REVIEW

CYPRUS
JOURNAL OF MEDICAL SCIENCES

**DOI:** 10.4274/cjms.2025.2024-60
Cyprus J Med Sci 2025;10(2):111-115

# Wearable Technologies and Psychiatry: Strengths, Weaknesses, Opportunities, and Threats Analysis

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## Abstract

As in every other field, technology has an impact on healthcare. As part of technological advancements, wearable technology can guide in identifying illnesses, clarifying diagnoses, and recognizing disease-related hazards early. Considering the advances in wearable technologies impact the mental health field, as they do in all other fields, it is important to assess their implications. Studies in this field and their results will be discussed, and current shortcomings and developments will be revealed. Considering disability, economic burden, and care burden, wearable technology for mental illness is also promising. Although it is generally in the pilot study phase, wearable technology will likely be encountered more frequently in the diagnosis, treatment, and follow-up of mental illnesses with the increase of prospective randomized controlled studies in the near future. The collection of simultaneous and objective data in patients will also benefit evidence-based mental care. Nevertheless, it is imperative to address the matter of patients' privacy and ethical concerns associated with the utilization of wearable technology, given its potential to gather extensive and prolonged data without being driven by specific hypotheses.

**Keywords:** Wearable technologies, psychiatry, psychiatric care

## INTRODUCTION

The World Health Organization has encouraged the integration of assistive technology into health reform initiatives.[1] Today, digital health tools and technology have emerged as promising advancements that substantially assist in identifying disorders and clarifying diagnoses.[2] Technology has played a key role in providing health services, particularly in domains such as mobile health, monitoring, data collection, warning systems, and record-keeping. Mobile health, previously referred to as wireless e-medicine, now encompasses the utilization of mobile or wireless communication devices in the context of health and healthcare services.[3-6] The wearable devices were first designed by Thorp Edward[7] and implemented with contributions from Claude Shannon. In recent times, the utilization of wearable technology in mobile health services has enabled the monitoring of various health issues and has presented novel solutions in both the scientific and industrial fields.[8-10] Wearable devices enable monitoring, recording, and transmitting physiological signals in non-hospital settings.[11] This review comprehensively examines the strengths, weaknesses, opportunities, and threats associated with wearable technology, a rapidly emerging phenomenon in the healthcare domain. Furthermore, it investigates specific instances of wearable technologies within the field of psychiatry. The aim of this review is not to emphasize statistical results but to focus on the advantages and the disadvantages.

### Wearable Technology

Wearable technologies encompass electronic devices that are designed to be conveniently worn on the human body or effortlessly integrated into clothing.[12,13] Wearable technologies that can be attached to or

**To cite this article:** Şahin Tokatlıoğlu T, Oflaz F, Semiz B. Wearable technologies and psychiatry: strengths, weaknesses, opportunities, and threats analysis. Cyprus J Med Sci. 2025;10(2):111-115

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**Received:** 09.07.2024
**Accepted:** 24.01.2025
**Epub:** 15.04.2025
**Publication Date:** 18.04.2025

integrated with the human skin enable the continuous and unobtrusive monitoring of humans; hence, minimizing disruptions to their everyday routines.[14] Wearable devices include smart gloves, smart watches, patched or patch-like systems, head-worn devices, and eyeglasses. The use of wearable technology enables the concurrent and optimally effective surveillance of patients' physiological parameters, which is a widely sought-after scenario in the healthcare field.[15,16] Wearable devices encompass primary functionalities, including user interface, communication, data management, energy management, and integrated circuits.[17] These devices are equipped with microprocessors and have been designed to transmit and receive data through the Internet.[18] Wearable technologies, characterized by the integration of microchips and sensors, are experiencing tremendous growth and are poised to exert even more significant influence in the future.[19] With the help of these devices, results such as biological feedback, psychological state assessment, and perception, which are not available on mobile phones and computers can be obtained.[20] Interest in this field has increased due to the monitoring, recording, and transmission of physiological signals.

## Wearable Technology and Strengths, Weaknesses, Opportunities, and Threats Analysis

### Strengths (Opportunities and Strengths) of Wearable Technology

Wearable technology devices enable data collection in the natural environment of patients.[21] Since these measurements are taken instantaneously and objectively from individuals, they may provide a better source of data than cross-sectional data collected by notification in a clinical setting. It can also be used to monitor treatment results.[22] In wearable technology, the data flow is continuous, and data can be collected automatically without the participant having to do anything. This prevents professionals from constantly asking patients for feedback and saves patients from answering questions. These questions continuously asked to the patients may create the risk of that reminding them of the symptoms of the disease, which may lead to changes in behavior and data.[23,24]

### Potential Problems (Weaknesses and Threats) Related to Wearable Technology

In a scoping review on wearable technologies and their reflections on the field of health, it was reported that, in the examined studies, the focus was on the positive aspects of wearable technology, generally omitting negative ones.[25] However, despite the advances in wearable technology that have been and will be reflected in the clinical field, there are also a few concerns. One of these concerns is the possibility of collecting vast longitudinal data from individuals without a hypothesis basis for analysis. Big data entails difficult analyses. Physiological signals exhibit high inter-subject and intra-subject variability, challenging the development of generalizable models. Additionally, motion artifacts and other interference sources might dominate the clinically important information embedded in the signals. That is why well-designed pre-processing frameworks are crucial for cleaner signals and accurate models. In addition, some technological accidents may be encountered during the data collection phase. Power outages or battery failure may cause data loss.[22]

Analyses of big data are possible with the support or cooperation of fields such as engineering or mathematics. This situation brings risks related to data security and patient privacy. For wearable technology studies to be acceptable to patients, they must be conducted openly and protected.[22] The United Kingdom's Department of Health and Social Care has published guidelines summarising and targeting key principles for safe and effective digital innovations. The Medicines and Healthcare Products Regulatory Agency has also published guidance for determining whether software and healthcare applications are medical devices.[26]

Patient participation and the sustainability of the studies are also important. In a study conducted on clinically hospitalized adolescents at risk of suicide, patients reported that the most enjoyable part was participating, especially since it could help people with similar problems in the future;[27] however, more studies are needed to generalize this result.[28,29] It is important for progress in this area to articulate how wearable devices are being adopted by users and how barriers to their widespread use are being addressed.[30]

## Wearable Technology and Mental Health

Mental illnesses are among the major causes of social and global disability.[31] Serious mental illnesses affect many individuals worldwide, and disorders such as depression and anxiety lead to reduced productivity and economic losses.[32] According to the global burden of disease reports, five of the twenty diseases in the burden of disease ranking are related to mental health issues.[33]

Utilizing technological advancements in psychiatry is an essential issue, considering the disease and financial burdens. Recently, measurement-based care has been emphasized and recommended as a basis for improving the quality of mental health services.[34,35] Wearable technology can improve patient outcomes through safely and objectively assessing patients with psychiatric disorders.[36] The use of digital tools in the field of psychiatry also benefits the dissemination of evidence-based practices. Evidence-based psychiatric care is not available in many parts of many developing and some developed countries. Inter-institutional reports related to the treatment compliance of patients with severe mental illness indicate that evidence-based treatment and care are applied in only 2% of cases.[37,38] In this context, the utilization of wearable technology can provide valuable objective data and measurements that can significantly contribute to the field in terms of patient follow-up and therapy.

Robinson et al.[39] analyzed 12 articles in a systematic review of wearable technologies used in mental illnesses. It was determined that bioparameters such as electrodermal activity/galvanic skin resistance/skin conductance/skin temperature, physical activity, and heart rate (HR) were mostly evaluated with wearable technology, considering the results of the reviewed articles. Information on the monitoring of physiological parameters is provided in Figure 1.

Wearable technologies can also enable early recognition of risks of self-harm or harm to other persons by monitoring physiological or potential acute behavioral changes. One of these parameters is early recognition of the risk of self-harm through sleep monitoring. For example, sleep data can be assessed as a potential predictive factor for the risk of self-harm and used in preventative measures.[40] Studies have shown that too much or too little sleep can trigger, accelerate, and perpetuate depression.[41] A study conducted with sensor-based sleep durations reported that sleep duration was effective in predicting suicidal ideation the next day, and this effect was similar to subjective sleep data.[42] In another study conducted on undergraduate and graduate students, the

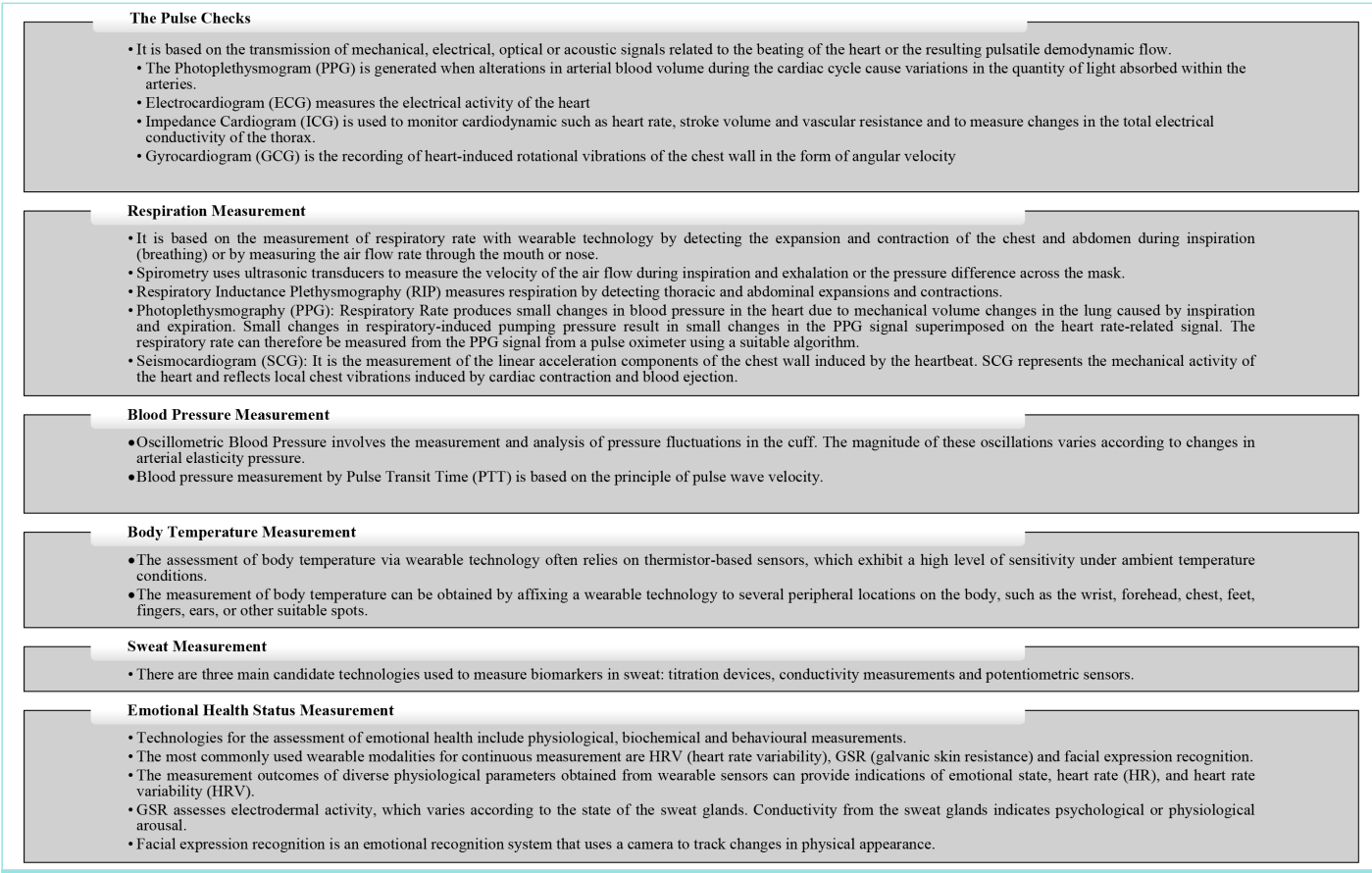


**Figure 1.** Describes several physiological signals that can be used in wearable technology device.

usefulness of wearable devices in predicting the severity of depression symptoms was examined. As a result of the study, it was reported that fluctuations in sleep efficiency can be measured with wearable devices, which may be associated with depression severity.[43]

HR may be another method used to predict self-harm behavior. In a study of patients at risk of self-harm in an acute adolescent psychiatric clinic, Sheridan et al.[44] assessed patients' HRs for seven days with wearable technology devices, and self-harm risk with Columbia Suicide Severity Scores. An inverse correlation was found between the parasympathetic values measured in the study results and the risk of self-harm. The HR variable measured by wearable technology devices decreased in patients diagnosed with depression at the same time without an accompanying cardiovascular disease.[45-47] Depression was inversely associated with physical activity measured from patients.[48,49] A wearable device implanted in the skin may have acted as a biomarker for depression.[50,51] HR is also one of the most effective methods for detecting and monitoring stress and anxiety in individuals.[52]

According to the results of a study conducted with medical students, mobile mood monitoring with the help of wearable sensors was effective in predicting students' depression.[53] Changes in sleep patterns and physical activities assessed by wearable technology may give clues about depression and anxiety disorders.[24] In some mental disorders, there is a more pronounced sympathetic nervous system activation. This is similar to the fight or flight response to physical danger or mental stress. This change can also be assessed with wearable technology, and used in the diagnostic phase of mental illnesses.[24]

Real-time physiological parameters obtained through wearable technology can be used to improve traditional mental health interventions such as therapy or medication It can also be used to guide the selection of the most appropriate treatment.[54,55] These parameters involve using objective data in diagnosis and treatment selection. For example, Collier et al.[56] reported that the motion measurement technology used in the study helps clinicians with early diagnosis by assessing gait, balance, and postural kinematics. Objective and systematic data are important for developing and supporting evidence-based psychiatric practice in diagnosis and care provision. Wearable technology devices may also be useful in supporting interventions to improve cardiometabolic health in patients with schizophrenia. It is also reported that wearable devices support patient weight loss, and may be effective in improving lifestyle.[57]

In addition to all these positive developments, Haines-Delmont et al.[58] used machine learning to analyze sensor and mobile data to assess the suicidal thoughts of patients discharged from a psychiatric hospital in the first week. The study results were reported as poor in terms of overall predictive accuracy.

## CONCLUSION

Considering the historical problems in mental health services and the burden of disability, economic challenges, and care needs in mental illnesses, wearable technologies may promise hope for the development of mental health services. Simultaneous and objective monitoring of symptoms can contribute to evidence-based psychiatric care and positively affect patient care. However, most wearable technologies are still in the prototype stage. In a review of wearable technology in child and adolescent psychiatry, most of the studies are pilot studies, and randomized controlled studies are needed. The population in which wearable technology is applied, the generalizability of patient results, and patient feedback while using these devices will contribute to the shaping of these studies. Issues such as acceptance of the applied population, safety, ethics, privacy, and big data concerns in wearable technology need to be addressed to improve the availability and functionality of these devices for practical use.

### Relevance Statement

Wearable technology provides us with objective data for monitoring and controlling existing risks. These objective data can help psychiatric nurses to make clinical decisions. It can help them recognize potential risks earlier and shape their care accordingly.

## MAIN POINTS

- Considering the advancements of wearable technologies impact the mental health field, as they do in all other fields.
- Studies in this field and their results will be discussed, and current shortcomings and developments will be revealed.
- Wearable technologies in psychiatry will be evaluated through a strengths, weaknesses, opportunities, and threats (SWOT) analysis, highlighting their practice potential and ethical concerns. Wearable technologies in psychiatry will be evaluated through a SWOT analysis, highlighting their practice potential and ethical concerns.

### Footnotes

### Authorship Contributions

Concept: F.O., T.Ş.T., B.S., Design: F.O., T.Ş.T., B.S., Data Collection or Processing: F.O., T.Ş.T., B.S., Analysis and/or Interpretation: F.O., T.Ş.T., B.S., Literature Search: F.O., T.Ş.T., B.S., Writing: F.O., T.Ş.T., B.S.

## DISCLOSURES

**Conflict of Interest:** No conflict of interest was declared by the authors.

**Financial Disclosure:** The authors declared that this study had received no financial support.

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