FORYŚ, Angelika, STAWSKA, Weronika, MIŁEK, Magdalena, BANACH, Mariola, KWAŚNIAK, Ksenia, ŚLUSARCZYK, Monika, MAGIERSKA, Agata, NIEMCZYK, Anna, KOTOWICZ, Zuzanna and KMIOTEK, Weronika. How do smartphones affect physical and mental health. Quality in Sport. 2024;15:51864. eISSN 2450-3118.
https://dx.doi.org/10.12775/QS.2024.15.51864
https://apcz.umk.pl/QS/article/view/51864

The journal has had 20 points in Ministry of Higher Education and Science of Poland parametric evaluation. Annex to the announcement of the Minister of Higher Education and Science of 05.01.2024. No. 32553.
Has a Journal's Unique Identifier: 201398. Scientific disciplines assigned: Economics and finance (Field of social sciences); Management and Quality Sciences (Field of social sciences).
Punkty Ministerialne z 2019 - aktualny rok 20 punktów. Załącznik do komunikatu Ministra Szkolnictwa Wyższego i Nauki z dnia 05.01.2024 r. Lp. 32553. Posiada Unikatowy Identyfikator Czasopisma: 201398.
Przypisane dyscypliny naukowe: Ekonomia i finanse (Dziedzina nauk społecznych); Nauki o zarządzaniu i jakości (Dziedzina nauk społecznych).

The authors declare that there is no conflict of interests regarding the publication of this paper.
Received: 01.06.2024. Revised: 20.06.2024. Accepted: 01.07.2024. Published: 03.07.2024.

How do smartphones affect physical and mental health

Angelika Foryś
Ludwik Rydygier Specialist Hospital, Złota Jesień 1 Street, 31-826 Kraków
forys.angelika@gmail.com
ORCID ID: https://orcid.org/0009-0006-6631-8179

Weronika Stawska
University Clinical Hospital in Opole, 26 Wincentego Witosa Avenue, 45-401 Opole
weronikastawska98@gmail.com
ORCID ID: https://orcid.org/0009-0002-8916-2585

Magdalena Miłek
University Clinical Hospital in Opole, 26 Wincentego Witosa Avenue, 45-401 Opole
milekmagdalena2@gmail.com
ORCID ID: https://orcid.org/0009-0006-1355-3386

Mariola Banach
Praski Hospital, 67 Solidarności Avenue, 03-401 Warszawa
mariolabanach01@gmail.com
ORCID ID: https://orcid.org/0009-0004-0295-7348

Ksenia Kwaśniak
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów, Lwowska Street 60, 35-301 Rzeszów
ksenia.f@vp.pl
ORCID ID: https://orcid.org/0009-0000-8826-4884

Monika Ślusarczyk
Ludwik Rydygier Specialist Hospital, Złota Jesień 1 Street, 31-826 Kraków
monslu97@gmail.com
ORCID ID: https://orcid.org/0009-0008-4765-7081

Agata Magierska
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów, Lwowska Street 60, 35-301 Rzeszów
magierskaagata01@gmail.com
ORCID ID: https://orcid.org/0009-0005-4150-0495

Anna Niemczyk
GMW - Center for Gynecological and Obstetrical Diagnostics Partnership M. Tomala & W. Niemczyk & G. Głąb, ul. Juliana Tuwima 1, 45-551 Opole
anna.niemczyk00@gmail.com
ORCID ID: https://orcid.org/0009-0001-3608-6112

Zuzanna Kotowicz
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów, Lwowska Street 60, 35-301 Rzeszów
kotowiczzuzia@gmail.com
ORCID ID: https://orcid.org/0009-0009-5711-3229

Weronika Kmiotek
Clinical Regional Hospital No. 2 named after St. Hedwig of Anjou in Rzeszów Lwowska Street 60, 35-301 Rzeszów
weronika55.12@o2.pl
ORCID ID: https://orcid.org/0009-0009-7699-0585

Abstract

Introduction and the aim of the study: Fast technology makes the use of mobile phones global. On one hand, it offers a wide range of opportunities, such as improved interpersonal communication, quick access to information and entertainment, on the other- it may have a negative impact on physical activity or mental well-being. The aim of this study is to summarize the current state of knowledge about the relationship between problems related to smartphone use and health.
Materials and methods: A literature search was conducted using the medical databases PubMed and Google Scholar. Articles were retrieved in English, employing the key words: "smartphone addiction", "mental health" in appropriate configurations. The analysis encompassed data from 39 scientific references published between 2014 and 2024.
Conclusions: Problematic smartphone use is a rapidly developing phenomenon, whereas mental health deviance may pose as a risk factor as much as an effect of smartphone overuse. Research results are needed to better describe this disorder and its medical consequences.

Keywords: smartphone addiction, physical activity, mental health

Introduction

The development of technology in the last century has gained an incredible pace which significantly improves human functioning in many areas of life and at the same time carries potential threats. Spending free time in front of a screen begins in early childhood - American children under 2 years of age spend an average of 42 minutes a day [1]. Many studies prove that the use of social media begins before the age of 13 and affects 90% of teenagers aged 13-17 [2]. According to EUROSTAT In 2022, 96% of people aged 16-29 use the Internet every day. This also applies to 84% of people over 29 years of age [3]. Research suggests that smartphone dependence is associated with broader mental health. The aim of this article is to summarize the current state of knowledge regarding the phenomenon of PSU and its impact on mental health in particular.

Discussion

Does social media addiction exist?

International Statistical Classification Diseases and Related Health Problems ICD-11 created a category called “disorders due to substance use or addictive behaviors” [4].

Addictive behavior, also known as non-substance addiction, can manifest in food addiction, pathological gambling, internet addiction and mobile phone addiction [5]. According to ICD-11, these are the syndromes associated with disruption of personal function occurring during repetitive, rewarding behaviors other than substance abuse or sexual behavior. Characteristically, they are favored over other life activities and continued despite the negative consequences [4].

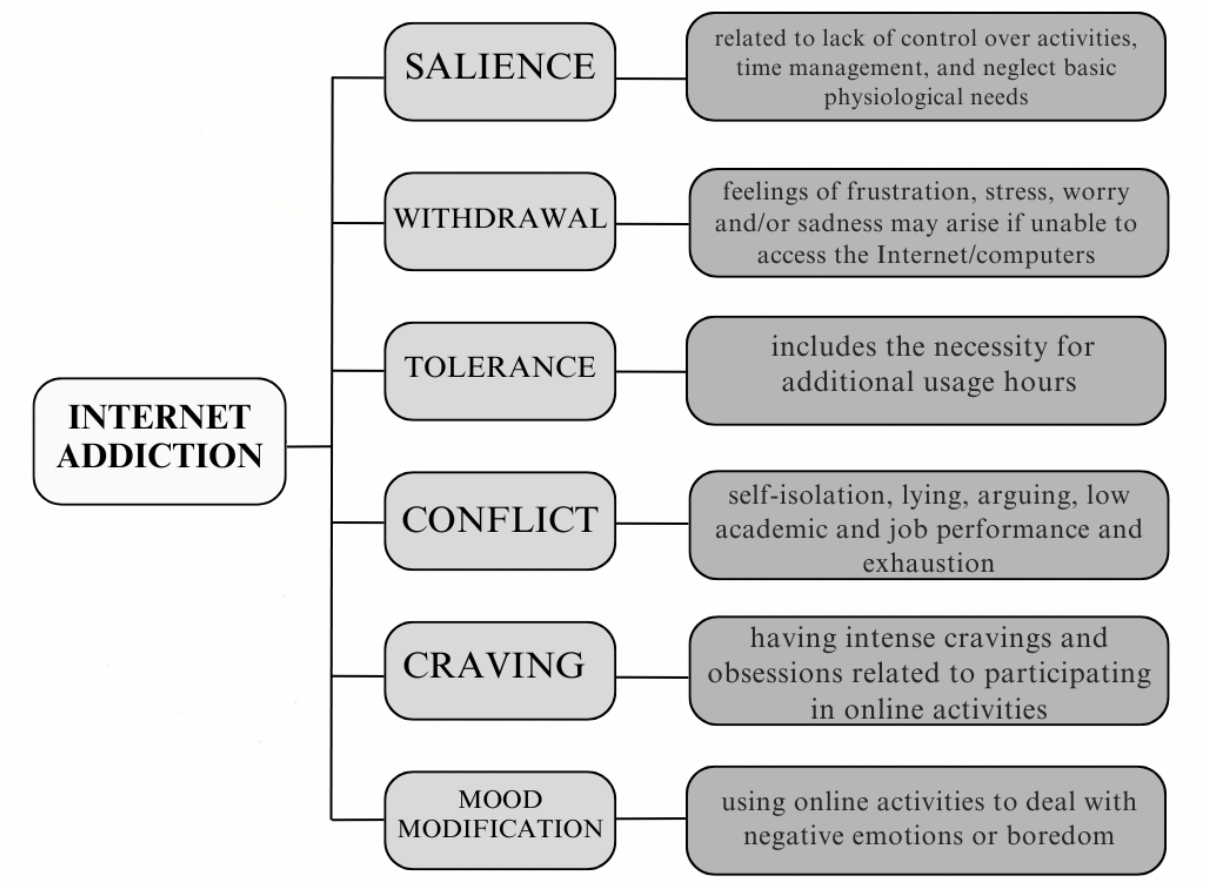
Various concepts can be found in the literature, among others:

- smartphone addiction [6],
- problematic smartphone use (PSU) [7],
- excessive use of mobile phone [8],
- compulsive internet use (CIU) [9].

The use of social media is often done via smartphone. Social interaction stimulates the dopaminergic reward system which brings a subjective feeling of pleasure [10]. The components of Internet addiction include six different groups of symptoms [11] (Figure 1). The term "smartphone addiction" is often used in the literature because it is difficult to find another term that covers symptoms such as lack of self-control, frequent use and negative

effects. However, its consequences are difficult to compare to the abuse of substances such as heroin or tobacco. Including hazardous or maladaptive use in the definition of addiction may blur the lines between these conditions and undermine the seriousness of disorders that are truly addictive [12]. It is debatable whether PSU meets the criteria for addiction. The use of the Internet can lead to numerous disorders and health issues, as well as physical and social consequences. Researchers support the use of the term "problematic use" instead of addiction because of lack of research covering this area [13].

Figure 1. Components of internet addiction



Physical activity

The study based on a large sample of Korean adolescents examined the relationship between physical activity (PA) and strength exercise with the risk of PSU. Data from 53,534 students were analyzed, taking into account smartphone addiction in three groups of people - moderate physical activity, vigorous physical activity and strength training. Confounding variables such as gender, grade, BMI, academic achievement, sleep satisfaction, depression, loneliness and stress were also taken into account. In each of the mentioned groups, the risk of addiction was higher compared to students who did not practice sports [14].

It was found that individuals with high-risk smartphone addiction tended to take fewer steps and consume fewer calories per day compared to those with no-risk or potential-risk smartphone addiction. High-risk users also had higher level of fat mass and lower level of muscle mass, with no significant differences in height or weight. Moreover, they spent more time on their smartphones and used them more frequently than those with no-risk or potential-risk addiction. These findings indicate that individuals with smartphone addiction may be at risk of lower energy expenditure due to spending more time on their phones and engaging in less physical activity, leading to reduced muscle mass and increased fat mass [15].

Another research confirms that PSU is negatively correlated with physical activity levels and positively correlated with BMI and central adiposity. Spending long hours on smartphones could lead to addiction, which may result in decreased physical activity and increased body weight. Males had higher levels of general and central adiposity compared to females, with high smartphone users showing non-significantly higher levels. The authors suggest that the higher levels of smartphone addiction in males could explain their lower physical activity levels and increased adiposity [16].

Other authors claim that PSU decreases intrinsic motivation (IM) for PA and increases extrinsic motivation, particularly for students with appearance and health-related exercise goals. The study suggested that interventions focusing on improving SE or transitioning motivation types from extrinsic to intrinsic could help mitigate the negative effects of SA and enhance PA levels among university students [17].
Please note that PSU may also occur in case of professional athletes. A study of 212 licensed handball players showed a 27.7% prevalence of PSU, proving that behavioral addiction affects even people who practice a healthy lifestyle [18].

Sleep quality

Over the years, the sleep process has evolved which proves its key role in meeting the basic physiological needs of organisms, especially metabolic needs. This includes, but is not limited to, saving energy, coordinating chemical reactions, and distributing metabolic resources[19]. Blue light waves have the strongest impact on the endogenous human circadian rhythm among the entire range of visible light. By disturbing the secretion of melatonin, it makes it difficult to fall asleep [20].

A study of 1,043 students at King's College in London showed a relationship between increased smartphone use and poor sleep quality. This thesis is consistent with previous research that PSU is associated with difficulty falling asleep, shorter sleep duration, and fatigue during the day. The probable cause of these symptoms is the negative impact of smartphone use before bed on the regulation of circadian rhythm. The authors of the study suggest that daily exposure does not have to be a criterion for the diagnosis of gaming and gambling disorders according to ICD-11 [21]. In turn Chu Y. et al. [22] confirm the existence of correlation between PCU and reduced sleep quality, which may be caused not only by impaired melatonin secretion, but also due to the use of the phone itself, through reduced quality of sleep hygiene and physiological arousal. They draw attention to the risk involved and the measures that should be taken to avoid them, especially education, maintaining sleep hygiene and consulting a doctor.

Another study showed that, among other things, due to technology addiction, young adults are more likely to delay going to bed compared to older ones. Surprisingly, their sleep quality did not suffer as much as expected. Adults and middle-aged adults are impacted by stressors and responsibilities that reduce their ability to compensate for lost sleep. This suggests that there are other factors influencing sleep quality in older age groups than smartphone overuse and pre-sleep habits [23].

There are many reports on the negative impact of the excessive smartphone use on sleep, pointing to the limitations of these studies and emphasizing the need for further research [24].

Emotional problems

PSU is associated with an insecure attachment style and maladaptive cognitive-emotional regulation strategies in adolescents, such as self-blame and catastrophic thinking. The stage of adolescence is full of stressful events, so using technology helps reduce the level of difficult emotions. PSU is also positively correlated with binge eating, restrained eating, and higher body fat percentage in adolescents. In turn, in college students, PSU increased the level of anger and

worry. There is also a relationship between internet addiction and loneliness, and this correlation is independent of the presence of the COVID-19 pandemic. The effect of PSU may be a reduction in the frequency of direct contact with people which leads to a greater sense of loneliness [25,26,27]. On the other hand, the use of social media sites has been shown to be associated with improved mental health, which was explained by a sense of belonging and receiving emotional support from online friends [28].

The relationship between various emotion regulation mechanisms and PSU has been investigated. A positive correlation of PSU with catastrophizing and impulse control difficulties was demonstrated. Suppression of emotional expression had no significant relationship with smartphone addiction, while lack of emotional awareness showed no relationship. Younger age groups had a more pronounced association between emotion regulation and smartphone addiction, but gender had no effect on this association. Research findings indicate that people who suppress their emotions are more likely to use mobile phones for content consumption and entertainment than for social interactions [29].

Depression and anxiety

PSU is also associated with anxiety and depression. Some authors claim that the cause of the symptoms of mental disorders is telephone abuse. Other studies show an inverse relationship - symptoms of anxiety and depression may lead to PSU. In fact, the cause and effect relationship may be more complicated - symptoms of mental disorders are a risk factor for PSU, which may worsen mental problems [10].

Other studies confirm that PSU can be a predictor of depression and anxiety [30,31]. Moreover, it was noticed that self-control significantly reduces the correlation of PSU with anxiety and depressive symptoms. Smartphone overuse may increase the risk of mental health symptoms, but careful use may lower the risk. Self-monitoring may therefore be a useful tool in solving the problem of excessive telephone use and the resulting health effects [32]. Additionally, prolonged smartphone use may increase the risk of suicidal thoughts and attempts. Even after taking into account potential issues related to smartphone use, such as conflicts with family or peers and disruption in school work, this relationship remained significant with only minor changes in odds ratios [33].

It has been proven that a week-long break from using social media (Instagram, Facebook, Twitter and TikTok) reduces the severity of anxiety and depression symptoms compared to normal social media use. The severity of these symptoms was partially driven by a reduction in the total number of minutes spent on Twitter and TikTok [34].

Alcohol and other substances

26% of cases of problematic smartphone use correlate with alcohol abuse and the father's education level. In turn, alcohol abuse increases the likelihood of excessive smartphone use [35]. A study conducted on 10,000 students using the AUDIT test confirmed that alcohol abuse occurs more often in people who use smartphones problematically compared to the control group. Interestingly, there was no connection with the increased frequency of taking other substances such as marijuana, cocaine or amphetamine. According to the authors, the reason may be the susceptibility of socially isolated people to both PSU and excessive alcohol consumption. Another explanation may be that alcohol abuse and PSU are based on common personality traits. Over the course of the study, PSU symptoms occurred earlier than alcohol abuse, suggesting that the former leads to the latter, not the other way around [36]. The relationship between problematic substance abuse and PSU is confirmed in another study, which showed a positive correlation of PSU with risky single-occasion drinking and a negative correlation of PSU with cannabis use and cigarette smoking [37].

Risk factors

When it comes to age, research shows variation in smartphone addiction among different age groups. One of the risk factors for PSU is female gender [38,39]. This may be explained by their more frequent experience of social stress, which triggers specific behavioral patterns. It was noticed that girls use phones more often for communication purposes, while boys use them more often for playing games and sharing data. Another risk factor may be attending a private school. On the other hand, educational success, reading habits and enjoyment of school appear to be negatively correlated with PSU [39].

Parental punishment and restrictive mediation can increase the risk of children developing smartphone addiction, while attachment to parents and a democratic parenting style can offer protection. Factors like domestic violence, parental addiction, neglect, abuse and traumatic experiences can also contribute to smartphone addiction, with effects influenced by body image dissatisfaction, social anxiety and depression. Parental neglect can lead to smartphone addiction by affecting relationships with teachers, emotional intelligence and coping styles. High levels of parental supervision, monitoring, and affection are linked to lower levels of problematic smartphone use in both preteens and adolescents, improving self-control. In contrast, permissive parenting behavior raises the risk of problematic smartphone use in preteens [38,40].

Adolescents with lower self-control are more likely to be addicted to smartphones and factors such as low self-esteem, depression and certain personality traits. Those can be: neuroticism and conscientiousness and are associated with problematic phone use. Externalizing problems like hyperactivity and inattention increase the risk of smartphone addiction in preteens, while internalizing issues do not have the same impact. Both internalizing and externalizing problems influence smartphone use initially, but over time, externalizing problems become more influential. The smartphone overdependence group is characterized by high negative emotionality and aggressive behaviors, with studies suggesting a link between smartphone addiction and increased aggression [38,39,40].

Advantages

It’s worth mentioning that using a smartphone also has positive effects. During the COVID-19 pandemic, teenagers' one-on-one online communication helped them reduce feelings of loneliness and relieve stress. Humorous content on social media has also been shown to increase happiness [41].

Another important aspect is the opportunity for people struggling with mental disorders to share their experiences and seek support. People suffering from bipolar disorder often use online forums to ask for help, while people suffering from schizophrenia share information and experiences about the disease. Communication via online forums can lead to greater awareness of one's illness, making friends and feeling of belonging to a social group. Content analysis of YouTube comments by individuals with mental illness showed potential for connection, hope, support, learning and sharing coping strategies for daily challenges [42]. 57% of teenagers hospitalized for psychiatric purposes received mental support thanks to social media in the two weeks before admission to hospital.

There are many apps that have the potential to impact mental health. A study on a meditation app reported improved symptoms of depression and anxiety compared to a control group [43]. It has been shown that the mobile application is able to improve well-being and reduce stress in its active users - the study was concerning a group of women working in hospitals, over 4 and 8 weeks [44].

In a recent survey, 77% of teens stated that social media played a role in staying connected with friends on a daily basis, while 69% said it was somewhat valuable for engaging in meaningful conversations with close friends. What's more, 81% of teens say that communicating via social media helps them feel more connected to their friends.

The Internet has the potential to revolutionize youth mental health, including new applications such as screening, treatment and prevention. Social networking sites introduce intervention mechanisms when users notice symptoms of anxiety. Additionally, these platforms serve to educate the public about mental health and support mental well-being efforts [1].

CONCLUSIONS

In conclusion, problematic smartphone use is a real phenomenon that affects individuals across all age groups, with potential negative impacts on physical activity and mental health. The use of social media and smartphones can lead to sleep disturbances, emotional issues, depression, anxiety, and even substance abuse. Decreased physical activity may increase the risk of PSU. On the other note - phone overuse may in turn lead to decreased exercise frequency. Risk factors for PSU include female gender, low self-control, and certain parenting styles. However, it is important to note that smartphones also have positive effects, such as providing a platform for individuals to seek support, share experiences, and improve mental well-being. Further research is needed to fully understand the complexities of the relationship between smartphone use and mental health, and to develop effective interventions for individuals struggling with problematic smartphone use.

Disclosure

Authors do not report any disclosures.

Author's contribution

Conceptualization: Foryś A, Miłek M;

Methodology: Foryś A, Kwaśniak K;

Software: Banach M, Magierska A, Miłek M, Stawska W, Niemczyk A; Kotowicz Z; Kmiotek W;

Check: Foryś A, Ślusarczyk M;

Formal analysis: Foryś A, Stawska W;

Investigation: Foryś A, Kwaśniak K, Banach M, Ślusarczyk M, Magierska A, Miłek M, Stawska W, Niemczyk A, Kotowicz Z, Kmiotek W;

Resources: Banach M, Magierska A, Miłek M, Stawska W, Niemczyk A; Kotowicz Z; Kmiotek W

Data curation: Miłek M, Stawska W, Niemczyk A, Kotowicz Z, Kmiotek W;

Writing - rough preparation: Ślusarczyk M, Foryś A, Kwaśniak K, Banach M, Magierska A, Miłek M, Stawska W, Niemczyk A; Kotowicz Z, Kmiotek W;

Writing - review and editing: Ślusarczyk M, Foryś A, Kwaśniak K, Banach M, Magierska A, Miłek M, Stawska W, Niemczyk A; Kotowicz Z, Kmiotek W;

Visualization: Foryś A, Stawska W, Miłek M, Kwaśniak K, Banach M, Magierska A, Ślusarczyk M, Niemczyk A; Kotowicz Z, Kmiotek W;

Supervision: Foryś A, Stawska W;

Project administration: Foryś A, Miłek M.

Receiving funding: no funding was received.
All authors have read and agreed with the published version of the manuscript.
Disclosures: No disclosures.
Financial support: No financial support was received.
Conflict of interest: The authors declare no conflict of interest.

References

1. Nesi J. The Impact of Social Media on Youth Mental Health: Challenges and Opportunities. N C Med 2020;81(2):116-121. https://doi.org/10.18043/ncm.81.2.116

2. Mann RB, Blumberg F. Adolescents and social media: The effects of frequency of use, self-presentation, social comparison, and self esteem on possible self imagery. Acta Psychol (Amst). 2022;228:103629. https://doi.org/10.1016/j.actpsy.2022.103629

3. Eurostat: 96% of young people in the EU uses the internet daily. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/ddn-20230714-1 (Access: 18.03.2024).

4. ICD-11 International Classification of Diseases 11th Revision.The global standard for diagnostic health information. https://icd.who.int/en (Access: 20.03.2024).

5. Zou Z, Wang H, d'Oleire Uquillas F, Wang X, et al. Definition of Substance and Non-substance Addiction. Adv Exp Med Biol. 2017;1010:21-41. https://doi.org/10.1007/978-981-10-5562-1_2

6. Ratan ZA, Parrish AM, Zaman SB, et al. Smartphone Addiction and Associated Health Outcomes in Adult Populations: A Systematic Review. Int J Environ Res Public Health. 2021 Nov 22;18(22):12257. https://doi.org/10.3390/ijerph182212257

7. Elhai JD, Dvorak RD, Levine JC, et al. Problematic smartphone use: A conceptual overview and systematic review of relations with anxiety and depression psychopathology. J Affect Disord. 2017;207:251-259. https://doi.org/10.1016/j.jad.2016.08.030

8. Tyagi A, Prasad AK, Bhatia D. Effects of excessive use of mobile phone technology in India on human health during COVID-19 lockdown. Technol Soc. 2021;67:101762. https://doi.org/10.1016/j.techsoc.2021.101762

9. Jovičić Burić D, Muslić L, Krašić S, et al. Croatian validation of the Compulsive Internet Use Scale. Addict Behav. 2021;119:106921. https://doi.org/10.1016/j.addbeh.2021.106921

10. Augner C, Vlasak T, Aichhorn W, et al. The association between problematic smartphone use and symptoms of anxiety and depression-a meta-analysis. J Public Health (Oxf). 2023;45(1):193-201. https://doi.org/10.1093/pubmed/fdab350

11. World Health Organization. (2015). Public health implications of excessive use of the internet, computers, smartphones and similar electronic devices: meeting report, Main Meeting Hall, Foundation for Promotion of Cancer Research, National Cancer Research Centre, Tokyo, Japan, 27-29 August 2014. World Health Organization. https://iris.who.int/handle/10665/184264 (Access: 20.03.2024).

12. Panova T, Carbonell X. Is smartphone addiction really an addiction? J Behav Addict. 2018;7(2):252-259. https://doi.org/10.1556/2006.7.2018.49
13. Demkow M, Jakubczyk A. Problematic mobile phone use. Review of literature. Alcoholism and Drug Addiction/Alkoholizm i Narkomania. 2019;32(3):211-236. https://doi.org/10.5114/ain.2019.91003
14. Kim, J., & Lee, K. (2022). The Association between Physical Activity and Smartphone Addiction in Korean Adolescents: The 16th Korea Youth Risk Behavior Web-Based Survey, 2020. Healthcare (Basel, Switzerland), 10(4), 702. https://doi.org/10.3390/healthcare10040702
15. Kumar S, Rajasegaran R, Prabhakaran S, et al. Extent of Smartphone Addiction and its Association with Physical Activity Level, Anthropometric Indices, and Quality of Sleep in Young Adults: A Cross-Sectional Study. Indian journal of community medicine : official publication of Indian Association of Preventive & Social Medicine. 2024; 49(1), 199–202. https://doi.org/10.4103/ijcm.ijcm_706_22
16. Lin B, Teo E. W, & Yan, T. The Impact of Smartphone Addiction on Chinese University Students' Physical Activity: Exploring the Role of Motivation and Self-Efficacy. Psychology research and behavior management. 2022; 15, 2273–2290. https://doi.org/10.2147/PRBM.S375395
17. Sahin Koybulan S, Altin D, Yararbas G, et al. Smartphone Addiction and Related Factors among Athletes. Behavioral sciences (Basel, Switzerland). 2024; 14(4), 341. https://doi.org/10.3390/bs14040341
18. Kim S. E, Kim J. W, & Jee, Y. S. Relationship between smartphone addiction and physical activity in Chinese international students in Korea. Journal of behavioral addictions. 2015; 4(3), 200–205. https://doi.org/10.1556/2006.4.2015.028
19. Anafi RC, Kayser MS, Raizen DM. Exploring phylogeny to find the function of sleep. Nat Rev Neurosci. 2019;20(2):109-116. https://doi.org/10.1038/s41583-018-0098-9
20. Salamon M. How Blue Light Affects Your Sleep. https://www.webmd.com/sleep-disorders/sleep-blue-light (Access: 24.03.2024).
21. Sohn SY, Krasnoff L, Rees P, et al. The Association Between Smartphone Addiction and Sleep: A UK Cross-Sectional Study of Young Adults. Front Psychiatry. 2021;12:629407. https://doi.org/10.3389/fpsyt.2021.629407
22. Chu Y, Oh Y, Gwon M, et al. Dose-response analysis of smartphone usage and self-reported sleep quality: a systematic review and meta-analysis of observational studies. J Clin Sleep Med. 2023;19(3):621-630. https://doi.org/10.5664/jcsm.10392

23. Correa-Iriarte S, Hidalgo-Fuentes S, Martí-Vilar M. Relationship between Problematic Smartphone Use, Sleep Quality and Bedtime Procrastination: A Mediation Analysis. Behav Sci (Basel). 2023;13(10):839. https://doi.org/10.3390/bs13100839
24. Leow MQH, Chiang J, Chua TJX, et al. The relationship between smartphone addiction and sleep among medical students: A systematic review and meta-analysis. PLoS One. 2023;18(9):e0290724. https://doi.org/10.1371/journal.pone.0290724
25. Wacks Y, Weinstein AM. Excessive Smartphone Use Is Associated With Health Problems in Adolescents and Young Adults. Front Psychiatry. 2021;12:669042. https://doi.org/10.3389/fpsyt.2021.669042
26. Wang Y, Zeng Y. Relationship between loneliness and internet addiction: a meta-analysis. BMC Public Health. 2024;24(1):858. https://doi.org/10.1186/s12889-024-18366-4
27. Extremera N, Quintana-Orts C, Sánchez-Álvarez N, et al. The Role of Cognitive Emotion Regulation Strategies on Problematic Smartphone Use: Comparison between Problematic and Non-Problematic Adolescent Users. Int J Environ Res Public Health. 2019;16(17):3142. https://doi.org/10.3390/ijerph16173142
28. Yin, X.-Q., de Vries D. A., Gentile D. A., et al. Cultural Background and Measurement of Usage Moderate the Association Between Social Networking Sites (SNSs) Usage and Mental Health: A Meta-Analysis. Social Science Computer Review, 2019;37(5), 631-648. https://doi.org/10.1177/0894439318784908
29. Shahidin SH, Midin M, Sidi H, et al. The Relationship between Emotion Regulation (ER) and Problematic Smartphone Use (PSU): A Systematic Review and Meta-Analyses. Int J Environ Res Public Health. 2022;19(23):15848. https://doi.org/10.3390/ijerph192315848
30. Demirci K, Akgönül M, Akpinar A. Relationship of smartphone use severity with sleep quality, depression, and anxiety in university students. J Behav Addict. 2015;4(2):85-92. https://doi.org/10.1556/2006.4.2015.010
31. Distress tolerance and mindfulness mediate relations between depression and anxiety sensitivity with problematic smartphone use. Comput Human Behav. 2018;84:477– 84. https://doi.org/10.1016/j.chb.2018.03.026.
32. Geng Y, Gu J, Wang J, et al. Smartphone addiction and depression, anxiety: The role of bedtime procrastination and self-control. J Affect Disord. 2021;293:415-421. https://doi.org/10.1016/j.jad.2021.06.062
33. Kim H, Cho MK, Ko H, et al. Association between Smartphone Usage and Mental Health in South Korean Adolescents: The 2017 Korea Youth Risk Behavior Web-Based Survey. Korean J Fam Med. 2020;41(2):98-104. https://doi.org/10.4082/kjfm.18.0108

34. Lambert J, Barnstable G, Minter E, et al. Taking a One-Week Break from Social Media Improves Well-Being, Depression, and Anxiety: A Randomized Controlled Trial. Cyberpsychol Behav Soc Netw. 2022;25(5):287-293. https://doi.org/10.1089/cyber.2021.0324
35. Wacks Y, Weinstein AM. Excessive Smartphone Use Is Associated With Health Problems in Adolescents and Young Adults. Front Psychiatry. 2021;12:669042. https://doi.org/10.3389/fpsyt.2021.669042
36. Grant JE, Lust K, Chamberlain SR. Problematic smartphone use associated with greater alcohol consumption, mental health issues, poorer academic performance, and impulsivity. J Behav Addict. 2019;8(2):335-342. https://doi.org/10.1556/2006.8.2019.32
37. Dey M, Studer J, Schaub MP, et al. Problematic smartphone use in young Swiss men: Its association with problematic substance use and risk factors derived from the pathway model. J Behav Addict. 2019;8(2):326-334. https://doi.org/10.1556/2006.8.2019.17
38. Fischer-Grote L, Kothgassner OD, Felnhofer A. Risk factors for problematic smartphone use in children and adolescents: a review of existing literature. Neuropsychiatr. 2019;33(4):179-190. https://doi.org/10.1007/s40211-019-00319-8
39. Seo BK, Hwang Y, Cho H. Mental Health and Personality Characteristics of University Students at Risk of Smartphone Overdependence. Int J Environ Res Public Health. 2023;20(3):2331. https://doi.org/10.3390/ijerph20032331
40. Yun J, Han G, Son H. Protective and risk factors of problematic smartphone use in preteens using panel study on Korean children. Front Psychiatry. 2022;13:981357. https://doi.org/10.3389/fpsyt.2022.981357
41. Marciano L, Ostroumova M, Schulz PJ, et al. Digital Media Use and Adolescents' Mental Health During the Covid-19 Pandemic: A Systematic Review and Meta-Analysis. Front Public Health. 2022;9:793868. https://doi.org/10.3389/fpubh.2021.793868
42. Naslund JA, Bondre A, Torous J, et al. Social Media and Mental Health: Benefits, Risks, and Opportunities for Research and Practice. J Technol Behav Sci. 2020;5(3):245-257. https://doi.org/10.1007/s41347-020-00134-x
43. Huberty J, Puzia ME, Green J, et al. A mindfulness meditation mobile app improves depression and anxiety in adults with sleep disturbance: Analysis from a randomized controlled trial. Gen Hosp Psychiatry. 2021;73:30-37. https://doi.org/10.1016/j.genhosppsych.2021.09.004
44. Coelhoso CC, Tobo PR, Lacerda SS, et al. A New Mental Health Mobile App for Well-Being and Stress Reduction in Working Women: Randomized Controlled Trial. J Med Internet Res. 2019;21(11):e14269. https://doi.org/10.2196/14269