The impact of smartphone addiction on exercise patterns: a systematic review

El impacto de la adicción a los teléfonos inteligentes en los patrones de ejercicio: revisión sistemática

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Abstract

Introduction: Smartphone addiction has become a pervasive issue, impacting various aspects of health and lifestyle. This study examines the relationship between smartphone addiction and exercise habits, focusing on psychological, physical, social, and neurobiological dimensions. By synthesizing existing evidence, it provides a comprehensive understanding of how excessive smartphone use influences physical activity levels and overall well-being.
Methods: A systematic review following PRISMA principles was conducted. Eligibility criteria included peer-reviewed studies in English, examining smartphone addiction and exercise habits. Databases such as PubMed, Google Scholar, Scopus, Web of Science, and PsycINFO were searched using relevant keywords. Included studies were randomized controlled trials, cohort studies, longitudinal studies, and cross-sectional studies. Data extraction emphasized impacts on exercise habits and associated health outcomes.
Results: The review found significant correlations between excessive smartphone use and negative health outcomes. Smartphone addiction was linked to increased depression, anxiety, and stress, alongside decreased self-esteem. A negative correlation was observed between smartphone use and physical activity, with higher usage linked to reduced exercise habits. Physical discomfort and impaired performance from prolonged smartphone use were also reported. These findings were consistent across students, athletes, and adolescents.
Conclusion: Targeted interventions are needed to mitigate smartphone addiction's adverse effects on mental and physical health. Educational programs, psychological support, and initiatives promoting physical activity are crucial. Future research should explore longitudinal studies and digital well-being tools to address smartphone addiction and foster healthier, more active communities.

Keywords

Smartphone addiction; exercise habits; physical activity; mental health; physical health.

Resumen

Introducción: La adicción a los teléfonos inteligentes se ha convertido en un problema generalizado que afecta a diversos aspectos de la salud y el estilo de vida. Este estudio examina la relación entre la adicción a los teléfonos inteligentes y los hábitos de ejercicio, centrándose en las dimensiones psicológicas, físicas, sociales y neurobiológicas. Al sintetizar la evidencia existente, proporciona una comprensión integral de cómo el uso excesivo de teléfonos inteligentes influye en los niveles de actividad física y el bienestar general.
Métodos: Se realizó una revisión sistemática siguiendo los principios PRISMA. Los criterios de elegibilidad incluyeron estudios revisados por pares en inglés, que examinaron la adicción a los teléfonos inteligentes y los hábitos de ejercicio. Se realizaron búsquedas en bases de datos como PubMed, Google Scholar, Scopus, Web of Science y PsycINFO utilizando palabras clave relevantes. Los estudios incluidos fueron ensayos controlados aleatorios, estudios de cohorte, estudios longitudinales y estudios transversales. La extracción de datos enfatizó los impactos en los hábitos de ejercicio y los resultados de salud asociados.
Resultados: La revisión encontró correlaciones significativas entre el uso excesivo de teléfonos inteligentes y los resultados negativos para la salud. La adicción a los teléfonos inteligentes se relacionó con un aumento de la depresión, la ansiedad y el estrés, junto con una disminución de la autoestima. Se observó una correlación negativa entre el uso de teléfonos inteligentes y la actividad física, y un mayor uso se relacionó con una reducción de los hábitos de ejercicio. También se informó de malestar físico y deterioro del rendimiento por el uso prolongado de teléfonos inteligentes. Estos hallazgos fueron consistentes entre estudiantes, deportistas y adolescentes.
Conclusión: Se necesitan intervenciones específicas para mitigar los efectos adversos de la adicción a los teléfonos inteligentes en la salud mental y física. Los programas educativos, el apoyo psicológico y las iniciativas que promueven la actividad física son cruciales. Las investigaciones futuras deberían explorar estudios longitudinales y herramientas de bienestar digital para abordar la adicción a los teléfonos inteligentes y fomentar comunidades más saludables y activas a los teléfonos inteligentes y fomentar comunidades más saludables y activas.

Palabras clave

Adicción a los smartphones; hábitos de ejercicio; actividad física; salud mental; salud física; adolescentes; estudiantes; atletas.

Introduction

The proliferation of smartphones has indeed transformed modern life, offering unparalleled access to information, communication, and entertainment. However, this ubiquity has also led to concerns about smartphone problematic use, especially addiction, is defined as a behavioral addiction marked by the excessive use of smartphones that interferes with daily functioning, relationships, and overall well-being and characterized by excessive and compulsive use (Alageel et al., 2021), which can have significant negative impacts on users' physical and psychological health. Research indicates that smartphone problematic use, especially addiction is prevalent among adolescents, with a significant portion at high risk or already addicted, influenced by socio-demographic factors and usage patterns (Alageel et al., 2021). This addiction is associated with various adverse outcomes, including heightened levels of anxiety, stress, and depression, as individuals become increasingly engrossed in their devices, often neglecting daily activities and social interactions (Lowe-Calverley & Pontes, 2020). Furthermore, excessive smartphone use has been linked to poorer sleep quality and higher perceived stress, contributing to co-morbid conditions such as obesity, heart diseases, and psychiatric disorders like OCD and ADHD (Nikolic et al., 2023). Among students, particularly medical undergraduates, excessive screen time for social purposes correlates with mild to moderate symptoms of stress, anxiety, and depression, highlighting the detrimental impact of social media on mental health (Popescu et al., 2022). Additionally, smartphone addiction can impair academic performance, as seen in elementary school students who exhibit decreased motivation and concentration, leading to lower learning achievements (Lane et al., 2021). The issue extends to younger children, where gadget addiction can result in social isolation, communication problems, and health issues like eyesight deterioration, necessitating parental guidance to mitigate these effects (Amin et al., 2024). Therefore, while smartphones offer numerous benefits, their potential for addiction and the associated negative outcomes underscore the need for balanced and mindful usage to safeguard physical well-being.

The psychological effects of smartphone problematic use, especially smartphone addiction are indeed alarming, with numerous studies highlighting its association with increased levels of depression, anxiety, and stress, particularly among young adults and students. For instance, a study conducted in Austria found that problematic smartphone use (PSU) was prevalent among adolescents and young adults, with 38.1% of respondents exceeding the cut-off for PSU, which was significantly associated with depressive symptoms, anxiety, disordered eating, and alcohol abuse (Abid et al., 2020). Similarly, research among medical students in South India revealed that smartphone addiction significantly increased life satisfaction and loneliness scores among extroverts, indicating a complex relationship between smartphone use and psychosocial well-being (Pera, 2020). Another study focusing on medical undergraduates in India found that excessive smartphone use, particularly for social purposes, was linked to mild to moderate symptoms of depression, anxiety, and stress, underscoring the negative impact of social media on mental health (Villegas Dominguez et al., 2023). Furthermore, research involving high school students in the United States demonstrated significant correlations between PSU and decreased self-esteem, increased stress, and lower academic performance, with stress, self-esteem, and grit identified as significant predictors of PSU (Spiratos & Ratanasiripong, 2023). Additionally, a study examining the effects of smartphone use on sleep quality, depression, and anxiety among students found significant relationships between smartphone use and poor sleep quality, as well as heightened levels of depression and anxiety, although no significant impact on academic achievement was observed (Park & Ryou, 2021). These findings collectively emphasize the need to understand the psychological underpinnings of smartphone addiction to develop effective interventions, as the constant need to stay connected and the fear of missing out (FOMO) can create a cycle of dependency that exacerbates mental health issues. Therefore, it is crucial to promote responsible smartphone use and implement policies that mitigate the adverse effects of excessive smartphone use on mental health.

In addition to psychological consequences, smartphone addiction has been found to negatively affect physical health, particularly exercise habits (Choksi, 2021). High levels of smartphone use are associated with reduced physical activity, which can lead to adverse health outcomes such as increased fat mass and decreased muscle mass (Alageel et al., 2021). This is concerning given the importance of regular physical activity for maintaining overall health and well-being. Given these multifaceted impacts, the primary objective of this research is to examine the relationship between smartphone addiction and exercise habits, encompassing psychological, physical, social, and neurobiological dimensions. By

synthesizing existing evidence, this study aims to provide a comprehensive understanding of how excessive smartphone use influences physical activity levels and to offer insights for developing effective interventions.

Method

The literature search was conducted using the PRISMA (Preferred Reporting Item for Systematic Reviews and Meta-analysis). Prisma provides guidelines for reporting and evaluating systematic reviews (Subirana et al., 2005).

Eligibility Criteria

The eligibility criteria for articles to be included in this systematic review on the impacts of smartphone addiction on exercise habits will include studies that examine the relationship between smartphone addiction and various psychological, physical, social, and neurobiological outcomes. The PICO criteria for inclusion will encompass studies involving participants with varying levels of smartphone addiction, with outcomes focusing on exercise habits, physical activity levels, and associated health impacts. Eligible study designs will include randomized controlled trials, cohort studies, longitudinal studies, and cross-sectional studies. The setting for eligible studies will be global, encompassing diverse geographic regions and populations. The time frame for included studies will cover all years up to the present. Eligible articles must be published in peer-reviewed journals, written in English, and provide sufficient information on methodology, results, and conclusions to assess their relevance and quality. Preprints and conference abstracts will be excluded from consideration. Studies from 2000 to 2024 were included to ensure contemporary relevance. Additionally, cross-validation methods were employed during the data extraction phase to minimize selection bias and improve reliability. Manual searches of reference lists further ensured comprehensive coverage of relevant studies from google scholar and Research Gate.

Inclusion Criteria

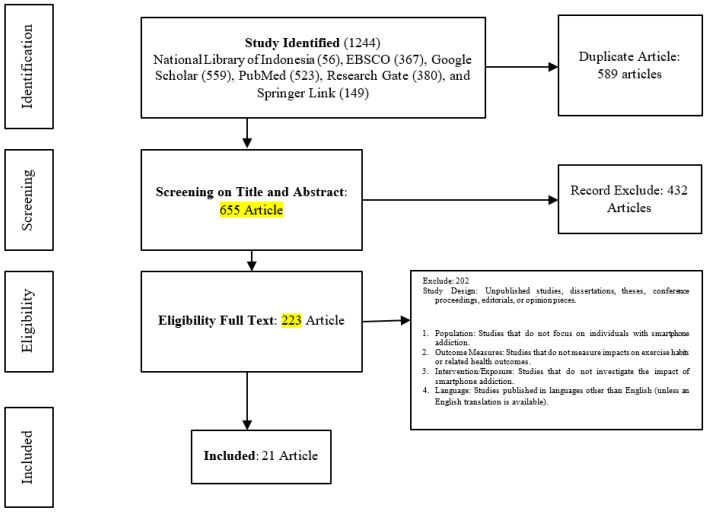
1. Study Design: Published, peer-reviewed studies including randomized controlled trials, cohort studies, longitudinal studies, and cross-sectional studies that investigate the impacts of smartphone addiction.
2. Population: Studies involving individuals with varying levels of smartphone addiction.
3. Outcome Measures: Studies that measure impacts on exercise habits, physical activity levels, and associated psychological, physical, social, and neurobiological outcomes.
4. Intervention/Exposure: Studies that explicitly examine the impact of smartphone addiction.

Exclusion Criteria

1. Study Design: Unpublished studies, dissertations, theses, conference proceedings, editorials, or opinion pieces.
2. Population: Studies that do not focus on individuals with smartphone addiction.
3. Outcome Measures: Studies that do not measure impacts on exercise habits or related health outcomes.
4. Intervention/Exposure: Studies that do not investigate the impact of smartphone addiction.
5. Language: Studies published in languages other than English (unless an English translation is available).

These criteria will help ensure that the systematic review focuses on relevant and high-quality research exploring the relationship between smartphone addiction and exercise habits.

Figure 1.



Information Sources

This systematic review investigates the impacts of smartphone addiction on exercise habits and overall health outcomes. The research aims to analyze various information sources, including academic databases, contact with study authors, trial registers, and grey literature sources from reputable international organizations were considered to provide a broader perspective. These sources encompass a range of publication dates from 2020 to 2024. By synthesizing findings from these diverse sources, the review aims to elucidate the consequences of smartphone addiction and provide insights into effective strategies for mitigating these impacts.

Search Strategy

The search strategy for articles investigating the impacts of smartphone addiction on exercise habits will involve utilizing electronic databases such as PubMed, Google Scholar, Scopus, Web of Science, and PsycINFO. The search terms will include variations of "smartphone addiction," "exercise habits," "physical activity," "mental health," "physical health," and "social implications." Boolean operators such as "AND" and "OR" will be used to combine these terms effectively. To ensure comprehensive coverage, synonyms and related terms will also be included. Planned limits will include publication date ranges to ensure relevance, English language, and peer-reviewed articles. Additionally, specific inclusion criteria will be set to focus on studies that directly investigate the impacts of smartphone addiction. The search strategy will be repeated systematically across all chosen databases to minimize the risk of overlooking relevant studies. Finally, manual searches of reference lists from relevant articles will be conducted to identify any additional sources that may have been missed through the electronic search.

Study Records

To conduct a systematic review on the impacts of smartphone addiction, a comprehensive search strategy will be employed. This strategy will involve thorough data management, including the organization and storage of relevant articles and research records. The selection process will entail screening potential studies based on predetermined inclusion criteria, such as relevance to the topic and methodological rigor. Data collection will involve extracting pertinent information from selected studies, focusing on the impacts of smartphone addiction on exercise habits. Additionally, the strategy will involve synthesizing findings from academic abstracts to identify key factors influencing exercise habits. By implementing this systematic approach, the review aims to provide valuable insights into effective strategies for mitigating the impacts of smartphone addiction.

Data Items

In conducting a systematic review on the impacts of smartphone addiction on exercise habits, several variables and assumptions will be considered. The primary variables of interest, following the PICO framework, include:

1. Population: Individuals with varying levels of smartphone addiction.
2. Intervention/Exposure: Smartphone addiction.
3. Comparison: Different levels of smartphone use or absence of smartphone addiction.
4. Outcome: Impacts on exercise habits, physical activity levels, and related psychological, physical, social, and neurobiological outcomes.

   The review will highlight the importance of addressing smartphone addiction early to mitigate its impacts on exercise habits and overall health. Furthermore, the review will seek to identify best practices in interventions that effectively reduce smartphone addiction and its long-term consequences.

Outcomes and Prioritization

The primary outcome of interest is the impact of smartphone addiction on exercise habits and physical activity levels. Secondary outcomes include psychological, physical, social, and neurobiological consequences of smartphone addiction. These outcomes will be prioritized based on their relevance to public health and their potential for informing effective intervention strategies.

Risk of Bias in Individual Studies

The risk of bias in individual studies is a critical aspect of systematic reviews, particularly in assessing the reliability and validity of research findings. Anticipated methods for evaluating bias will involve thorough scrutiny at both the outcome and study levels. This comprehensive approach ensures a robust analysis by considering biases that may affect specific outcomes as well as those inherent to the study design itself. By meticulously assessing the risk of bias, researchers can discern the credibility of individual studies and their contributions to the overall synthesis of data. This information serves as a crucial tool in synthesizing findings, allowing for a nuanced interpretation of the evidence and ensuring the integrity of conclusions drawn from the systematic review (Higgins & Altman, 2008).

Data Synthesis

The synthesis of data regarding the impacts of smartphone addiction involves several key criteria. Firstly, the study will identify specific criteria under which the gathered data will be quantitatively synthesized. This includes determining the appropriateness of data for quantitative synthesis and outlining planned summary measures, data handling methods, and techniques for combining data from various studies. Research indicates that smartphone addiction significantly influences exercise habits and long-term health outcomes. Various environmental and socio-economic factors play pivotal roles in this regard. Insights from academic abstracts shed light on best practices for interventions aimed at mitigating the impacts of smartphone addiction.

Meta-Bias

The systematic review investigates how smartphone addiction influences exercise habits and related health outcomes. It suggests that these factors play a significant role, with various environmental and socio-economic elements affecting the outcomes. By addressing smartphone addiction, potential long-term health benefits may arise, mitigating the associated health concerns. The study's findings, drawn from academic abstracts, offer valuable insights into optimal intervention practices aimed at reducing the prevalence and impacts of smartphone addiction. Additionally, the review considers potential meta-biases, such as publication bias across studies and selective reporting within studies, to ensure the robustness and validity of its conclusions.

Confidence in Cumulative Evidence

The strength of the body of evidence regarding the impacts of smartphone addiction on exercise habits will be assessed through a systematic review methodology, employing frameworks such as the Grading of Recommendations Assessment, Development, and Evaluation (GRADE). This approach involves evaluating the quality of evidence based on factors like study design, risk of bias, consistency of results, and directness of evidence. By systematically analyzing available research, the confidence in the cumulative evidence can be determined, allowing for informed conclusions regarding the relationship

between smartphone addiction and exercise habits. The systematic review indicates that smartphone addiction significantly influences exercise habits and long-term health outcomes. Various environmental and socio-economic factors play pivotal roles in shaping these outcomes. The findings provide valuable insights into effective strategies for interventions aimed at mitigating the impacts of smartphone addiction, thereby fostering healthier and more active communities.

Results

The results of this systematic review reveal significant and multifaceted impacts of smartphone addiction on various aspects of psychological and physical health. This relationship extends to various demographic groups, including athletes, adolescents, and medical students, highlighting the pervasive nature of the issue. Overall, the compiled evidence underscores the critical need for targeted strategies to mitigate the adverse effects of smartphone addiction on mental and physical health.

Impact of smartphone addiction on psychological health

Across multiple studies, there is a consistent finding that excessive smartphone use correlates with increased levels of depression, anxiety, and stress, particularly among young adults and students.

Impact of smartphone addiction on physical health

Additionally, a negative correlation between smartphone addiction and physical activity is evident, suggesting that higher smartphone use is associated with reduced exercise habits. Furthermore, several studies indicate that smartphone addiction can lead to physical discomfort and impaired physical performance, reinforcing the need for ergonomic interventions and increased awareness.

Table 1. Systematic review results The Impact of Smartphone Addiction on Exercise Patterns

Author(s)	Year	Method	Result	Insight
Jan Stirnberg et al.(Stirnberg et al., 2024)	2024	Qualitative and Quantitative Analysis	Found a relationship between reasons for smartphone use, addictive tendencies, fear of missing out, depression, and life satisfaction.	Highlights the complex interplay between psychological factors and smartphone addiction, impacting life satisfaction and mental health.
Sultan Sahin Koybulan et al.(Sahin Koybulan et al., 2024)	2024	Behavioral Science Study	Identified factors related to smartphone addiction among athletes.	Emphasizes the need for targeted interventions to address smartphone addiction in athletic populations to maintain their physical and mental health.
K. Prafull et al.(Prafull et al., 2024)	2024	Cross-sectional Study	Showed a significant impact of smartphone use on the mental health of medical undergraduates.	Suggests that medical institutions should consider the mental health effects of smartphone use and develop strategies to mitigate its impact.
Doris Mayerhofer et al.(Mayerhofer et al., 2024)	2024	Survey Study	Found an association between problematic smartphone use and mental health issues in Austrian adolescents and young adults.	Indicates the importance of monitoring smartphone use to prevent mental health problems in young populations.
Venkatesh Murthy J et al.(J & Tauro, 2024)	2024	Survey Study	Explored the factors and patterns of smartphone use among adolescents.	Highlights the diverse purposes of smartphone use and its potential implications for addiction and behavioral patterns in adolescents.
Yuanyuan Ke et al. (Ke et al., 2024)	2024	Cross-sectional Study	Found that self-esteem mediates the relationship between physical activity and smartphone addiction in Chinese college students.	Suggests that enhancing self-esteem through physical activity can be an effective strategy to reduce smartphone addiction.
Inwoo Kim et al. (Kim & Ahn, 2023)	2023	Longitudinal Study	Found that exercise time is positively related to subjective happiness, with smartphone dependency mediating this relationship.	Emphasizes the long-term benefits of regular exercise in improving happiness and reducing smartphone dependency.
Melih Zeren et al. (Zeren et al., 2021)	2023	Clinical Study	Investigated the impact of smartphone addiction on maximal exercise capacity in young adults.	Suggests that excessive smartphone use may impair physical performance, necessitating interventions to balance smartphone use and physical activity.
Aleksandra Nikolic et al. (Nikolic et al., 2023)	2023	Survey Study	Showed a correlation between smartphone addiction, poor sleep quality, depression, anxiety, and stress among medical students.	Highlights the need for educational programs to address the mental health issues related to smartphone addiction in medical students.
Soo Young Kim (Kim, 2023)	2023	Survey Study	Examined the relationship between excessive smartphone use and physical activity in adolescents.	Indicates that reducing smartphone use can promote higher levels of physical activity among adolescents.

Robert Wu-Wei Shen et al. (Shen & Rukmini, 2023)	2023	Experimental Study	Assessed the effectiveness of print and social media education in reducing smartphone addiction.	Demonstrates that educational interventions can be effective tools for reducing smartphone addiction.
Semra Topuz et al. (Metin et al., 2023)	2023	Clinical Study	Studied the effects of smartphone use on gait performance, spinal kinematics, and musculoskeletal discomfort.	Suggests that excessive smartphone use can lead to physical discomfort and issues, indicating the need for ergonomic interventions and awareness programs.
Nidhi Barot (Barot & Patel)	2023	Survey Study	Explored the correlation between smartphone addiction and physical activity among college students in Ahmedabad City.	Reinforces the negative correlation between smartphone addiction and physical activity, urging measures to promote balanced lifestyles among students.
Deepak Sharma et al. (Sharma et al., 2023)	2023	Survey Study	Investigated the prevalence of smartphone addiction and its relation with depression among school-going adolescents.	Indicates a high prevalence of smartphone addiction linked with depression, suggesting the need for early interventions in school settings.
Lena-Marie Precht et al. (Precht et al., 2024)	2023	Experimental Study	Evaluated lifestyle interventions to prevent problematic smartphone use and promote mental health.	Supports the implementation of physical activity as an alternative to smartphone use to improve mental health.
Marise Machado de Oliveira et al. (Machado de Oliveira et al., 2023)	2023	Longitudinal Follow-Up Study	Analyzed the impact of smartphone use and digital addiction on mental health, quality of life, motivation, and learning of medical students.	Emphasizes the long-term implications of smartphone addiction on various aspects of students' lives, advocating for sustained preventive measures.
V. P. Sheinov et al. (Sheinov, 2023)	2023	Survey Study	Examined the relationship between smartphone addiction, gender, externality, and failure avoidance.	Highlights the influence of gender and personality traits on smartphone addiction, suggesting targeted intervention strategies.
Rezky Aulia Yusuf et al. (Rezky Aulia Yusuf, 2022)	2022	Literature Review	Reviewed the impact of gadget addiction on physical activity among adolescents.	Emphasizes the need for promoting physical activity to counteract the negative effects of gadget addiction among adolescents.
V. P. Sheinov et al. (Шейнов et al., 2023)	2023	Survey Study	Investigated the relationship between smartphone addiction, self-confidence, emotional intelligence, and behavior in conflicts among Belarusian students.	Highlights the complex interplay between psychological factors and smartphone addiction, suggesting multifaceted intervention approaches.
Zubair Ahmed Ratan et al.(Ratan et al., 2022)	2022	Cross-Sectional Study	Assessed the prevalence of smartphone addiction and its association with sociodemographic, physical, and mental well-being among young adults in Bangladesh.	Indicates the widespread impact of smartphone addiction on various well-being aspects, advocating for targeted public health interventions.
Zitong Zhao et al. (Zhao et al., 2022)	2022	Survey Study	Examined the effects of physical exercise on mobile phone addiction in college students, highlighting the chain mediation effect of psychological resilience and perceived stress.	Suggests that physical exercise can reduce smartphone addiction by improving psychological resilience and reducing perceived stress.

Table 2. Detailed Overview of Selected Research Articles

Theme	Subtheme
Psychological Effects of Smartphone Addiction on Exercise Habits	- Depression, anxiety, and stress among college students due to excessive smartphone use. - Negative correlation between smartphone addiction and physical exercise. - Impact of decreased self-esteem on exercise habits.
Impact of Smartphone Addiction on Physical Health and Exercise Habits	- Reduced physical activity and adverse health consequences (e.g., increased fat mass, decreased muscle mass) among high-risk smartphone users. - Negative correlation between smartphone addiction and physical exercise. - Positive effects of exercise interventions on reducing smartphone addiction.
Social Implications of Smartphone Addiction on Exercise Habits	- Decrease in physical activity levels among sports science undergraduates. - Increase in social motivation and decrease in self-efficacy as barriers to physical activity participation.
Neurobiological Mechanisms Underlying the Relationship Between Smartphone Addiction and Exercise Habits	- Prevention of smartphone addiction through moderate and vigorous physical activity. - Reduction of smartphone addiction by increasing sports participation and physical activity among adolescents and youth. - Indirect reduction of smartphone addiction through improved self-esteem from physical exercise.

Impact of smartphone addiction on Exercise Pattern

In conclusion, the psychological effects of smartphone addiction on exercise habits are evident, with research highlighting the negative impact on mental health and the potential link between smartphone addiction and reduced physical activity. Additionally, smartphone addiction has implications for physical health, social motivation, and self-efficacy, which can influence exercise habits. The neurobiological mechanisms underlying the relationship between smartphone addiction and exercise habits are complex, involving factors such as self-esteem and the frequency and intensity of physical activity. However, it's important to note that while there is evidence of a relationship between

smartphone addiction and exercise habits, further research is needed to fully understand the underlying mechanisms.

Discussion

The primary objective of this research is to examine the multifaceted impacts of smartphone addiction on exercise habits, encompassing psychological, physical, social, and neurobiological dimensions. By exploring these aspects, the study aims to provide a comprehensive understanding of how excessive smartphone use influences physical activity levels and overall well-being among different populations, particularly college students and adolescents. Through a systematic literature review (SLR), the research seeks to synthesize existing evidence and identify key factors that contribute to the interplay between smartphone addiction and exercise habits, ultimately offering insights for developing effective interventions to mitigate these negative effects.

Additionally, smartphone addiction is negatively correlated with physical exercise, suggesting a potential reduction in exercise habits (Sarhan, 2024). Research also indicates that smartphone addiction is associated with decreased self-esteem, further affecting exercise habits. Previous theories have suggested that excessive use of technology, particularly smartphones, can disrupt sleep patterns and physical activity, contributing to mental health issues (Larsen et al., 2023). Prior research also found that decreased self-esteem is often accompanied by a reduction in physical activity, negatively impacting overall health. The author believes that raising awareness about the negative impacts of smartphone use on mental health and exercise habits is crucial (Peng et al., 2023). Effective interventions, such as educational programs and psychological support, should be implemented to help mitigate these effects and promote healthier lifestyles among students.

Research suggests that high-risk smartphone users engage in less physical activity, such as walking, leading to adverse health consequences like increased fat mass and decreased muscle mass. Additionally, smartphone addiction is negatively correlated with physical exercise among college students (İnal & Serel Arslan, 2021). A systematic review and meta-analysis revealed that exercise interventions have positive effects on reducing smartphone addiction levels, with longer intervention durations producing greater effects (Qiu et al., 2022). Earlier studies have shown that sedentary behavior, often associated with high smartphone use, leads to poor physical health outcomes (He et al., 2022).

Theories have also posited that regular physical exercise can improve physical health and counteract the negative effects of sedentary lifestyles. The author emphasizes the importance of incorporating physical activity into daily routines to counterbalance the negative effects of smartphone addiction (Hasan et al., 2023). Institutions should encourage exercise interventions as part of their health programs, as these not only reduce smartphone addiction but also enhance overall physical health.

Smartphone addiction is associated with a decrease in physical activity levels among sports science undergraduates, highlighting the potential social implications of smartphone addiction on exercise habits. Additionally, a study found that smartphone addiction leads to an increase in social motivation and a decrease in self-efficacy, potentially acting as a barrier to personal participation in physical activities (Chopdar et al., 2022). Previous research has indicated that social factors, such as peer influence and social engagement, play a significant role in determining physical activity levels (Li et al., 2020).

Theories have also suggested that self-efficacy is a critical determinant of one's ability to engage in and maintain regular physical activity (Daei et al., 2019). The author suggests that addressing the social implications of smartphone addiction is essential for promoting healthier exercise habits (Feng et al., 2023). Strategies such as group exercise programs and social support networks can help enhance self-efficacy and reduce the negative social impacts of smartphone addiction.

A study on Korean adolescents revealed that participation in moderate physical activity for more than five days a week, vigorous physical activity for more than three days a week, or strength exercise for more than three days a week was effective in preventing smartphone addiction (Li et al., 2023). Additionally, a review of literature concluded that increasing sports participation and involvement in

physical activity/exercise among adolescents and youth can reduce smartphone addiction. Another study on college students found that physical exercise could indirectly reduce smartphone addiction by improving self-esteem (Liu et al., 2023).

Earlier theories have suggested that physical activity influences neurobiological mechanisms associated with addiction (Schmitgen et al., 2020). Research has shown that regular physical exercise can improve mental health and cognitive function, which may help mitigate addictive behaviors (Healthcare Engineering, 2023). The author believes that understanding the neurobiological mechanisms linking physical exercise and smartphone addiction can provide valuable insights for developing effective interventions (Kim & Lee, 2022). Promoting regular physical activity, especially among adolescents and youth, can play a crucial role in preventing and reducing smartphone addiction while also enhancing mental health and self-esteem.

Despite the comprehensive approach of this study, several limitations must be acknowledged. Firstly, the reliance on self-reported data in many of the reviewed studies may introduce biases and inaccuracies, as participants may underreport or overreport their smartphone usage and exercise habits. Secondly, the cross-sectional design of most studies limits the ability to establish causality between smartphone addiction and exercise habits. Thirdly, there is a lack of longitudinal studies that could provide insights into the long-term effects of smartphone addiction on physical activity levels. Additionally, the heterogeneity of the study populations and varying definitions of smartphone addiction and exercise habits across different studies pose challenges in generalizing the findings. Finally, language and publication biases may exist, as the review primarily includes studies published in English and accessible through selected databases. Addressing these limitations in future research would enhance the robustness and applicability of the findings.

Conclusions

The primary objective of this research was to examine the relationship between smartphone addiction and exercise habits, encompassing psychological, physical, social, and neurobiological dimensions. The findings indicate that excessive smartphone use is significantly correlated with increased levels of depression, anxiety, and stress, which negatively impact mental health and self-esteem. Additionally, a negative correlation between smartphone addiction and physical activity was consistently observed, suggesting that higher smartphone use is associated with reduced exercise habits.

These findings have important implications for public health and education, highlighting the need for targeted interventions to mitigate the adverse effects of smartphone addiction. Such interventions could include educational programs to raise awareness about the risks of excessive smartphone use, strategies to enhance self-esteem and mental resilience, and initiatives to promote physical activity. Moreover, ergonomic interventions and support systems could be developed to address the physical discomfort and impaired performance associated with prolonged smartphone use. Future research should focus on longitudinal studies to better understand the causal relationships and long-term effects of smartphone addiction on exercise habits. Additionally, exploring the role of technological advancements, such as digital wellbeing apps and wearable devices, in managing and reducing smartphone addiction could provide valuable insights for developing comprehensive intervention strategies.

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