

Wearable Device Use and Mental Health Outcomes in Female College Students

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A Signature Honors Project Presented to the

Honors College

East Carolina University

In Partial Fulfillment of the

Requirements for

Graduation with Honors

by

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March 2024

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Abstract

Wearable devices such as Apple Watches, Garmin, and Fitbits have taken over the fitness industry and have expanded to people outside of fitness. These devices are popular among many generations, but college students specifically are building habits based on the devices' constant notifications and fitness monitoring. Studies show that Apple Watches overestimate energy expenditure while the wearable device, Polar A370, underestimates energy expenditure. Users of wearable devices often heavily consider energy expenditure and change their daily habits to meet their goals. As the world becomes more connected through technology, the question arises as to how too much connection can be harmful. This is especially concerning in younger generations.

Purpose: The purpose of this study is to analyze the correlation between time on a wearable device and exercise addiction, sleep quality, and mental health in female college students.

Methods: Female college students ages 18-25 were assessed through self-report questionnaires, which focused on students' demographics, wearable device use, and sleep quality, mental health, and exercise habits.

Results: One hundred and eighty-nine participants completed the Qualtrics survey. Eighty five percent of respondents report wearing an Apple Watch. Eighty-four percent report wearing their device on the weekends, and seventy-four report they do not exercise without wearing their device. Twenty-seven percent report feeling pressure to exercise by their device even when they are ill. Ninety-nine percent of respondents reported having their text message notifications enabled, and eighty-eight percent feel pressured to look at their device when it vibrates. Despite these high wearable device time responses, there was not a significant correlation between wearable device time and mental health($p=.999$), sleep quality($p=.984$), or exercise addiction($p=.635$). *Conclusion:* Wearable devices were intended to support regular physical activity and lead users to a healthy lifestyle. This study supports that wearable devices

are not harmful to mental health, sleep quality, or exercise habits. Therefore, further research is needed to determine the validity of wearable devices to support physical activity without harmful side effects.

Chapter 1 — Introduction

Wearable technology, including devices such as Apple Watches and Garmin trackers, has become increasingly advanced and widely accessible. These devices are equipped with a variety of sensors, such as heart rate monitors, sleep trackers, and electrocardiogram (EKG) analyzers, allowing users to monitor their physiological data in real-time (Prieto-Avalos et al., 2022). Consequently, wearable devices enable a detailed analysis of daily activity, capturing metrics down to the number of steps and breaths.

This study investigates the dependency on wearable devices among female college students and the associated mental health outcomes. Despite the growing prevalence of wearable technology, there is a lack of research addressing the potential negative effects of their use. It is hypothesized that excessive reliance on wearable devices may contribute to adverse mental health outcomes, including anxiety, poor sleep quality, and exercise addiction behaviors.

The literature surrounding accuracy of sensors wearable technology is not limited however the effects that the technology has on the user has not been heavily researched. This study aims to address the gap in the literature by assessing mental health, sleep quality, and exercise addiction in wearable device users. For example, individuals reporting high wearable device use may report high stress or poor sleep than individuals reporting less use.

Purpose Statement

The purpose of this study is to investigate the correlation between female college student's wearable device time and their mental health, exercise addiction, and sleep quality.

Research Questions

Research Question #1: Does wearable device use impact the physical activity routine of female college students?

Hypothesis #1: Female college students that report more wearable device use will report more physical activity, along with more guilt and shame surrounding exercise.

Research Question #2: Does wearable device use impact sleep quality of female college students?

Hypothesis #2: Female college students that report more wearable device use will report poor sleep quality.

Research Question #3: Does wearable device use impact the mental health of female college students?

Hypothesis #3: Female college students that report more wearable device use will report negative mental health outcomes.

Significance of the Study

This study is significant due to the limited existing research the impact of wearable technology on the mental health of college female students. While these technologies are widely promoted for their ability to enhance fitness and support goal tracking, there is a lack of guidance cautioning users against an over reliance on device sensors. It is essential to emphasize that physiological self-awareness is crucial; individuals should prioritize their internal cues and subjective experiences over data provided by wearable devices to evaluate their well-being.

Chapter II – Review of the Literature

I – Introduction

When analyzing wearable technology literature, the factors that are highly researched are accuracy of energy expenditure, analysis of cardiorespiratory fitness, and accuracy of tools like heart rate measurement and ECG readings(Sabry et al., 2022). Despite the advancements that have been made to improve accuracy of wearable technology, there are still incongruencies between studies about the accuracy of these devices.

There is continuing research on the accuracy of wearable devices, but there is little research on the mental health outcomes that wearable technology may inflict. Many wearable devices come equipped with tools such as Apple Activity Sharing that allow friends to stay updated on your daily exercise. Tools such as these are one factor that is concerning regarding social comparison(Sabry et al., 2022). Social media is already a large contributor to social comparison, and adding in exercise as part of people’s social media intake may exacerbate conditions such as anxiety and exercise addiction(Minutillo et al., 2024)

II – Physical Activity and College Students

There is a strong correlation($P < 0.01$) between physical activity and emotion regulation among college students(Sheng et al., 2024). A study focusing on female college students found that 29% of participants were not meeting the recommended levels of physical activity(Aljehani et al., 2022). This link between physical activity and emotion regulation raises concerns about the emotional well-being of female college students, particularly for those who are not engaging in regular physical activity.

III – Health and Wearable Device Use in Female College Students

a. Mental Health Outcomes

According to a study that completed a wearable device intervention, the wearable device group had a significant decrease($P=.03$) in body weight(Wang et al., 2022). Those who report using wearable technology appear to have a lower BMI and lower body fat percentage when compared to those who do not. Obesity is a disease that has been linked to depression, and research has found that “Obesity at baseline increased the risk of onset of depression..”(Luppino et al., 2010). Therefore, it can be concluded that the use of wearable devices may have an impact on depression. Negative mental health outcomes and wearable device use is their effect on exercise addiction thanks to features such as “activity sharing.” Activity sharing is a feature on many wearable devices that act as a form of social media based on exercise statistics. It has been researched that social media use and exercise addiction have been linked. In a study on social media addicts and non-social media addicts, 42% of social media addicts reported meeting physical activity guidelines($p=.093$). Of the non-addict group, 37% reported meeting physical activity guidelines(Yıldız & Kuyumcu, 2022).

b. Stress Outcomes

Wearable technology is developing incredible biomarkers that can be used to identify stress, anxiety, and other emotions(Minutillo et al., 2024). These biomarkers can be used to help an individual assess their emotions and providing real time feedback. For example, an individual who suffers from panic attacks may be warned when their heart rate begins to elevate, triggering the individual to relax and attempt to lower the heart rate(Alhejaili & Alomainy, 2023).Wearable technology can track everything from steps, heart rate, respiratory rate, quality of sleep, and more; they can essentially track the users’ every move. One study investigated participants with chronic illness to analyze how well wearable devices tracked their physiological symptoms. Along with monitoring their physiological symptoms, Middlemass et al. also investigated the

stress and anxiety outcomes. One participant in the study stated the following: “Yes, I have to say I am one of these people who do worry about things. I do get concerned about myself... and I just thought this is silly. This is reminding me every day, then I should think I wonder what my reading is, how good it is or how bad it is and I thought no, get away from illness you know. Every time as soon I started thinking about it, I started thinking about my illness...”(Middlemass et al., 2017). This participant believed that the wearable device just magnified her concerns about her known condition.

c. Sleep Outcomes

In a study that compared 2 groups, one who wore wearable technology and one who did not, they analyzed the sleep quality of both groups for 24 hours. It was determined that the group who utilized wearable technology slept more ($p=0.43$) than the control group(Berryhill et al., 2020). Furthermore, the study compared the sleep analysis performed by wearable technology versus gold standard polysomnography. The wearable device consistently measured within 5.38% of the gold standard technology(Berryhill et al., 2020).

IV – Physical Activity and Wearable Technology

Wearable technology can be used by anyone. It can be used by someone with a history of arrhythmias or a problematic heart rate. Literature reports that “a substantial number of scientific contributions to CVD management and prevention, including technology development, patient behavior analysis, and monitoring technologies”(Prieto-Avalos et al., 2022). While there is still developing research on this being fully trusted, consumers have begun sharing their own testimonies of wearable technologies “lifesaving” features. As wearable technology has advanced, more sensors have been added such as oxygen level readings. Companies have been able to keep a consumer-based wrist wearable device “trendy” while adding more sensors and

advancements(Arogamam et al., 2019). These sensors have added another level of monitoring to physical activity allowing users to track their physical fitness levels.

Chapter III – Methods

Introduction

This study was a survey-based design. Participants received this Qualtrics questionnaire through a designated website link via email. The online questionnaire captured demographics, mental health status, exercise routines, and sleep routines. All study protocols were approved by the Institutional Review Board.

I — Participants

The participants for this research study were female college students ages 18-25. Participants were currently enrolled in college whether it is Community College or a 4-year university as an undergraduate or a graduate student.

II — Recruitment of Participants

Following IRB approval, printed out flyers were posted around the facility. Digital flyers were posted on social media and posted in Canvas pages. Emails were sent out with the flyer attached and further explanation of the study.

III — Questionnaires

Participants completed a variety of questionnaires as a measurement tool for this study. These questionnaires include a Mental Health and Quality of Life questionnaire, a sleep questionnaire, and an exercise addiction questionnaire.

a. Demographics questionnaire

The demographics questionnaire collected data such as age, race, height and weight, major in school, year in school, sports participation, and zip code.

b. Exercise Addiction Index EAI (Terry et al., 2004).

The Exercise Addiction Inventory contains 6 items, rated on a 5 point scale ranging from strongly disagree to strongly agree. If the participant chose “strongly disagree”, they receive a rating of 1. If they chose “strongly agree”, they received a score of 5. If the participant received a rating of 24-30 it can be determined that the participant has an addiction to exercise.

c. The Pittsburgh Sleep Quality Index(Buysee et al., 1989)

The PSQI has 19 items that are scored from 0 to 3, 3 indicating the greatest disturbance to the sleep routine. The 19 items are then added up for a total score, with higher scores indicating poorer sleep quality.

d. Mental Health Quality of Life(van Krugtene et al., 2022)

The MHQoL is comprised of seven questions with four different responses. Each response is scored from 0-3, 3 indicating a positive score. The total score is out of 21 and a higher score indicates a higher quality of life.

IV — Data Analysis

The data was analyzed using a data analysis software program, Statistical Package for the Social Sciences (SPSS). Demographics were analyzed and noted to express the participants who completed the study. Three correlations were run to determine the relationship between wearable device time and mental health, quality of sleep, and exercise addiction. These correlations were given an R-value as a correlation value. The higher the R-value, the higher the correlation between the two variables. The two variables also have a p-value. P-values are considered significant when $p < 0.05$.

Chapter IV — Results

Participants

This study had a total of 189 participants with the average age being 20 (SD=1.39).

Below are statistics stating the participants characteristics regarding their wearable device habits.

Table 1

Category	Percentage(%)	N (out of 189)
Wear an Apple Watch	85%	161
Wear device on weekends	84%	159
Do not exercise without wearing device	74%	140
Feel pressure to exercise when ill	27%	51
Text message notifications are enabled	99%	187
Feel pressure to check device when it vibrates	88%	166
College athletes	1%	2
Graduate student	5%	9
Affiliated with Greek life	12%	23
Race		151
White	80%	
Black	5%	9
Indian	2%	4
Asian	10%	19
Prefer not to say/other	3%	6

Table 2: Exercise Addiction and Wearable Device Time (N=177)

Variable 1	Variable 2	Pearson Correlation(r)	p-value
Exercise Addiction	Wearable Device Time	-.036	.635

There is no significant correlation ($p=.635$) between exercise addiction and wearable device time. There is a slightly negative correlation (-.036) but it is close enough to 0 that it is almost negligible. If the correlation was more significant, it would indicate that the higher wearable device time, the poorer the mental health outcomes.

Table 3: Sleep Quality and Wearable Device Time (N=72)

Variable 1	Variable 2	Pearson Correlation®	p-value
Sleep Quality	Wearable Device Time	-.002	.984

There is no significant correlation ($p=.984$) between sleep quality and wearable device time. There is a slightly negative correlation ($r=-.002$) but it is close enough to 0 that it is almost negligible.

Table 4: Mental Health and Wearable Device Time (N=136)

Variable 1	Variable 2	Pearson Correlation(r)	p -value
Mental Health	Wearable Device Time	.000	.999

There is no significant correlation ($p=0.999$) between mental health and wearable device time.

Chapter V — Discussion

Findings

Existing literature suggests that users of wearable devices experience decreased quality of mental health, increased amount of physical activity, and an increase in hours of sleep. Findings from this quantitative research study demonstrated that there is not a significant correlation between wearable device time and the associated mental health outcomes.

Results of this study concluded that pressure to check notifications on their device was significant (88%). Meanwhile, the exercise addiction and wearable device time was insignificant ($p=0.635$). Compared to a previous study by Sheng et al., participants who reported higher device time reported meeting the physical activity guidelines ($p=.093$). These results do not correspond with results in this study. However, in a different study by Shiyuan et al., there was no correlation between physical activity and wearable device use ($p=.756$).

This study concluded that there is no significant correlation between wearable device time and sleep quality (0.984). According to a previous study by Berryhill et al. comparing two groups, one control group and one wearable technology group, the one with the technology slept more than the control ($p=.28$). However, the same study by Berryhill et al. found that the wearable device did not have a significant impact on quality of sleep (.28).

This study concluded that there was not a significant correlation between wearable device time and mental health ($p=0.635$). According to previous studies, mental health, specifically anxiety, was proven to be worsened with more social media time ($p=-0.21$). Thus, due to the highly advanced intercommunication ability of wearable technology, it was hypothesized that the findings of this study would correlate with the social media use results. However, the mental health and wearable device time correlation was insignificant.

Strengths

Strengths of this research study include access to well-designed and effective questionnaires, ensuring the collection of relevant and meaningful data. The study benefited from a wide range of responses, providing a comprehensive perspective on the research topic. Additionally, the questionnaires used were unbiased, which helped eliminate any potential influence on participants' answers, thereby enhancing the validity of the findings.

Limitations

Limitations of this research study include the uniformity of the sample, as it consisted solely of female participants, all of whom were college students between the ages of 18 and 25. The participants were all from different universities but had to be a college student which eliminated some participants who may be training to be or are professional athletes. Moreover, the age requirement narrowed down the target population and making the data less representative of older age groups, as well as males and non-college students.

Future Research

Future research surrounding wearable devices can expand to other populations including males and older participants. This research can investigate similar measures to this research study, such as sleep quality and mental health in correlation with wearable technology use. Furthermore, research regarding effectiveness of wearable technology to implement exercise habits would be beneficial to exercise professionals. This research study would answer the question should exercise professionals encourage the use of wearable devices to implement habitual exercise.

Public Health Implications

This study found no significant correlation between mental health and the use of wearable devices. As a result, it remains appropriate for professionals to continue promoting the use of wearable devices until further research conducted.

Conclusion

In conclusion, there is no significant relationship between wearable device use and sleep quality, exercise addiction, and mental health. The strongest, yet still insignificant, correlation was seen between wearable device time and exercise addiction. Some limitations include a small variety of questionnaires used, as well as a small population of which completed the study. Therefore, future research can expand the assessed population and use a wide variety of questionnaires. Further research should aim to identify the factors that mediate the benefits and drawbacks of wearable devices to promote healthy engagement with this technology. Notifications and reminders embedded within wearable devices are designed to encourage physical activity, which can have both positive and negative effects depending on the user's circumstances. For individuals struggling to establish consistent exercise routines, such alerts may serve as effective motivational tools, promoting healthier habits.

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