Is real screen time a determinant of problematic smartphone and social network use among young people?

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ABSTRACT

Smartphone use by adolescents is increasingly attracting the interest of social scientists, parents, and educational stakeholders (teachers, educators, educational policy makers), generally in a negative context. There are, however, many myths surrounding the issue, resulting from the reproduction of stereotypes about the psychosocial functioning of adolescents in cyberspace, as well as inadequately constructed research tools that measure how new media are used. This text is an attempt to show the phenomenon of problematic Internet use through the prism of screen time measured using real data from smartphones. The research was conducted in first half of 2022 among adolescents aged 13–19 in Bosnia and Herzegovina (N = 1185, mean age = 15.47 with standard deviation = 1.84). The research was implemented using a triangulation of tools such as the Smartphone Addiction Scale (SAS Scale), Software Installed on the Smartphone (SIS Scale), The Bergen Social Media Addiction Scale (BSMAS), and the Screen Time Scale (STS). From the data collected, it was noted that: 1) Screen time correlates weakly with problematic smartphone use and social networking; 2)The average period of smartphone use in the study group is 3 h49 minutes per day, of which 37 min are related to web browsing, while 2 h22 minutes are related to social networking; 3) A quarter of adolescents use a smartphone more than 5.5 h per day, of which more than 2 h15 minutes is screen time related to social media; 4) Approximately half of the respondents use smartphones slightly more than 2 h per day; 5) Girls use smartphones for longer than boys; 6) Place of residence (city or countryside) does not affect screen time; 7) Screen time is related to a medium degree to the type of software installed on the smartphone; 8) There is a need to refine the measurement methodology of screen time and to abandon self-declaration in this area.

1. Introduction

Problematic Internet use (identified with the contested term Internet addiction) has attracted the interest of many researchers in the fields of psychology, pedagogy, and the sociology of new media. For each type of problematic Internet use (PUI), the issue of selecting adequate diagnostic indicators and fully explaining the mechanisms involved in the PUI phenomenon is increasingly under debate. At present, there is no single universal diagnostic tool that allows unambiguous and indisputable thresholds for the occurrence of PUI types that take into account the specificities of different age groups.

This article is part of an attempt to take both a critical and a constructive look at issues related to the real time use of smartphones and PUI. Among adolescents, screen time is one of the most frequently cited criteria indicative of the inappropriate use of smartphones or computers, which leads to a disturbed approach to the use of new media and the consolidation of negative habits. In general, time is one of the main criteria used in indicating the occurrence of Internet "addiction" in many studies devoted to e-use among adolescents. However, in the vast majority of studies, screen time indicators are characterised by artificial– measurement, and this kind of measurement is entirely inadequate. Opinion-forming articles (including those produced by the EU KIDS Online research network) present screen time as a variable quantified through indicative self-declarations - without real reference to actual data from the device (phone, tablet, computer). In addition, screen time is considered as an umbrella term without due notice being paid to the activities carried out during that time. In order to address these critical methodological shortcomings, the study uses a unique method to measure three types of screen time using software embedded in smartphones running the Android or iOS operating systems and then compares the indicated data with two types of PUI.

The text presented here therefore fills a gap related to the presentation of the relationship between different types of real screen time associated with smartphone use and the prevalence of problematic smartphone and social network use among adolescents (Milosevic et al., 2022; Smahel et al., 2020; Velicu & Marinescu, 2019). The article not only attempts to highlight measurement errors related to screen time, but also aims to counteract the myths about smartphone use styles among young people. The data collected is also unique in that it was obtained from adolescents within the Federation of Bosnia and Herzegovina, where large scale studies of smartphone use among adolescents are very rarely conducted. This article is the first attempt at a research showing real screen time in juxtaposition with data on problematic smartphone use. The presented article fills the empirical gap related to the presentation of the smartphone use style of adolescents in Bosnia and Herzegovina and contributes to the debate on the psychosocial functioning of young people in cyberspace.

2. Overview of studies

The 2019 World Health Organisation recommendations on screen time have sparked discussion among experts in parenting and preventive health care for children and young people in the digital world. Systematic analyses conducted as a result of these WHO recommendations have shown that there is currently no evidence that increasing screen time automatically increases problematic behaviour among young people (Ophir et al., 2021; Przybylski & Weinstein, 2019). The duration of use of new media (including smartphones) continues to be a topic characterised by mixed research reports on the harmful effects of new media on the psychosocial functioning of children and adolescents (Chen et al., 2020; Vacchiano & Valente, 2021). Research on the intensity of digital media use, especially smartphones, is particularly prominent in socialisation and media education, in which one of the guiding principles is the safe use of cyberspace resources and digital devices such as smartphones (Alabdulkareem, 2015; Kordrostami et al., 2018; Riesmeyer, 2020). In recent months, increased research on the issue of increased screen time among children and adolescents can also be observed, with this linked not only to the intensive development of the information society (Oliveira, 2019), but above all to the pandemic situation that shifted many activities to the Internet, thus increasing screen time (Holzer et al., 2021; Blahušiaková et al., 2021; Pyżalski & Walter, 2021). Taking into account trends related to the quantitative development of e-services, media convergence, the efficiency of smartphones, and almost unlimited internet access, it can be seen that daily screen time has been steadily increasing over recent years (Tomczyk et al., 2020). These phenomena are a natural consequence of the development of the information society (Ziemba, 2019). This trend has become a cause for discussion among both the public and experts dealing with the health consequences of new media mediated behaviour (Olson et al., 2022; Walter & Pyżalski, 2022).

The analysis of the literature on the style of use of new media (including the use of smartphones) by adolescents is currently yielding a number of interesting findings, which are setting new directions for research as well as making it necessary to undertake in-depth studies related to digital security (Huk, 2018). Of particular relevance is research on the style of use of smartphones as devices that are used intensively by young people and are a primary tool for obtaining information, communication, entertainment, and accessing what have become the essential e-services of daily life (Cvek & Pšunder, 2021; Huk, 2016; Srinivassin & Sasikala, 2022). The high intensity of smartphone use has a not inconsiderable impact on both the positive aspects associated with new technologies, but also on the generation of individual and social problems (Tomczyk, 2021).

Among the negative consequences of intensive smartphone use, problematic internet use (PUI) is mentioned first and foremost. PUI can be defined as the inability to control one's internet use, and is linked to negative consequences in everyday life (Spada, 2014). The different types of PUI currently include problematic smartphone use, i.e. a lack of self-control of phone use that can lead to both individual and social problems (Van Velthoven et al., 2018; Fischer-Grote et al., 2019). In the article, the concept of problematic smartphone use was operationalised through the following indicators (Kwon et al, 2013): dropping out of scheduled activities due to smartphone use; difficulty concentrating at school or during homework due to smartphone use; experiencing pain in the wrists or back of the neck when using a smartphone; intolerance of the situation of not having a smartphone in hand; impatience and nervousness when not having a smartphone in hand; thinking about the smartphone when not using the device; not wanting to give up using the smartphone due to the great impact of the device on the individual's daily life; constantly checking the smartphone in order not to miss conversations and information from other people on social media platforms; using the smartphone longer than intended; and receiving information from people in the immediate environment about excessive smartphone use.

Another type of PUI is the problematic use of social networks (SNS), which, as in the other case, is related to a lack of self-control. By SNS are meant sites such as Facebook, Instagram, Tik-Tok, Telegram, Twitter, Tinder, and others. Problematic use of social networks is seen as a behaviour that is inappropriate to the situation and the person's needs, and has a negative impact due to the intensity of use on the individual's life (Zimmer, 2022; Imperato et al., 2022). In the present study, problematic SNS use includes the following set of

diagnostic indicators (Andreassen et al., 2012): spending time with thoughts or planning related to SNS use; feeling the need to use SNS more and more; using SNS to forget personal problems; unsuccessfully trying to reduce SNS use; experiencing feelings of anxiety or worry when not using SNS; and using SNS in a way that negatively affects work/learning. The two aforementioned types of PUI are often equated as addictions in the literature (Andreassen, 2015 Yellowlees & Marks, 2007; Fineberg et al., 2018). However, given the variation in diagnostic criteria and disagreements over the explicitness of the theoretical framework, there is disagreement over the use of the term Internet addiction. Therefore, in the text, both concepts, i.e. problematic use of smartphones and SNSs due to differing diagnostic approaches and fuzzy measurement thresholds, will not be included in the category of addiction, but as problematic phenomena on which conceptual work is ongoing.

Sorting out the aforementioned terms related to the misuse of new media, a few important facts need to be clarified. Firstly, all currently analysed harmful phenomena such as FOMO, nomophobia, phubbing, problematic use of smartphones, or problematic use of social networks are linked to the underlying phenomenon of problematic Internet use (previously defined as Internet addiction) (Sánchez Vega et al. 2016). Secondly, each of the aforementioned forms of problematic Internet use has a different object of study e.g. accessing information, accessing a device (Kim, 2017), using e-services (e.g. SNS, online shopping, gambling). This means that for all problematic behaviours it is necessary to use different diagnostic tools related to the object of study, even though they share common characteristics (e.g. loss of self-control, neglect of responsibilities, social and health problems as a consequence). In this context, screen time, which is the main object of analysis, appears as one of the universal diagnostic criteria for the vast majority of behaviours linked to problematic Internet use.

Analysing the results of studies on problematic use of smartphones and social networks among adolescents, it can be noted that screen time, i.e. the length of use of the devices, constitutes one of the significant diagnostic criteria used in the determination of the level of PUI (Brino et al, 2022; Restrepo et al, 2020; Saletti et al., 2021; Kamolthip et al, 2022; Tang et al, 2021). However, the data on the length of time adolescents use their smartphones and SNS is usually gathered through declarative surveys, and since self-declarations carry with them a large margin of error the conclusions of such studies must be questioned.

Research that prioritises direct measurement instead of self-declaration is rarely conducted, though the means exist – software can be embedded in the operating system of the device that measures how long the smartphone is used as well as for what purpose. But such research as exists tends not to include adolescents in their representative samples (Gansner et al., 2022a; Gansner et al, 2022b). This is probably due to the fact that surveys with real device data require much more financial and time resources than those based exclusively on online questionnaires measuring approximate screen time (e.g. in the form of time intervals). However, unit studies using real screen time data can be found in the literature. For example, one of the few studies in this area ($N = 267$, 18–25 years old) confirmed that there are large discrepancies between the self-perception of smartphone use and real data recorded by the device (screen time, battery consumption) (Hodes and Thomas, 2021). This suggests that reporting data derived from questionnaires without reference to real data from the device risks generating artificial conclusions that do not reflect the true nature of the use of digital devices. This problem with the perception of real screen time is also confirmed by a study among US adults (N = 405). Another study conducted by using the software embedded within the iOS platform demonstrated how respondents' perception of time differs from that recorded by the device (Oeldorf-Hirsch and Chen, 2022). A study among adults using real-world measurement of screen time (n = 1164; age M = 44.9) showed that the daily length of smartphone use was an important factor, but not the basis for determining problematic smartphone use (Horwood et al., 2021); with that study in mind, the question becomes whether the same relationship holds for adolescents as well as for adults.

Screen time is an attractive measurement construct that is very often used in research related to PUI or, more broadly, Internet use and at the same time provides a basis for drawing conclusions about the positive or negative impact of new media. However, screen time does not mean one single thing. Many actions can be carried out within that time, from learning to communication to entertainment. In considering the link between PUI and screen time, it is important to specify what the screen is being used for, and this can be done through the use of accurate measurement tools. Only by this means can this variable truly be understood.

3. Research methodology

3.1. Object and purpose of the research

The aim of the research is to show the real screen time associated with smartphone use among young people. An additional aim is to present the relationship between problematic smartphone and social media use and different types of screen time.

The subject of the study is the responses of adolescents aged 13–19 years on their use of smartphones, the specific software installed on smartphones, and the level of problematic use of social media. In addition, based on the data collected from the devices, specific questions relating to the three types of screen time were considered. The following questions (research problems) were assumed in the present study:

1. What are the three types of screen time associated with smartphone use among young people?
2. What percentage of the survey sample use their smartphones extensively?
3. To what extent do sociodemographic variables differentiate smartphone screen time use?
4. To what extent are the different types of screen time variables in the prediction of the extent of problematic smartphone use, or problematic social media use?

3.2. Characteristics of the research sample

The study was conducted among adolescents aged 13–19 in the Federation of Bosnia and Herzegovina. Responses and data from 1185 adolescents were analysed, with a mean age of 15.476 and a standard deviation of 1.843. Detailed sociodemographic indicators for the study sample are presented in Table 1.

3.3. Research tool

The research tool consisted of a battery of tests in the form of a digital survey (LimeSurvey). Triangulation of the research tools included the following measurement scales:

- Smartphone Addiction Scale consisting of 10 questions diagnosing the style of use of the device (SAS scale, Kwon et al., 2013). The tool used a scale from 1 to I strongly disagree to 6 - I definitely agree. Higher values suggested more problematic behaviour related to the use of the device. The internal consistency (Cronbach's α) for the tool was 0.836.
- Software Installed on the Smartphone (SIS Scale) is a proprietary tool consisting of 6 items covering Facebook, Instagram, Snapchat, TikTok. Twitter, and Pinterest. The tool uses a five-point response scale ranging from 1 to I do not have the software installed to 5 - I use the software very often (virtually all day). The internal consistency (Cronbach's α) for the tool was 0.549. The low level of internal consistency indicates that not all types of software listed are popular and thus used in a similar manner among the adolescents surveyed. Selected items lowering the level of internal consistency were not included in the calculation requiring a high level of variable consistency.
- The Bergen Social Media Addiction Scale (BSMAS) - the scale consists of 6 questions on the scale of problematic use of social networking sites, for which the answers were placed on a 5-point Likert scale from 1 - never to 5 - very often (Andreassen et al., 2012). The internal consistency (Cronbach's α) for the tool was 0.736.
- Screen Time Scale (STS Scale) - a proprietary tool covering nine parameters related to smartphone use duration for 3 categories. Among the categories, screen time related to: 1) general smartphone usage time (Cronbach's α = 0.807); 2) web browsing using the device (Cronbach's α = 0.856); and 3) browsing social media resources (Cronbach's α = 0.889). Each of the listed time categories was extracted separately for the most recent three days of use. For each category, the arithmetic mean of the last three days was also extracted. The data was downloaded using software embedded in the smartphones (iOS - Digital Balance and iPhone - Screen time). The parameter was expressed in minutes. The method of reading the data is presented in Fig. 1.

3.4. Research procedure

The research was conducted in the first half of 2022 in Bosnia and Herzegovina. The research was designed and implemented by an international team of researchers from Poland (Jagiellonian University in Krakow) and Bosnia and Herzegovina (University of Sarajevo). The research was part of a cyclical analysis conducted by a group of scholars from the two countries focused on the diagnosis of issues assigned to the risk paradigm of media pedagogy (Tomczyk & Lizde, 2022; Tomczyk and Selmanagic-Lizde, 2018).

The survey tool was originally designed in an English-language version and then translated into Bosnian. The first version of the tool was pilot tested with a sample of 35 students aged 13–19. Feedback regarding the readability of the tool and the technical aspects of survey completion obtained from the pilot respondents were used to finetune the final version of the research tool.

The researchers obtained permission from the Ministry of Education to distribute the questionnaire to school principals within the Federation of Bosnia and Herzegovina. A total of 2315 adolescents participated in the study; however, at the stage of data quality control (correctness of completion of fields related to screen time, test battery on PUI, and sociodemographic metric), only 1185 records, i.e. 49.46% of the data from the original research sample, were included in the final analyses. The sample selection for the

Table 1
Characteristics of the research sample.

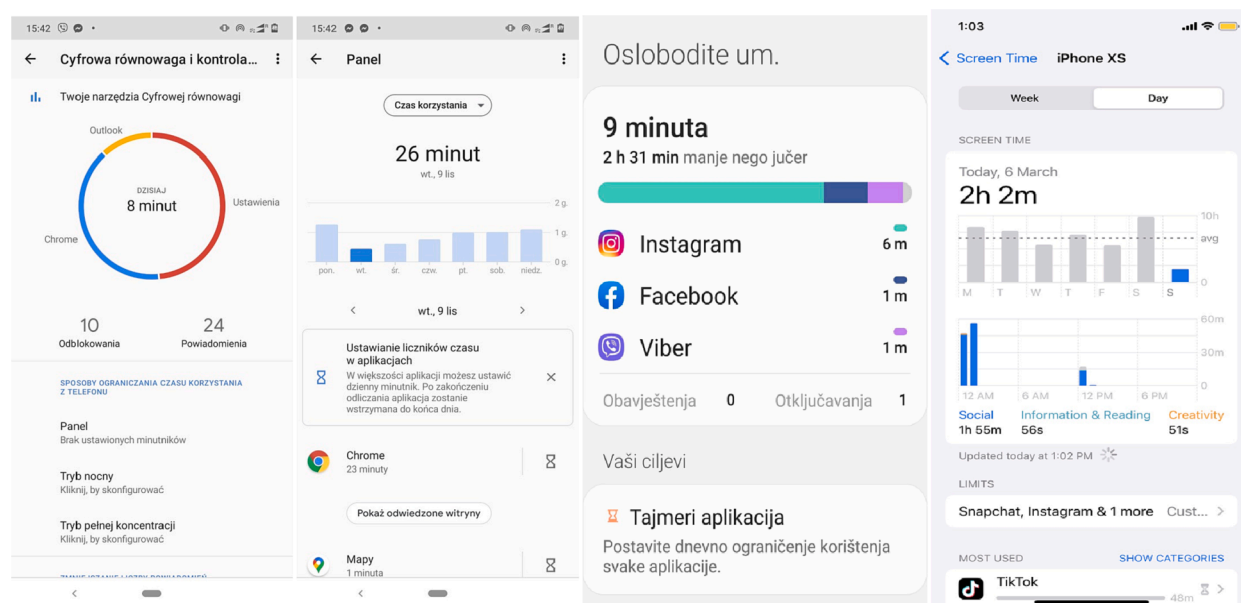|	N	%
Gender		
Male	463	39.072
Female	722	60.928
Parents present in the household		
Both parents	1005	84.979
My mother	114	9.705
My father	34	2.869
My parents are divorced, so I live with each at different intervals	32	2.447
Place of residence		
City	769	64.895
Countryside	177	14.937
Suburban	239	20.169
Type of school		
Primary school	709	59.831
High school	476	40.169

Fig. 1. Screen time measurement on Android (left side) and iPhone (Screen time).

study was non-random. The selection of respondents was determined by the following criteria: age concordance, consent to participate in the study, and access to the online version of the survey.

When completing the questionnaire, the students not only provided answers to the self-diagnosis of the two types of PUI and smartphone use, but they also used the embedded software on their smartphone to provide information about general smartphone use duration, time spent using specific websites, and time related to social media use.

3.5. Research ethics

The research was carried out within the framework of a project financed by the Polish National Agency for Academic Exchange under the Bekker programme Grant number: PPN/BEK/2020/1/00176. The research was carried out with special care related to obtaining the adolescents' consent to participate in the study. Participation in the study was completely voluntary. Respondents were able to opt out of completing the survey at any time. Participation in the study required the consent of the research subject and the school management. The research tools and the research procedure were constructed in a way that complied with the General Data Protection Regulation (GDPR) and the Declaration of Helsinki. Approval for the research was granted by the Ethical Committee of the Ministry of Education of Bosnia and Herzegovina (approval number 11–04-34–12049-1/22) dated 22.03.2022 represented by Minister Naida Hota-Muminović.

Table 2
Three types of screen time - descriptive statistics.

	Total time - average	Webpages - average	Social networks - average
Mean	229.371	37.265	142.107
Minimum	0.000	0.000	0.000
Maximum	777.667	500.000	849.300
Percentile 25	110.000	5.000	50.000
Percentile 50	200.000	18.333	110.000
Percentile 75	331.000	41.667	200.000
Std.Dev.	151.221	59.274	127.955
Confidence −95%	145.359	56.976	122.994
Confidence + 95%	157.580	61.766	133.335
Skewness	0.699	3.524	1.769
Kurtosis	−0.132	16.027	5.276
Kolmogorov-Smirnov test	K-S d = 0.093, p < 0.01; Lilliefors p < 0.01	K-S d = 0.264, p < 0.01; Lilliefors p < 0.01	K-S d = 0.133, p < 0.01; Lilliefors p < 0.01

4. Findings

4.1. Three types of screen time - descriptive statistics

In this study, screen time is a variable that was extracted from the data stored on the smartphone. Based on the average screen time, it can be seen that each adolescent uses their device for approximately 3 h49 minutes per day, of which 37 min are spent browsing the web, while 2 h22 minutes are spent using social networks. More than half of the surveyed adolescents use their phone more than 2 h20 minutes per day. In contrast, a quarter of the adolescents surveyed (percentile 75) use their smartphone on average daily for more than 5.5 h, of which more than 2 h15 minutes or more are spent browsing social networking resources. The record holder in this study spent an average of just under 13 h using a smartphone on any given day, while spending more than 14 h on social networking sites. The data presented in Table 2 do not have a normal distribution.

4.2. Smartphone users - four main groups

To see more clearly what these different screen times truly mean, it was decided to divide the respondents according to different categories of screen use. Based on a multiple cluster analysis using the k-means method, it was noted that the respondents could be divided into four groups. Cluster number 1 (15.17%) are intensive smartphone users. In this group, the average time spent using a smartphone exceeds 7 h - this is the collective that also uses social media most intensively (more than 5 h per day). Cluster number 2, comprising almost a third of the respondents, includes respondents who use their smartphones on average 5 h per day, with more than half of that time spent on social networks. Cluster number 3 (almost one in twenty respondents) averages 4 h per day of smartphone use, including similar use in terms of digital content consumption of both social networks and websites. The last cluster, Cluster 4, is the largest group (just under half of the respondents). The respondents included in this cluster (pink - Fig. 2) use their phone on average more than 2 h a day (of which about 1 h may be spent browsing online resources). This is the group using smartphones least intensively. Detailed statistics and visualisations for each cluster can be found in Table 3 and Fig. 2.

4.3. Sociodemographic variables and screen time

Girls spend slightly more time using smart phones than boys (241:209 min; Mann-Whitney $z = -3.334$, $p < 0.000$). This is also evident in SNS use (154:115 min; Mann-Whitney $z = -4.05$, $p < 0.000$). Place of residence does not differentiate screen time in any way (Mann-Whitney $z = -0.001$, $p < 0.989$). Adolescents attending secondary school use smartphones more intensively in terms of overall screen time (273:199 min; Mann-Whitney $z = 8.686$, $p < 0.000$) and time spent browsing SNS resources (165:124 min; Mann-Whitney $z = 6.734$, $p < 0.000$) than younger adolescents attending primary school. Overall screen time is slightly higher among students from single-parent families (255:224 min) than in those where parents live with the child; however, this difference is not statistically significant (Mann-Whitney $z = -1.111$, $p < 0.266$) Differences due to sociodemographic variables for screen time are illustrated in
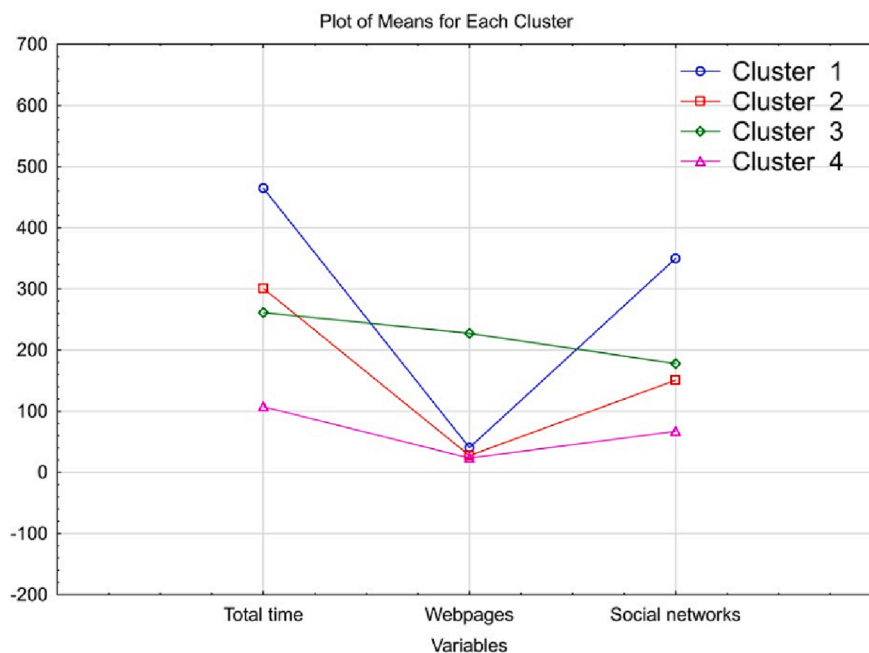

Fig. 2. Smartphone users - four elementary groups.

Table 3

Cluster analysis using the k-means method (descriptive statistics for the four clusters).

| Variable	Cluster 1 (N = 179; 15.17%)			Cluster 2 (N = 366; 31.02%)			Cluster 3 (N = 58; 4.91%)			Cluster 4 (N = 577; 48.90%)		
	Mean	Standard Deviation	Variance	Mean	Standard Deviation	Variance	Mean	Standard Deviation	Variance	Mean	Standard Deviation	Variance
Total time	464.747	101.357	10273.140	300.793	79.755	6360.909	261.391	99.218	9844.309	107.360	55.376	3066.518
Webpages	40.423	67.177	4512.764	27.429	28.607	818.350	227.293	80.385	6461.728	23.461	27.432	752.541
Social networks	349.727	129.880	16868.680	150.635	72.902	5314.772	177.914	106.165	11271.090	67.096	56.303	3170.018
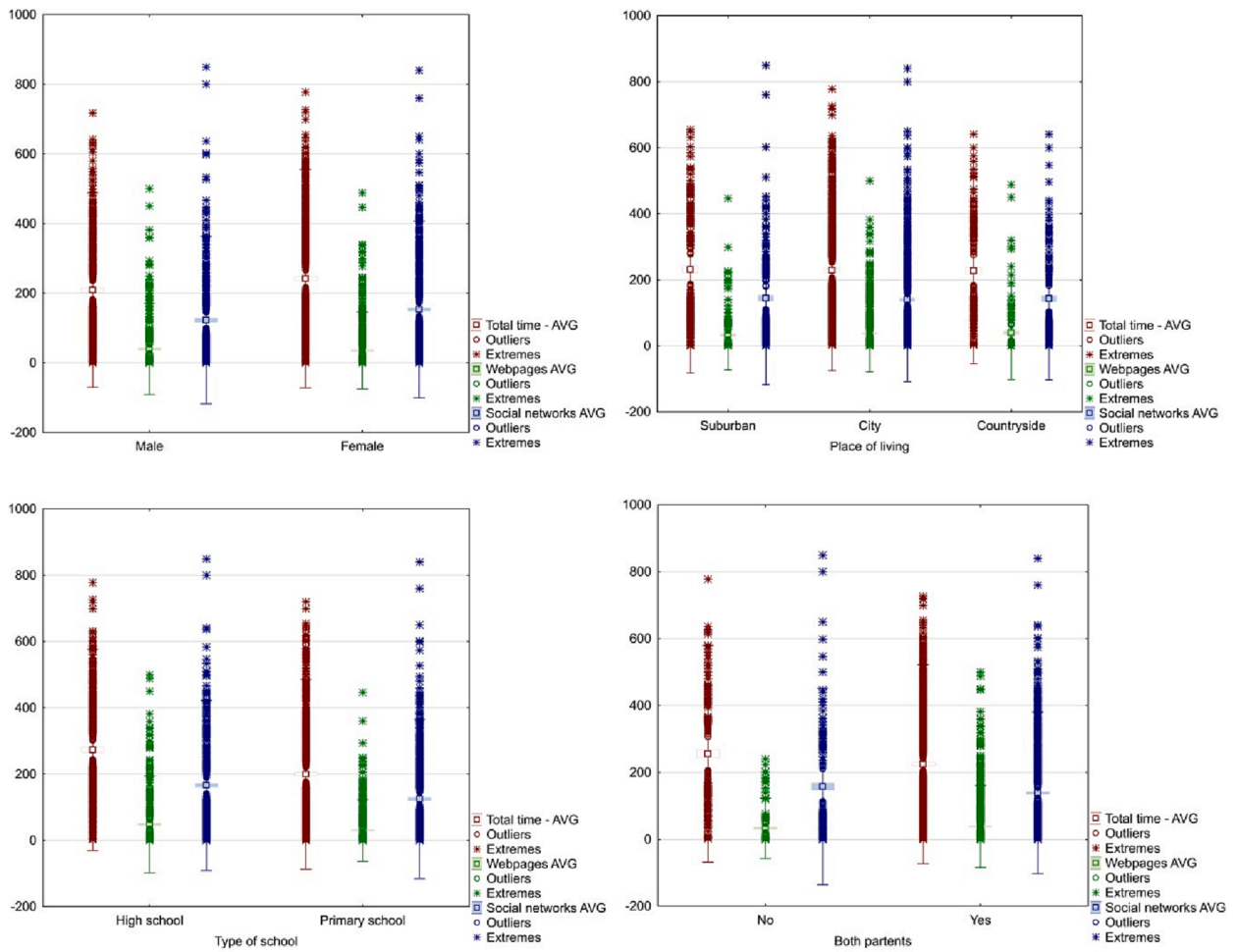
Fig. 3. Sociodemographic variables versus screen time.

4.4. Screen time versus problematic smartphone use and problematic SNS use

The text assumes from the extant literature that there is a need to confirm or reject hypotheses related to the relationship between different types of screen time and the incidence of problematic smartphone and social network use among young people. To this end, structural data modelling analyses were applied using the SmartPLS 4.0 package (Ringle et al., 2022). Classical analysis using the PLS-SEM algorithm was used in the calculations. Considering properties such as Construct Reliability and Validity, it was noted that the model was suitable for analysis. The internal consistency (Cronbach's Alpha) is characterised by a high level. Furthermore, Composite Reliability exceeded the minimum value of 0.7 (Hair et al., 2019), while Average Variance Extracted (AVE) despite being slightly below the 0.5 cut-off was found to be appropriate for the model due to the high CR value (Lam, 2012). Details of Construct Reliability and Validity are presented in Table 4.

In order to estimate the validity of the model, the Fornell-Larcker criterion was also checked. The results of this test are shown in

Table 4
Construct Reliability and Validity.

|	Cronbach's alpha	rho_A	Composite Reliability	Average variance extracted (AVE)
BSMAS	0.739	0.743	0.821	0.434
SAS Scale	0.836	0.855	0.869	0.407
SIS Scale	0.568	0.632	0.741	0.433
Social networks time	1.000	1.000	1.000	1.000
Total time smartphones	1.000	1.000	1.000	1.000
Webpages time	1.000	1.000	1.000	1.000

Table 5
Discriminant validity - Fornell-Larcker criterion.

	BSMAS	SAS Scale	SIS Scale	Social networks time	Total time smartphones	Webpages time
BSMAS	0.659					
SAS Scale	0.667	0.638				
SIS Scale	0.301	0.333	0.658			
Social networks time	0.321	0.335	0.349	1.000		
Total time smartphones	0.286	0.351	0.310	0.632	1.000	
Webpages time	0.053	0.090	0.018	0.156	0.152	1.000

Table 5. In addition, the VIF values for the main variables were checked and found to be<1.182. Furthermore, the standardised Root Mean Square Residual (SRMR) was 0.064, Normed Fit Index (NFI) = 0.770, and Chi-Square = 1717.440, d_G = 0.248. These values confirm that the model is fit and therefore there is a possibility of predicting the selected variables.

An analysis taking into account the interpretation of the R-factor^2 showed that the model presented in Fig. 4 explains the variance for the individual variables as follows: BSMAS (15.1%), SAS Scale 19.0%), Social networks time (42.5%), Total time using smartphones (9.6%), and Webpages time (2.4%). The predictive properties of the model range from Cohen's (1988) low to high depending on the variable.

Table 6 shows the results for the structural model including standardised beta (β), standard error, t-values and p-values. The results presented in the table and in Diagram 5 do not confirm the existence of a relationship of moderate or strong strength between different types of screen time and the occurrence of problematic smartphone use or problematic social network use. It would appear that drawing a simple line connecting PUI and screen time indicators is a mistaken approach. However, interesting correlations were observed that allow the prediction of overall screen time in the context of the intensity of use of the software installed on the
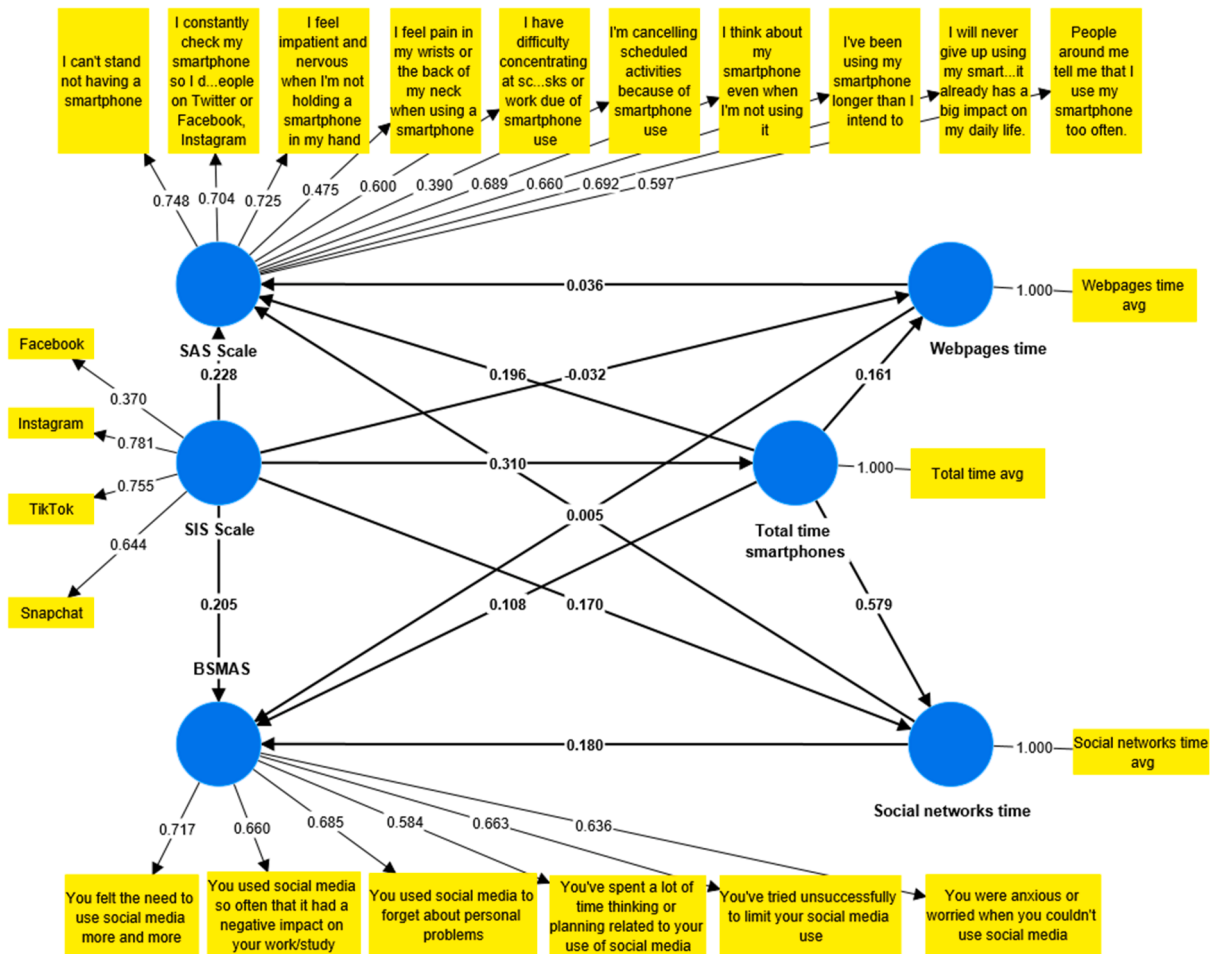
Fig. 4.

Table 6
Testing hypotheses about the relationship between different types of screen time and problematic use of smart phones and social networks.

	β	Standard deviation	T statistics	P values
SIS Scale -> BSMAS	0.205	0.029	7.129	0.000
SIS Scale -> SAS Scale	0.228	0.029	7.792	0.000
SIS Scale -> Social networks time	0.170	0.024	7.017	0.000
SIS Scale -> Total time smartphones	0.310	0.024	13.072	0.000
SIS Scale -> Webpages time	−0.032	0.031	1.002	0.317
Social networks time -> BSMAS	0.180	0.040	4.463	0.000
Social networks time -> SAS Scale	0.126	0.036	3.520	0.000
Total time smartphones -> BSMAS	0.108	0.037	2.876	0.004
Total time smartphones -> SAS Scale	0.196	0.035	5.534	0.000
Total time smartphones -> Social networks time	0.579	0.027	21.654	0.000
Total time smartphones -> Webpages time	0.161	0.032	5.093	0.000
Webpages time -> BSMAS	0.005	0.033	0.148	0.883
Webpages time -> SAS Scale	0.036	0.032	1.123	0.261

smartphone (β value exceeding the threshold of the average power of the correlation). In addition, it was also noticed that overall screen time is strongly correlated with time spent using social networks. There are also two weak correlations between installed smartphone software and the occurrence of symptoms attributed to problematic smartphone use (β = 0.228) and problematic social media use (β = 0.205). Therefore, given the power of β and the R-parameter[2], the listed screen time indicators are not adequate predictors to explain the two forms of PUI. Details of the hypothesis testing in this area are presented in Table 6.

5. Discussion

Screen time is a variable that appears as a key predictor in many studies of different forms of PUI (Yatan Pal Singh et al., 2020; Kutscher, 2016; Wang et al., 2021) or problematic smartphone use (Guo et al., 2021). However, based on the data collected among adolescents in Bosnia and Herzegovina, such a relationship is characterised by weak strength, suggesting that previous studies might have exaggerated or misinterpreted the importance of this variable as a predictor of PUI. Screen time is a complex measurement variable, and is highly contextualized: in the information society, actions that would have previously been accomplished without a screen now demand the presence of one, and this kind of technological shift must be understood before PUI can be considered (Van Deursen & Van Dijk, 2014). Therefore, as indicated by Squire and Steinkuehler (2017), great care should be taken when interpreting screen time without taking into what is being done on the device, why, and for how long.

Screen time is a parameter that is easy to measure since it is recorded by the operating system on most digital devices. However, studies that make use of such data are rare due to the greater complexity of the research procedure compared to using self-reported approximations (Randjelovic et al., 2021). This phenomenon may be the main reason for the presentation of screen time as one of the main warning signals for the occurrence of PUI and problematic SNS use (Zdanowicz et al., 2020). Nevertheless, over the last few years, one fact is discernible very clearly. Regardless of the research tool used, there is an increase in screen time associated with overall smartphone use time, including SNS use (Singh, & Balhara, 2021; Trott et al. 2022; Limone & Toto, 2021). In this study, the average respondent spent just under 4 h per day on their phone, of which just under 2.5 h was spent on SNS use. Although these data do not directly correlate with the incidence of high rates of the two types of PUI, it should be borne in mind that excessive smartphone use does nonetheless contribute to myopia (McCrann et al., 2021), or may co-occur with other physical health disorders e.g. musculo-skeletal pain and headaches (Domoff et al., 2019). Of course, this assumption refers not to occasional high levels of screen time, but to systematic and prolonged interaction with smartphones.

Based on the data presented by Wiederhold (2020), it can be noted that the average daily screen time spent on entertainment is between 5 h and 7 h. Analysing the Bosnian data, it is noted that about a quarter of the adolescents use a smartphone 5.5 h per day or more, of which more than 2 h15 minutes is screen time related to SNS. These data are slightly lower than the information presented by Wiederhold (2020). However, the data from Bosnia do not include screen time from other digital devices such as computers, games consoles, or tablets. Thus, it can be assumed with a very high probability that the total daily screen time summed from all devices will be much higher than the data in this study show.

At the same time, it is also worth noting the predominant group among Bosnian adolescents among whom use time exceeds just over 3 h per day, of which<2 h are devoted to SNS use. Extensive screen time raises concerns among parents and other caregivers, if only because of the previously mentioned negative consequences (McCrann et al., 2021; Domoff et al., 2019). Concerns about bio-psychosocial functioning mediated by smartphones held by those in the immediate environment (parents, teachers), are natural (Ladrón de Guevara Rodríguez et al., 2022) but might also reflect a generational divide. However, concerns are not always informed by knowledge ofk how new media work. The perspective of digitally aware and equipped educators and parents (Yildiz Durak & Sar-itepeci, 2019; Tomczyk & Fedeli, 2022) makes it necessary to redefine media education in an intensely developing information society, one which is marked by the growth of e-services and the transfer of many activities from the offline sphere to cyberspace, and thus the growth of different types of screen time. Thus, in the educational perspective relating to media education (Milenkova et al., 2018; Zhu et al., 2015; Livingstone & Helsper, 2008), a new area is emerging related not only to the control and understanding of screen time in different types of devices including smartphones, but above all the ability to form habits to prevent behaviours related to nomophobia (Essel et al., 2022; Niu et al., 2020), and FOMO (Al-Furaih and Al-Awidi, 2021). At the same time, screen time is becoming a baseline

for the discussion of software allowing the achievement of digital balance in extreme cases where classical parenting methods fail, or for approaches that lead to so-called digital detox (Nguyen, 2022).

Obviously, discussion and constructive education for safe use of new media should include the development of awareness of the impact of new media, including smartphones, on the behaviour of individuals and groups. Furthermore, activities that increase the intentional use of new media among adolescents should include not only systemic solutions of institutional prevention, e.g. those implemented in schools (Toto, 2018), but, above all, activities to strengthen self-control skills, and understanding the mechanisms hidden in devices that cause involuntary prolongation of online activity time (e.g. types of notifications emitted by devices, specifics of the functioning of software on the smartphone) (Gansner et al, 2020; Fabio et al., 2022; Liao & Sundar, 2022). In addition, activities related to off-screen time – hobbies and sports - are also universal protective activities against behaviours classified as PUI (Shin & Gweon, 2020). Furthermore, when analysing the different forms of PUI mediated by smart phones, special attention should be paid to the issue of the modelling of adolescent behaviour in the family environment, thus multiplying the problematic style of new media use that also occurs among adults e.g. parents (Xie et al., 2019).

Some studies strongly suggest that not all screen time has the same meaning in terms of the occurrence of PUI (Twenge & Farley, 2021). Therefore, there is a need to revise existing views on the diagnostic criteria of PUI and to pay attention to the more complex nature of screen time. The increase in smartphone use duration may have a dual nature that illustrates increased engagement in daily life activities mediated by digital media or, in selected cases, problematic behaviour that meets the criteria for problematic smartphone use.

6. Research limitations and further research directions

The present study is a rare attempt to measure screen time among young smartphone users based on real data instead of self-declaration. Despite the use of sharable data measurement, it should be emphasised that the study time was limited to only the most recent three days of device use. This may be too short a period to show a person's real smartphone use in a longitudinal perspective. Therefore, the use of software that will conduct a longitudinal measurement in further stages of the study is advocated. In addition, it should be emphasised that smartphones are not the only devices that offer access to the Internet. Further studies should also consider screen time from other devices, such as desktops, laptops, tablets, and consoles.

A shortcoming of this study is that it fails to show the context of smartphone use among young people. Despite the division of the research tool measuring time of use into three categories: general screen time, time spent using websites, and screen time associated with the use of social networks, there is a need for further research (e.g. using triangulation of qualitative and quantitative methods), which will examine what smartphones are being used for beyond those issues related to problematic smartphone use (e.g. homework, communication with other SNS users, entertainment - watching films, listening to music).

The present research represents the next stage in the analyses conducted since 2017 by the Polish-Bosnian research team, whose aim is to develop clear diagnostic criteria for different types of problematic Internet use (including smart phones) among adolescents, as well as to show the real scale of the phenomena. Such a goal offers new perspectives related to the exploitation of the potential hidden in new media, where it is possible to accurately monitor the time of use of individual e-services, as factors determining the likelihood of negative phenomena such as nomophobia, phubbing, FOMO and others. Therefore, in the next stage, researchers will attempt to construct software that measures the aforementioned parameters while retaining the ability to contextualise the data collected, as well as incorporating software that measures different types of PUI depending on the circumstances in the experiment (Lee et al., 2022).

7. Conclusions

Screen time has been considered for many years as one of the key indicators for determining the level of problematic Internet use (Loid et al., 2020). It is a criterion that is very common in measurement tools targeting adolescents. This text highlights two critical aspects relating to this parameter. Firstly, screen time needs to be measured very precisely, avoiding the creation of inaccurate data based on self-declarative measurement (Hodes and Thomas, 2021). In addition, the screen time criterion is complex and needs to be disaggregated into a number of specific indicators (e.g. related to school tasks, communication, entertainment and so on). Screen time, due to the intensive development of information society services (Ziemba, 2019), is becoming a criterion that, when interpreted on its own, does not allow for a clear interpretation of the occurrence of phenomena such as FOMO, Phubbing, and the problematic use of smart phones.

The relationships between different types of screen time and different forms of PUI presented in the text make it clear that the duration of smartphone use is not a factor that allows an unambiguous prediction of problematic smartphone or social network use. Screen time, on the one hand, should not be treated as an issue that unambiguously signals problematic behaviour, but, on the other hand, there is an ongoing need (from a pedagogical point of view) to strengthen self-control mechanisms, to understand the impact of smartphones on the behaviour of individuals and groups, and to create alternatives to unproductive and unrelated use of the device (Király et al., 2020).

The research findings presented also point to the need to redefine the phenomenon of problematic Internet use in the context of the development of the information society, to change the habits associated with the use of smart phones and other devices, to increase the precision of measurement of various new media mediated behaviours, and to exploit the measurement potential inherent in the digital devices in use (Browne et al., 2021).

CRediT authorship contribution statement

Łukasz Tomczyk: Conceptualization, Methodology, Formal analysis, Investigation, Data curation, Writing – original draft, Visualization. **Elma Selmanagic Lizde:** Conceptualization, Data curation, Investigation, Writing – review & editing, Supervision.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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