

INFORMATION STRATEGIES FOR ENHANCING THE EFFECTIVENESS OF PHYSICAL ACTIVITY IN THE MANAGEMENT OF DEPRESSIVE SYMPTOMS

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Abstract: Depression represents one of the leading causes of disability worldwide and significantly impacts the quality of life, productivity, and overall health of individuals. Scientific literature indicates a growing body of evidence supporting the effectiveness of physical activity in reducing depressive symptoms through a variety of neurobiological, psychological, and behavioral mechanisms. The recent advances in digital health technologies and medical information systems provide new opportunities to enhance the effectiveness of exercise therapy in managing depressive symptoms. Specifically, information strategies can significantly enhance the effectiveness of exercise therapy in managing depressive symptoms. The present paper gives an analytical overview of scientific works concerning the use of information approaches and digital health technologies to improve the efficacy of exercise therapy applied to patients with depression, paying special attention to adherence, personalization, and effectiveness of intervention. As long as information strategies are used responsibly and ethically, digital health technologies could enhance the efficacy of exercise-based interventions and improve mental health outcomes for individuals.

Keywords: depression; physical activity; digital health; health information systems; wearable technologies

INTRODUCTION

It has been estimated by the World Health Organization that more than 280 million individuals worldwide suffer from depressive disorders, making it one of the most common mental health conditions. Depression not only results in emotional distress but also increases the risk of acquiring other chronic conditions, impairs cognitive abilities, social isolation, and affects work performance (Liu et al., 2024).

The usual treatment modalities for depression have been pharmacotherapy and psychotherapy. Antidepressant drugs and psychological interventions like cognitive behavioral therapy have been found to be effective in managing depression in a significant number of patients (Cuijpers et al., 2021). However, these treatment modalities have not been effective in all patients with depression. While in a few patients, only partial relief from symptoms has been observed, in others, the treatment has been stopped due to adverse effects or due to lack of access to mental health services. In recent times, complementary and lifestyle-based interventions have been in the spotlight for managing depression. Physical activity has been found to be the most promising intervention in managing depression (Merlo et al., 2026).

There is a growing body of clinical studies that support the efficacy of physical activity interventions in reducing depressive symptoms among various populations (Yang et al., 2025). Exercise interventions have been associated with improved

mood states, cognitive functioning, and overall psychological well-being (Pujari, 2024). However, one of the biggest challenges that individuals with depression experience is maintaining regular adherence to physical activity interventions. These depressive symptoms make it difficult for patients to adhere to regular physical activity interventions (Duina et al., 2025). Therefore, there is a need to develop innovative solutions that can support patients in maintaining regular adherence to physical activity interventions (Cody et al., 2022). In this context, information technologies and information-based intervention strategies can help in improving the efficacy of physical activity interventions. Advances in information technologies and information systems can help monitor various behavioral and physiological parameters. These information systems can help healthcare providers monitor patients' physical activity levels and develop appropriate intervention strategies (Popescu et al., 2022).

Past literature has already confirmed the efficiency of engaging in physical exercises as an alternative treatment strategy to reduce depression symptoms. At the same time, there is increasing evidence that demonstrates the importance of using digital health technologies, such as mobile applications, wearables and health care systems, to enhance mental well-being services. The problem is that both topics were explored independently from each other. Although there is a vast amount of literature that confirms the antidepressant benefits of exercising and the use of information technology, there is a notable lack of information-on-information strategies that combine the above-mentioned concepts. Thus, the current gap in literature refers to the development of a theoretical foundation for integrating digital technologies with physical activities in the treatment and management of depression.

The purpose of this study is to analyze how information technologies can help improve the efficacy of physical activity interventions in reducing depressive symptoms. By reviewing existing literature on information technologies and physical activity interventions, this study aims to identify the potential mechanisms that can help improve the efficacy of physical activity interventions.

RESEARCH METHODOLOGY

This paper utilizes the structured literature review approach to investigate the contribution of information-based strategies to the efficacy of physical activity-based interventions aimed at improving depressive symptoms. The relevant scientific literature was found through online searching in major scientific databases, including PubMed, Scopus, Web of Science, and Google Scholar. These databases are considered to be some of the most comprehensive sources of literature in these areas.

The search strategy involved the use of keywords such as “depression”, “depressive symptoms”, “physical activity”, “exercise”, “digital health”, “wearable technology”, “health information systems”, and “behavioral monitoring”. Literature published during the period from 2015 to 2025 was selected as the search covered recent trends in digital health applications.

Once the articles were selected, their content was evaluated to reveal patterns in scientific research and uncover evidence of the contribution of information to depression treatment via exercise therapy. The selection of the relevant literature was performed through a three-phase process (Fig. 1).

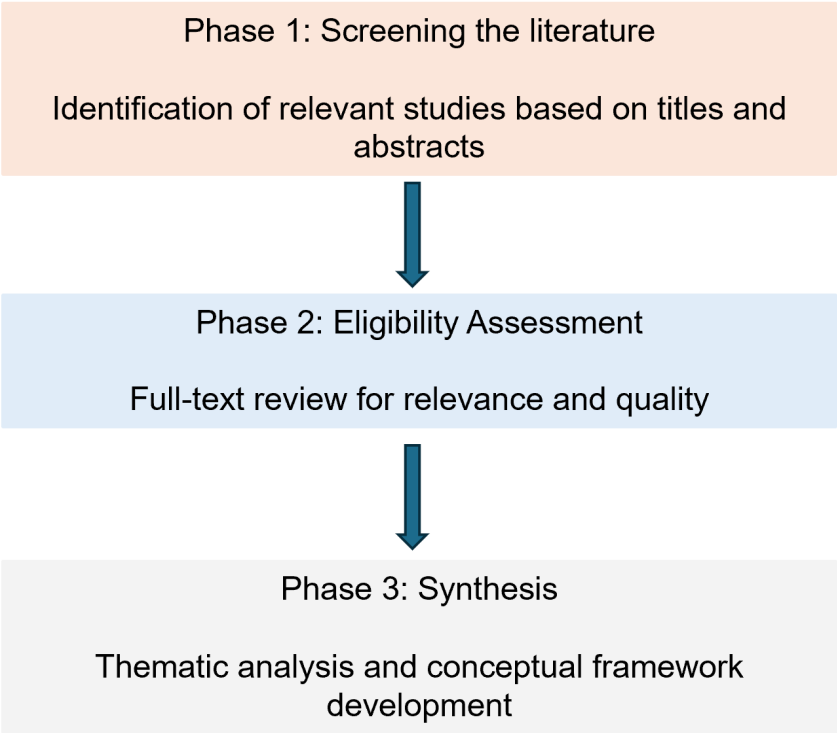


Fig. 1. Three-phase process of selection of the relevant literature

RESULTS

Overview of the benefits of physical exercise on depressive symptoms

The literature has consistently demonstrated that physical activity is associated with significant improvements in symptoms of depression. Exercise has been found to influence various biological pathways, which are closely associated with the pathophysiology of depression (Gujral et al., 2017). The exercise effect on one of these pathways has been examined in considerable depth. The pathway is centered on the regulation of brain-derived neurotrophic factor (BDNF), which is an essential factor in various functions such as neuroplasticity, neuronal survival, and cognitive functioning (Romero Garavito et al., 2024). Lower levels of BDNF have been observed in individuals with major depressive disorder. Physical exercise has been demonstrated to enhance BDNF levels, which in turn is likely to improve neural functioning and consequently mood and cognitive performance (Romero Garavito et al., 2024).

Exercise has also been demonstrated to influence other pathways such as neurotransmitter functioning, which is essential in mood regulation. Physical exercise has been found to release neurotransmitters such as serotonin, dopamine and endorphin, which are associated with positive mood states (Alizadeh Pahlavani, 2024). In addition, exercise has also been demonstrated to influence pathways such as inflammation, which is increasingly being recognized as an essential factor in depression. Physical exercise has been demonstrated to decrease pro-inflammatory cytokines and modulate stress hormones such as cortisol (Carrera-Bastos et al., 2025). These pathways suggest that exercise has the potential to influence various physiological pathways, which are essential in the development and maintenance of depression. Apart from physiological effects, exercise interventions have also been found to have significant psychological and behavioral effects, which can contribute to mental health recovery (Sharma et al., 2006). Exercise interventions can improve sleep quality. Improving sleep patterns can contribute to improvements in emotional and cognitive functioning (Bojarska et al., 2024). Exercise interventions in groups can improve social interactions, thus reducing feelings of social isolation. Social support is an essential factor in recovery from mental illness and can improve behavioral changes.

Despite all these positive effects, it is often found that it is difficult for individuals with depression to adhere to exercise interventions (Mahmood et al., 2023). Adherence is an essential factor in improving the effectiveness of exercise interventions. Digital health technologies offer innovative tools for behavioral interventions that encourage individuals suffering from depression to be physically active (Philippe et al., 2022).

Wearable technologies offer a range of benefits, including objective monitoring of physical activity, which allows both individuals suffering from depression and healthcare practitioners to monitor adherence to exercise regimens in real-time (Jafleh et al., 2024). Mobile health technologies offer a range of benefits, including exercise recommendations, monitoring of mood swings, and motivation for individuals suffering from depression to be physically active (Leong et al., 2022). These technologies can encourage individuals to be physically active by offering motivation for exercise, goal-setting, and tracking of activity (Fig. 2).

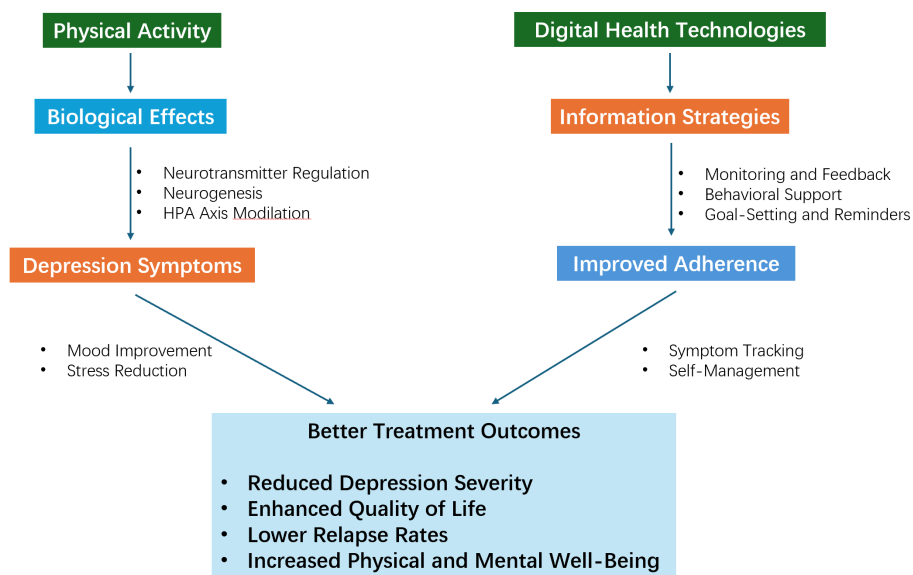


Fig. 2. Digital Health-Exercise-Depression Framework

Information Strategies for Improving Exercise Adherence

Information strategies are considered critical in promoting the effectiveness of exercise interventions aimed at addressing depression. Information strategies are defined as a set of organized approaches that are used to collect and analyze information and apply this information to improve health. Digital monitoring systems can be used to monitor patient behavior continuously. Once a decline in physical activity is detected, a message can be sent to motivate the patient. Personalization is another critical information-based intervention strategy that can be used to improve patient engagement and compliance (Chen et al., 2016). Digital systems can be used to collect information and provide personalized feedback that is unique to each patient's behavioral patterns. Some digital systems can be used to provide gamification elements that can be used to improve patient engagement and increase their willingness to participate in physical exercises.

Integration with Health Information Systems

The incorporation of information related to physical exercises within a general framework of health information systems is an important step in the field of digital health care. Electronic health records enable healthcare providers to access clinical information, behavioral information, and lifestyle information within a single electronic platform (Evans, 2016). This facilitates a more holistic understanding of a patient's health status and can facilitate more individualized treatment planning (Jandaghian-Bidgoli et al., 2025).

Psychiatrists, psychologists, physiotherapists, and general physicians can work together using information sharing systems to coordinate patient care and monitor treatment outcomes (Fleury et al., 2012).

The information sharing systems can facilitate the creation of decision support tools that help healthcare providers identify appropriate candidates for physical interventions and assess the outcomes of such interventions.

Digital Phenotyping and Behavioral Data Analysis

Another area in digital health research is the concept of digital phenotyping. The concept is based on the idea of continuous measurement of behavioral and physiological data through personal digital devices (Oudin et al., 2023). These include smartphones and other connected health technologies. They can be used to passively gather information regarding physical activities, sleep patterns, mobility, and social interactions (Sheikh et al., 2021).

Regarding depression management, digital phenotyping is an essential tool for understanding behavioral patterns in mental health conditions. Changes in physical activities, such as reduced mobility and sleep patterns, can be an early warning system for depression. By understanding these behavioral patterns, it is possible to develop an early warning system for mental health deterioration. For example, wearable technology can be used to monitor step count, heart rate, and physical activity intensity. These can be used to develop large data sets regarding daily behavioral patterns (Huhn et al., 2022). These data can be analyzed to understand correlations between exercise engagement and mood swings.

Digital phenotyping can be used to look beyond self-reporting methods, which are often biased and based on interpretation. The objective nature of behavioral data can be used to develop an accurate understanding of physical activities and exercise engagement (Yoon et al., 2018).

Using digital phenotyping in exercise-based depression interventions can be an effective tool for improving depression management (Price et al., 2023). The objective nature of behavioral data can be used to develop effective intervention strategies for depression. The data can be used by healthcare professionals to develop effective intervention strategies for improving exercise engagement in patients.

DISCUSSION

The incorporation of digital health technologies in exercise-based interventions for depression offers tremendous opportunities to enhance treatment outcomes. However, this transformation also brings about various challenges that need to be addressed to ensure that information-based health strategies are implemented effectively.

One of the major challenges associated with this transformation is that there is a possibility that such a shift could result in overdependence on digital health technologies. Although digital monitoring systems, wearable devices, and mobile health technologies can offer tremendous benefits in terms of providing information on individual behaviors and enabling individuals to make better health-related decisions, they cannot replace the role of healthcare professionals. This is because only a healthcare professional can interpret various behaviors and emotions of an individual. Therefore, it is important that such information is used in conjunction with digital health technologies. The other major challenge associated with this transformation is that such a shift

could result in overdependence on digital infrastructures and technological platforms. Healthcare providers that heavily depend on proprietary digital health systems could find it difficult to cope with changing market dynamics. Therefore, it is essential that information is made available to healthcare providers about the importance of maintaining transparency in terms of data management.

Ethical issues also appear to be playing an increasingly important role in this regard. In fact, information strategies often involve the collection and analysis of sensitive information. Even though such information can be very useful in understanding the behavior and mental health status of patients, it is also important to ensure that ethical issues regarding privacy, data protection, and informed consent are addressed through appropriate regulations and ethical guidelines. In fact, appropriate regulations and ethical guidelines need to be put in place to ensure that information strategies in healthcare settings are implemented in an ethical fashion and patient privacy is completely protected.

Thus, it is very clear that addressing these issues requires collaborative efforts from multiple stakeholders. Collaborative efforts from multiple stakeholders are very important in designing information strategies in healthcare settings. In fact, it is clear that information strategies in mental healthcare settings will be playing an increasingly important role in the future. Information strategies in mental healthcare settings might be able to monitor patients' behavior in a very precise fashion. In addition, inter-disciplinary collaboration is likely to be more significant in developing digital mental health interventions. There will be a need for mental health professionals, exercise scientists, physiotherapists, data scientists, and information technology experts to collaborate in developing integrated care models that bring together behavioral interventions and digital monitoring systems. In this changing healthcare environment, healthcare professionals will be required to act as a bridge linking complex digital technologies and end-users. They will be required to interpret digital health data, translate technological insights into actionable advice, and facilitate end-users in effectively harnessing digital technologies for self-management.

In conclusion, the incorporation of information strategies in exercise-based interventions is a significant move toward more personalized, data-driven, and preventative models of mental health care. If information strategies are used responsibly and ethically, digital health technologies hold promise for enhancing the efficacy of exercise-based interventions and improving mental health outcomes for individuals suffering from depression.

CONCLUSION

This paper attempts to fill the research gap through an examination of the use of information-based techniques and exercise interventions in order to alleviate depression. The literature review has shown that physical activity is a significant intervention that can be used in combination *with traditional interventions* to treat depression. Exercise has a potential influence on a number of biological, psychological, and behavioral factors that can improve mental health outcomes. One of the main challenges that people suffering

from depression face is how to maintain long-term adherence to exercise intervention. Information technologies offer a potential solution for addressing this challenge.

In the light of this contribution, the article can help advance information processes in the field of mental health by bringing together information about physical activity interventions and digital health technologies, as well as introducing a framework for improved adherence and behavioral tracking. Digital monitoring systems, wearable technologies, and personalized feedback mechanisms offer a potential for more adaptive intervention strategies. These technologies may offer potential benefits in terms of patient engagement and long-term adherence to physical activity intervention. The combination of physical activity intervention and digital health information technologies is a significant move towards more personalized and technology-based mental health care. Future research should be conducted to assess the long-term effectiveness of this intervention strategy and how information technologies can be further used in a comprehensive mental health care model.

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ИНФОРМАЦИОННИ СТРАТЕГИИ ЗА ПОВИШАВАНЕ НА ЕФЕКТИВНОСТТА НА ФИЗИЧЕСКАТА АКТИВНОСТ ПРИ ЛЕЧЕНИЕТО НА ДЕПРЕСИВНИ СИМПТОМИ

Резюме: Депресията е една от основните причини за функционални увреждания в световен мащаб и оказва значително влияние върху качеството на живот, производителността и общото здраве на хората. Научната литература сочи все по-голям брой доказателства в подкрепа на ефективността на физическата активност при намаляване на депресивните симптоми чрез различни невробιολογични, психологически и поведенчески механизми. Последните постижения в областта на цифровите здравни технологии и медицинските информационни системи предоставят нови възможности за повишаване на ефективността на двигателната терапия при управлението на депресивните симптоми. По-конкретно, информационните стратегии могат значително да повишат ефективността на упражненията при лечението на депресивни симптоми. Настоящата статия представя аналитичен преглед на научни трудове, свързани с използването на информационни подходи и цифрови здравни технологии за подобряване на ефективността на упражненията, прилагани при пациенти с депресия, като обръща специално внимание на спазването на режима, персонализацията и ефективността на интервенцията. Стига информационните стратегии да се използват отговорно и етично, цифровите здравни технологии биха могли да повишат ефективността на интервенциите, базирани на упражнения, и да подобрят резултатите за психичното здраве на хората.

Ключови думи: депресия; физическа активност; цифрово здравеопазване; информационни системи в здравеопазването; носими (аксесоарни) технологии

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