.885		.003	.420

	Total Energy intake (Kcal)		Sleep Time (hour)	
	Sig. (2-tailed)	Pearson Correlation	Sig. (2-tailed)	Pearson Correlation
	.644	.051	.104	.180
	.666	.048	.888	.016
	.420	.090	.003	.318**
	.304	-.114		1
		1	.304	-.114

Note **. Correlation is significant at the 0.01 level (2-tailed).

As the results for gender revealed, there were not any significant correlations between the variables except for BMI and physical activity in men. For screen time, both males and females had a similar amount of time consumed on-screen time 18.68±4.17 hours/day and 18.90±5.54 respectively. For physical activity, men had a positive significant correlation with BMI r (46) =.345*p*=.016, but women did not r (81) =.054 *p*=.630. Female students had a lower mean of physical activity (1.99 hours/day) compared to men (mean = 2.06 hours/day). The results illustrated that women were more sedentary than men: 20 (60.60%) and 13 (39.4%) students respectively.

Dietary habits for both genders demonstrated that male students consume 1855.17 kcal/day, which is more calories than the females'1376.81 kcal/day (Table 9). Females' average consumption of saturated fat, added sugar, and sodium were 17 g/day, 45 g/day,

and 2154 mg/day respectively, which was less than the consumption of men's (68 g/day, 64 g/day, and 3190 mg/day respectively).

Table 8: Students' Mean Amount of Time (hours) Spent on Technology per/day.

	Technology usage (hour/day)					Frequencies								
	Snapchat	**Pin Boards**	**Instagram**	**Facebook**	**Discussion Boards**		**Unidentified**	**None**	**1 <hour**	**1-2 hours**	**3-4 hours**	**4-6 hours**	**>6 hours**	**Total**
						F (%)		F (%)	F (%)	F (%)	F (%)	F (%)	F (%)	F(%)
	3 (2.3)	4 (3.1)	2 (1.5)	5 (3.8)	4 (3.1)									
	30 (22.9)	94 (71.8)	15 (11.5)	75 (57.3)	69 (52.7)									
	38 (29.0)	20 (15.3)	32 (24.4)	40 (30.5)	22 (16.8)									
	30 (22.9)	10 (7.6)	51 (38.9)	7 (5.3)	28 (21.4)									
	22 (16.8)	1 (.8)	21 (16.0)	3 (2.3)	5 (3.8)									
	6 (4.6)	0	7 (5.3)	0	1 (.8)									
	2 (1.5)	2 (1.5)	3 (2.3)	1 (.8)	2 (1.5)									
	131 (100)	131 (100)	131 (100)	131 (100)	131 (100)									

Others	Twitter	Reddit	YouTube	Tumblr
56 (42.7)	4 (3.1)	4 (3.1)	2 (1.5)	4 (3.1)
48 (36.6)	68 (51.9)	77 (58.8)	13 (9.9)	108 (82.4)
1 (.8)	27 (20.6)	29 (22.1)	28 (21.4)	11 (8.4)
8 (6.1)	23 (17.6)	14 (10.7)	39 (29.8)	7 (5.3)
10 (7.6)	7 (5.3)	4 (3.1)	28 (21.4)	1 (.8)
5 (3.8)	2 (1.5)	2 (1.5)	11 (8.4)	0
3 (2.3)	0	1 (.8)	10 (7.6)	0
131 (100)	131 (100)	131 (100)	131 (100)	131 (100)

Table 9: This table illustrates the mean intake of carbohydrate, fat, protein, and sodium for both genders.

	Mean						
	Carb g/day	**Fat g/day**	**Protein g/day**	**Saturated fat g/day**	**Cholesterol mg/day**	**Added sugar g/day**	**Sodium mg/day**
Male	238.70	68.18	77.61	23.38	281.60	63.88	3190.11
Female	183.31	51.12	50.42	17.52	194.92	45.10	2154.64

Additional statistical tests were computed to assess relationships, including BMI, screen time, and diet. To test our hypothesis of whether screen time influences BMI, an independent t-test and stepwise regression was performed. T-tests were used between BMI and technology level usage (Table 10). Participants' total usage time of social media was grouped with three levels: low usage, medium usage, and high usage. The low usage and high usage were compared with BMI. On average low-tech usages (M=23.24, SD=5.09) had lower BMI scores than high-tech usage (M=24.71, SD=6.81). As is seen in Table 10, the results of the independent t-test showed that the difference is statistically non-significant, t (84) = -1.13, p>.05 which indicates that there is no effect of using social media on BMI.

Table 10: Independent T test for BMI and level of screen time usage

		Independent Samples Test					**95% Confidence Interval**	
		t	df	*P*	Mean	SE	Lower	Upper
BMI	Equal variances assumed	-1.13	84	0.26	-1.47	1.30	-4.05	1.11

Equal variances not assumed	-1.13	77.79	0.26	-1.47	1.30	-4.05	1.11

A stepwise linear regression was used to identify possible predictors of the outcome on BMI based one the following candidate variables: tech usage, sleep, energy, and total PA time (Table 11). A non-significant regression equation was found ($F(4,126) = 1.877$, $p>.05$, with an R^2 of .056, $R^2_{Adjusted}=.026$.

Table 11: Stepwise regression between BMI and technology level usage, sleep, energy, and total PA time.

			95% CL			
Variables	B	SE	LL	UL	Beta	*P*
(Constant)	20.946	2.145	16.702	25.190		.000
Sleep time (hours)	.035	.041	-.109	.276	.077	.393
Total energy intake (kcal)	.001	.001	-.046	.116	.082	.353

Total Physical activity time (hours)	.040	.020	-.001	.002	.177	.051
Screen time (hours)	.083	.097	.000	.080	.074	.393

Note. *P<.05

CHAPTER 5: DISCUSSION AND CONCLUSION

Discussion

The primary objective of this study was to examine the relationship between using screen time and an increase in body mass index (BMI) among George Mason University freshman college students. The principal result of our study indicated that there was not a statistically significant correlation between higher screen time usage and an increase in BMI among the students. However, there was a positive strong correlation between BMI and physical activity (p=.016) among males' students. The analysis does not support the theory that spending more time on screens can influence people's weight. The result of our study is in line with some of the previous studies about that there is not significant correlation between screen time and BMI (Johnson et al., 2019).

Some of the previous research support the negative influence of increased screen time on body weight (*Chau et al., 2014*; Liu et al., 2021; Melton et al., 2014). Results showed that individuals who are obese tend to spend a lot of time on their screens nearly twice the average (>10 hours/day) compared with their counterparts who had normal BMI (*Chau et al., 2014*; Liu et al., 2021; Melton et al., 2014). Our results contradict the claims of those studies that using screen time plays an important factor in having poorer BMI. Our findings illustrate those higher levels of using screens have a positive effect on weight, but it was not significantly enough to influence the body weight p=.416.

There are several factors related to obtaining this result: the data was collected through an online questionnaire which may reduce the result reliability due to

participants' bias. The definition of screen time in this study is using social media only rather than including TV, video game, and computer. People can walk while they browse Instagram, Twitter, or Facebook, but they are less likely to walk while they watch a movie on the Netflix platform. Another reason is that social media can potentially encourage people to exercise. A randomized trial study showed that using social media such as Facebook is a great way to make people support each other to do physical activity (Rote et al., 2015). On these platforms, people who share the same aim can form a support and encouragement group to stay healthy (Rote et al., 2015).

Additionally, our study's result elaborates there was not a significant relationship between BMI and sleep, and BMI and diet, and no significant correlation was observed between gender (Table 6, Table 7). Sleep deprivation and an unhealthy diet play a significant role in increasing or decreasing BMI (Fry, 2020; Mu et al., 2017). However, the majority of our participants have a normal BMI which can be a clue that they sleep well and their diet not that bad. The sleep analysis clarified the mean hours of sleep was 8 hours/day and the mean total calorie intake for men and females were 1855.17 kcal/day and 1376.81 kcal/day respectively. Sedentary behaviors such as watching TV for more than 3 hours were connected to an increase in BMI and sleep problems in one of the studies in the literature review (Liu et al., 2021). As previously said, browsing social media may be done while exercising and does not necessitate being sat in front of a television or computer. These data were collected during the entry time during the first year, so the massive changes that college students experience may have not happened yet.

The difference in results between our study and other studies can be attributed to the fact that we do not have a second set of data for the same subjects to compare. In our case, we only have data for one time, and we did not follow the students' weight and amount of screens used for enough period. In our study, we observed a total of 32.8% of first-year college students who are overweight/obese. A systemic review study revealed that the use of cellphones, smartphones, computers, etc. are a significant factor in becoming sedentary (Thorp et al., 2011).

In addition, the mean intake of calories per day for both males and females were 1855.17 kcal/day and 1376.81 kcal/day respectively (Table 3). The means intake reported is less than the recommended average for total calorie intake, so this may interpret why most of the students in this investigation have a normal BMI (59.5%). The average recommendations state that males should consume total calories between 2000 and 3,200 kcal per day while 1,600 to 2,200 kcal per day for females (*How Many Calories Do Adults Need?*, 2019). The daily mean consumption of sugar and added sugar among both females and males exceeded the health recommendations. The American Heart Association recommends that males should not exceed 36 g/day of sugar and 25 g/day of sugar for females (*How Much Sugar Is Too Much?*, n.d.). The total amount consumed of both sugar and added sugar was 176 g/day for males and 143 g/day for females. The recommendation for saturated fat to be consumed only 6% or less of the total calories (*Saturated Fat*, 2021) which is about 12 grams/day for men and 9 grams/day for females based on their total calorie consumption of 1855.17 kcal/day and 1376.81 kcal/day respectively. Both genders exceeded their consumption of saturated fat, and men's intake

was 23 g/day while 17.5 g/day for females. The intake of sodium was high in men by 3190 mg/day which is above the recommendations that emphases on consuming less than 2300 mg/day (*Dietary Guidelines for Americans, 2020-2025*, n.d.) while females' intake consumed less than the recommendation 2154 mg/day.

The results indicated that students' activity levels were distributed between sedentary (25.2%) to low active of (46.6%) while active and very active students were 20.6% and 5.3% respectively. A previous systemic review showed that the concerns about college students' rising use of cell phones stem from prior claims that sedentary behaviors were linked to increasing screen time use (O'Donoghue et al., 2016). Physical activity was positively significantly correlated with BMI (p=.016) for men students. The positive relationship between BMI and physical activity in men may be associated with the increase in their muscle mass. Men are more likely to incorporate with weightlifting in their physical activity regimens to increase their body muscle mass (*Sports and Exercise among Americans*, 2016), so this would interrupts the positive increase for men only.

The interpretations of the positive results that our study obtained may indicate several things: the year of the collected data was 2020, which was the year that the COVID started, so the pandemic may be impacted people's lives in terms of the amount of time used on screens. However, a lack of previous data on the same population prior to the pandemic can weaken the accusation of it. Screen time usage is attributed to the increase in overweight and obesity rates, but screens are more than that. For instance, during the pandemic, everything was switched to be virtually from schools, hospitals

appointments, etc. However, that does not support that people were sedentary. With the changes during the pandemic, training was switched to online too, and many people used technology to be physically active during the lockdown (Newbold et al., 2021).

The studies' dates presented in the literature were before the start of the pandemic. Those studies are obsolete because the COVID-19 caused a tremendous change in people's lives in all aspects. Those data are less likely to describe the present life. Currently, there is a huge reliance on technology in many areas such as education, hospital, fitness center, communication, etc. (Buabeng-Andoh, 2021). As a result, with continued expansion, more screen time use is expected to increase.

Limitations

There are several limitations in the current study, so the generalizability of the results is limited by numerous factors. First, the study was performed on a small sample size. Second, the reliability of the data is impacted by lacking sufficient data. All the variables were measured at one time, so no difference would be noticed. To illustrate, the body weight was measured for all participants only during entry time, so there was no more data on their weight changes to compare them with the entry data to obtain a more precise result. Third, the reason that we were unable to draw a conclusion about the relationship between screen time and body weight is due to the observational design nature of our study.

Recommendations

It is important for us to increase the knowledge and awareness about regulating screen time use, getting enough sleep, consuming a healthy diet, maintaining a healthy weight, and exercising regularly among college students specifically because of the tremendous transition that occurs in their lives, and setting the foundation for healthy habits later on in life. Further studies including a larger sample size are needed to confirm the generalizability of the results. We suggest utilizing a more accurate research design that allows us to monitor students' weights, screen time, and their diet over time. Screen time should be not limited to social media, and it should include all different types of technology that college students use frequently.

Conclusion

The high importance of using cell phones for college students may act as a barrier to having a healthy lifestyle pattern. Spending a greater amount of time on screens increases the chances of being an overweight individual or obese, lacking physical activity, and eating unhealthy food. The results of our study showed an association between cell phone usage and physical activity among males. However, the existing evidence had conflicted results on whether using screens has an impact on BMI. To strengthen the evidence, future research should shed the light more on college students due to the critical period of time in their lives by utilizing a stronger study design.

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