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RESEARCH ARTICLE

A SEX-RELATED, MULTIVARIABLE STATISTICAL ANALYSIS OF SCREEN TIME USE IN RELATION TO DIETARY HABITS, AMONG GREEK YOUNG ADULTS: AN EPIDIMIOLOGY STUDY

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Abstract

Background: Studies assessing screen time use in relation to lifestyle factors have predominantly concentrated on children and adolescents. Very few studies have been carried out on adult populations. The aim of this study was to investigate the association between time spent on screen (for work, education, entertainment), with dietary habits, among Greek young adults.

Methods and Material: This is a cross-sectional study, based on convenience sampling of 687 adults (522 females), 18-30 years old, that was conducted on May 2023, in Greece. A structured questionnaire was used in which participants were asked about on screen-time habits (i.e., cellphone/tablet, television, computer/laptop), regarding work, education and entertainment, as well as various lifestyle characteristics, including dietary habits. Univariate and multivariate statistical methods were applied to explore the research hypothesis.

Results: Mean daily screen time was 5±4 hours for work and 6±3.5 hours for entertainment. Unfavorable behaviors regarding excess screen time use and unhealthy dietary habits, were revealed. No significant association was observed between screen time use and adherence to the Mediterranean diet, when the analysis was stratified by sex.

Conclusion: An association between screen time use and unhealthy dietary habits was revealed among young adults, which in the long-term may significantly influence their health status.

Key words: Screen time, health, diet, lifestyle, young.

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INTRODUCTION

Screen time has received significant research attention in recent years, largely due to the dramatic increase in digital media accessibility. This integration of technology into daily life was further accelerated by the COVID-19 pandemic, which compelled many to adopt technological tools for both work, study and/or entertainment. According to EUROSTAT, Greece reported the highest average daily entertainment screen time (3 hours and 14 minutes) among 15 European countries, with 95.1% of the population engaging in non-work-related screen use.[1] Studies on children and adolescents indicate that excessive screen time is linked to poor dietary habits, such as increased junk food consumption, skipping breakfast, reduced physical activity, sleep disorders, and a higher prevalence of obesity.[2] Systematic reviews and meta-analyses further suggest that increased screen time in young people correlates with higher body mass index (BMI) and poorer dietary choices, including reduced fruit and vegetable intake and higher consumption of unhealthy foods, energy-dense snacks, and sugar-sweetened beverages.[3,4,5] As screens dominate our lives more than ever, the debate about the appropriate amount of screen time for both work, study and entertainment is an ongoing process. To the best of our knowledge, current data about screen time and health-related dietary habits in the Greek population and especially in young adults are lacking. Thus, the aim of this study was to investigate the association between time spent on screens (for work, study, entertainment), with dietary habits, among Greek young adults, in the post-COVID-19 era.

METHODOLOGY

Design

This is a cross-sectional, observational study, via web-based interviews. It was conducted in Greek young adults, 18-30 years of age.

Setting

A web-based, structured questionnaire was used. The questionnaire was spread via a convenience sampling scheme, throughout the country, during May 2023. Participants were from all provinces of Greece.

Sample

The sample consisted of 687 participants; of them, 522 were females (24±4 years) and 165 were males (23±3 years).

Bioethics

This study was carried out in accordance with the Declaration of Helsinki (1989) of the World Medical Association. The study approved by Institutional Ethics Committee of Harokopio University (#1644/2.5.2023). All participants were informed about the aims and procedures and agreed to participate by completing the corresponding questionnaire.

Measurements

Screen time in front of (a) cellphone/tablet, (b) television and (c) computer, was self-reported in hours per day, and was further categorized into, (i) screen time use for remote work, or complementary work, (ii) studying, and (iii) for entertainment purposes.

Dietary habits during screen time were assessed using a food frequency questionnaire that recorded the consumption of all main foods, beverages and snacks consumed. Consumption was categorized as never, rare/monthly, 1-3 times per week, 3-5 times per week, every day, and more than once per day. Moreover, the degree of adherence to the Mediterranean diet was assessed using the validated MedDietScore (range 0-55).[6] Other lifestyle behaviors included the assessment of physical activity status which was evaluated in terms of frequency (never, rare, 1-2 times per week, >3 times per week), duration (in minutes per time) and years of being physically active. Those who reported engagement in physical activities at least one time per week regardless of type and duration were defined as physically active.

Sociodemographic characteristics included the area of living, sex (male/female), age (year of birth), educational level (years of attending school, vocational institutes, college/university), and family status (unmarried, married or cohabitation, divorced, widowed). Employment-related questions were also included such as the assessment of current work status (i.e., self-employed, private or public employee, lack of steady job, unemployed) as well as the work type (i.e., physical, remotely, hybrid).

Statistical analysis

Continuous variables are presented as mean value (standard deviation, SD). Categorical variables are presented as absolute and relative (%) frequencies. Differences in group mean values were

evaluated through the t-test for equal or unequal variances (as appropriate). Multiple linear regression analysis, adjusted for age, was used to evaluate associations between screen time use, and MedDietScore (independent variables), or frequency of various foods consumed. Sex moderation effect was evaluated by introducing the relevant sex-by-screen time interaction terms in the models used the overall sample. The results of linear regression models are presented as *b*-coefficients, their corresponding standard errors, and standardized beta coefficients for cross-model comparisons. Normality of residuals or other variables of interest was tested using Q-Q plots. The assumption of homoscedasticity, linearity and independence of residuals across observations were evaluated by plotting standardized residuals versus predicted values and observations, respectively.

All analyses were conducted using R program (R Core Team (2024). _R: A Language and Environment for Statistical Computing_. R Foundation for Statistical Computing, Vienna, Austria). A *p*-value < 0.05 was set as significant for rejecting the null hypothesis.

RESULTS

Mean daily screen time was 5.0±4.0 hours for work and 6.0±3.5 hours for entertainment. In ***Table 1***, descriptive statistics of screen time use are presented in males and females.

Data are presented as frequencies (%), and mean values (standard deviation). *p*-values derived from t-test for the comparisons of screentime hours use between males and females.

As reported by the participants, 11.6% of males and 9.0% of females mentioned screen use for remote working, whereas 33.8% of males and 43.1% of females reported screen use for complementary work. There was no significant difference regarding mean hours/days of remote or complementary work between males and females (*ps* > 0.05). Almost 99% of males and females reported using their cellphone, television, tablets, etc., for studying purposes, without any sex-related significant difference in mean hours/day of screen use (*ps* > 0.05). Additionally, most males and females, i.e., 99%, used their cellphones/tablet/computer/laptop/TV for entertainment purposes. Significant differences between males and females were observed regarding mean of hours/day of TV use; females reported more hours per day of television use as compared to males, whereas computer/laptop use was higher among males (***Table 1***).

To test whether Mediterranean dietary habits are influenced by the hours/day participants spend on screens for work, studying and entertainment, age-adjusted linear regression models evaluated the association between screen time use and MedDietScore (the higher the score, the greater the adherence to the Mediterranean diet). Only in males, screen-time use for studying purposes was associated with better dietary habits (i.e., per 1 hour use, 0.28 units higher MedDietScore), whereas in females screen-time use in front of PC for entertainment was associated with lower MedDietScore (i.e., per 1 hour use, 0.31 units lower MedDietScore) (***Table 2)***. No other significant associations between overall dietary habits (i.e., Mediterranean diet adherence) and screen time use were observed in both males and females.

In addition, standardized beta-coefficients were also estimated for each model (***Table 2***), to evaluate and prioritize the impact of different sources of screen time use on the level of adherence to the Mediterranean diet. It was observed that, in males, work screen time was the most important influential source, followed by total screen time, study screen time, tv screen time, phone screen time and PC screen time. In females, PC screen time was the most important influential source, followed by total screen time, study screen time, TV screen time, phone screen time and work screen time.

We further evaluated total and use-specific screen time in relation to the weekly consumption of all main food groups and alcohol drinking. The results from various age-adjusted models for males and females, are presented in ***Table 3***. In males, an inverse association between hours per day they spend on their cell phone, PC or screens in total, and the consumption of fruits, vegetables and fish, was observed, whereas there was a positive association with the consumption of red meat. Moreover, there was an inverse association between the consumption of white meat and screen hours spend on TV. Similarly, in females, an inverse association between hours per day they spend on their cell phone, with the consumption of whole grains, fruits, vegetables and fish was observed, whereas there was a positive association with the consumption of red and white meat.

An inverse association was also observed between the consumption of whole grains and vegetables and a positive association with the consumption of red meat for every hour/day spend in front of TV. Moreover, an inverse association was observed between the consumption of whole grains and fish with hours per day that females spend on PC and a positive association with the consumption of red meat and overall screen-time use (***Table 3***). No significant moderation effect based on sex was observed regarding screen time use and dietary habits of the participants, by the exception of the consumption of fish. Particularly, for every 1 additional hour spend on phone screen, females eat less fish (-0.06 (0.02), <0.001) than males, independently from their age.

DISCUSSION

The aim of this study was to investigate the association between time spent on screens for work, study, or entertainment, with young adults' dietary habits, in the post-COVID-19 era. Unfavorable behaviors regarding excess screen time use and specific unhealthy dietary habits, were revealed, that may lead to adverse diet-related health outcomes in the future. To our knowledge, this is the first study conducted in Greece, and one of the few in Europe, that evaluated the associations between screen time use and dietary habits among young adults. Understanding the impact of screen time use on dietary and other lifestyle habits is crucial in identifying barriers to its proper use, and thus the findings from this study deserve further attention.

The COVID-19 pandemic has substantially altered daily routines, with increased reliance on digital devices for work, education, and social interaction. This shift has likely impacted various lifestyle factors, including dietary behaviours.[7,8,9,10] As it was reported by the participants of the present study, mean daily screen time was approximately 5 hours for work and 6 hours for entertainment purposes among young Greek adults, which makes approximately half of a regular day spent in front of screens. As it was already presented, according to EUROSTAT, Greece has reported the highest average daily entertainment screen time (i.e., more than 3 hours) among 15 European countries, and with more than 95% of the population engaging in non-work-related screen use.[1] Several studies have shown that **i**ncreased screen time has been linked to unhealthy behaviors, including higher consumption of unhealthy snacks and fast food, leading to poor nutritional intake. This was attributed to distracted eating, where individuals consume food while engaged in screen activities, paying less attention to hunger cues and portion sizes. Moreover, prolonged use of screens can disrupt regular meal patterns, leading to skipping meals or eating at irregular times. This can negatively affect metabolism and overall health. The present analysis revealed significant associations regarding specific dietary behaviors and screen time use. In males, there was an inverse association between screen hours per day spent on cell phone, PC or screens in total, and consumption of healthy foods, like fruits, vegetables and fish, whereas a positive association was observed with the consumption of unhealthy food choices, like meat and its by-products. In females, there was also an inverse association between hours per day spent on their cell phone, with the consumption of various healthy foods, like whole grains, fruits, vegetables and fish, whereas there was a positive association when it came to the consumption of red and white meat. However, no significant association emerged between screen time use and adherence to the Mediterranean diet, when the analysis was stratified by sex, in contrast to a previous analysis of the same study that revealed an inverse relationship in the overall sample [7]. In a similar study conducted in Greek students, it was found that the longer the screen time, the greater the likelihood of adopting unhealthy eating behaviors such as frequent fast-food and sweets consumption [2]. But the latter study was conducted in schoolchildren and not young adults that have more complicated behaviors and needs. The sex specific analysis performed here underlines the specific role of gender in the tested hypothesis. Sex has been strongly associated with dietary behaviors and other emotional-related characteristics.[11] Research indicates that males and females may respond differently to increased screen time in terms of their dietary choices. For instance, young males have been reported to be more likely to consume high-calorie, energy-dense foods such as fast food and sugary drinks, whereas women might prefer snacks that are high in sugar and fat, such as sweets and pastries.[2]

Excess screen time has been associated with sedentary behavior, which can contribute to weight gain, obesity, and related health issues such as cardiovascular disease and diabetes. As it was reported in a previous analysis of the present study, recreational screen time was inversely associated with the likelihood of a person being physically active and body mass index was also positively associated with remote work screen time use.[12] Finally, although it was not studied here, it should be acknowledged that excessive screen use, and especially before bedtime, can interfere with sleep patterns. The blue light emitted by screens can disrupt the production of melatonin, a hormone that regulates sleep, leading to sleep disorders and associated health problems. Extended screen time has also been linked to various mental health issues, including anxiety, depression, and increased stress levels. The constant connectivity and exposure to social media can contribute to feelings of isolation, inadequacy, and cyberbullying.[13,14,15] This deserves further attention, as young people with depressive symptoms experience difficulties in school performance and social life and tend to exhibit weight fluctuation due to regular changes on their eating habits.[16,17,18]

Preventing chronic diseases in youth is crucial for ensuring long-term health and reducing the burden of these conditions later in life. There are several key strategies and considerations for preventing chronic diseases among young people. **For example,** encouragement in adhering a diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats, while limiting processed foods, sugary beverages and high-sodium snacks intake. Furthermore, it is crucial to educate children and adolescents about the importance of nutrition and healthy food choices and simultaneously ensuring that schools and communities provide access to nutritious foods, including school meal programs that meet dietary guidelines. Schools should also provide quality physical education programs and opportunities for extracurricular physical activities.[19,20]

Limitations

This cross-sectional epidemiological study cannot establish causal relationships, but only state hypotheses for future research. Regarding the sampling, the sex ratio was unbalanced (i.e., 76% female and 24% male) and therefore cannot be generalized to the general population. In addition, the data is subjected to recall bias as they were collected by web-based, self-administered survey which may have resulted in under- or over-estimation of screen time use.

Conclusions

The results presented regarding screen time use and dietary behaviours in the post-COVID-19 era among Greek young adults may significantly contribute to the current scientific understanding of the modern phenomenon of excessive screen time use. In the context of Greek young adults, examining the correlation between increased screen time and dietary habits offers valuable insights into how these changes manifest in specific populations. It highlights potential health risks associated with prolonged screen exposure, such as poor nutritional choices, increased consumption of unhealthy snacks, and irregular meal patterns. Furthermore, understanding these behaviours in the post-pandemic era can inform public health strategies aimed at mitigating negative health outcomes and promoting healthier lifestyle choices.

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Conflict of interest

The authors report that there is no conflict of interest.

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ANNEX

TABLE 1. Time spent in front of the screens for work, study and entertainment

	Males (N=165)		**Females** (N=522)		***p***
	N (%)	**Hours/day**	**N (%)**	**Hours/day**	
Remote work, *yes*	19 (11.6%)	8.1 (2.8)	47 (9.0%)	8.4 (1.6)	0.690
Complementary work, *yes*	59 (35.8%)	2.0 (1.9)	225 (43.1%)	2.5 (2.8)	0.106
Studying, *yes*	164 (99.4%)	3.3 (2.9)	519 (99.4%)	3.3 (4.5)	0.761
Entertainment, *yes*					
Cellphone/tablet	164 (99.4%)	3.5 (2.3)	521 (99.8%)	3.5 (2.1)	0.908
Television	164 (99.4%)	0.7 (1.0)	521 (99.8%)	1.1 (1.5)	0.0002
Computer/laptop	166 (100.0%)	2.0 (2.0)	519 (99.4%)	1.4 (1.7)	0.002

Data are presented as frequencies (%), and mean values (standard deviation). *p*-values derived from t-test for the comparisons of screentime hours use between males andfemales.

TABLE 2. Results from age-adjusted linear regression models that evaluated the association between screen time (independent variables) and MedDietScore (dependent outcome), adjusted by the age of the participants.

	Males (b(SE); Beta; *p-value*)	**Females** (b(SE); Beta; *p-value*)
Total Screen time (per 1 hour/day)	0.05 (0.11); 0.03 *0.666*	-0.03 (0.06); -0.02 *0.604*
Work screen time (per 1 hour/day)	-0.41 (0.29); -0.32 *0.176*	0.02 (0.21); 0.02 *0.908*
Study screen time (per 1 hour/day)	0.28 (0.13); 0.16 *0.039*	0.06 (0.05); 0.05 *0.227*
TV screen time (per 1 hour/day)	0.01 (0.41); 0.003 *0.973*	-0.18 (0.14); -0.05 *0.204*
Cell phone screen time (per 1 hour/day)	-0.19 (0.18); -0.09 *0.270*	-0.17 (0.10); -0.07 *0.093*
PC screen time (per 1 hour/day)	-0.23 (0.19); -0.09 *0.244*	-0.31 (0.12); -0.11 *0.014*

Results are presented as b-coefficients their standard error (SE) and standardized Beta coefficients, as well as *p-values.*

TABLE 3. Results from linear regression models that evaluated screen time in hours per day (independent variables) in relation to dietary habits (dependent outcome, in times per week) of main food groups and alcohol drinks, adjusted by age.

Males	Whole grains	Fruits	Vegetables	Fish	Red meat	White meat	Alcohol
Work screen time	-0.05 (0.06); 0.399	-0.02 (0.06); 0.683	-0.06 (0.06); 0.311	-0.13 (0.07); 0.074	0.03 (0.07); 0.699	-0.05 (0.09); 0.584	0.11 (0.07); 0.178
Study screen time	0.03 (0.03); 0.338	-0.009 (0.03); 0.755	-0.01 (0.03); 0.823	0.06 (0.04); 0.137	0.07 (0.03); 0.032	0.03 (0.04); 0.489	0.03 (0.03); 0.405
TV screen time	-0.06 (0.09); 0.483	0.03 (0.08); 0.731	-0.06 (0.09); 0.527	-0.08 (0.12); 0.507	0.12 (0.09); 0.196	-0.29 (0.12); 0.014	0.101 (0.103); 0.332
Cell phone screen time	0.02 (0.04); 0.624	-0.14 (0.03); 0.0001	-0.09 (0.04); 0.021	-0.13 (0.05); 0.011	0.11 (0.04); 0.006	0.04 (0.05); 0.405	0.05 (0.04); 0.261
PC screen time	-0.06 (0.04); 0.172	-0.10 (0.04); 0.009	-0.05 (0.05); 0.315	0.03 (0.06); 0.611	0.07 (0.04); 0.137	0.01 (0.06); 0.901	-0.03 (0.05); 0.497
Total screen time	0.01 (0.02); 0.689	-0.06 (0.02); 0.014	-0.03 (0.03); 0.250	0.01 (0.03); 0.778	0.07 (0.03); 0.012	-0.02 (0.03); 0.590	0.02 (0.03); 0.436
Females							
Work screen time	-0.08 (0.05); 0.151	-0.03 (0.05); 0.529	-0.02 (0.04); 0.504	0.02 (0.06); 0.732	0.06 (0.04); 0.143	0.04 (0.04); 0.286	-0.06 (0.06); 0.348
Study screen time	0.003 (0.01); 0.756	0.001 (0.01); 0.933	0.01 (0.01); 0.193	-0.005 (0.01); 0.705	0.005 (0.009); 0.588	0.001 (0.01); 0.881	0.01 (0.01); 0.446
TV screen time	-0.08 (0.03); 0.009	-0.03 (0.03); 0.411	-0.07 (0.03); 0.009	-0.01 (0.04); 0.748	0.09 (0.03); 0.0006	-0.03 (0.03); 0.284	-0.04 (0.03); 0.266
Cell phone screen time	-0.06 (0.02); 0.013	-0.06 (0.02); 0.013	-0.07 (0.02); 0.0001	-0.08 (0.03); 0.004	0.07 (0.02); 0.0006	0.05 (0.02); 0.033	-0.01 (0.02); 0.712
PC screen time	-0.09 (0.03); 0.001	-0.003 (0.02); 0.923	-0.03 (0.02); 0.242	-0.08 (0.04); 0.024	0.03 (0.02); 0.219	-0.01 (0.03); 0.783	-0.02 (0.03); 0.557
Total screen time	-0.02 (0.01); 0.202	-0.011 (0.013); 0.392	-0.02 (0.01); 0.142	-0.02 (0.02); 0.245	0.03 (0.01); 0.010	0.001 (0.01); 0.969	-0.01 (0.01); 0.321

All models were age adjusted. Results are presented as b-coefficients their standard error (SE), as well as *p-values*.