



Effectiveness of the Apple Watch as a mental health tracker

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In recent times, the prevalence of mental health conditions such as anxiety, depression, and posttraumatic stress disorder (PTSD) has been increasing drastically, consequently increasing suicide rates, loss in economic productivity, and substance abuse worldwide [1]. This significant rise in mental health disturbances may be attributed to deteriorating health conditions and the emergence of viral outbreaks such as the coronavirus disease 2019 (COVID-19) pandemic and the monkeypox epidemic. These aforementioned environmental conditions have had a substantial negative influence on people's mental health and daily activities. Consequently, there has been an increased demand for mental health services and a growing interest in methods to assist individuals in managing their mental well-being, including through the use of wearable technology such as smartwatches [2]. While smartwatches cannot directly quantify mental health, studies have shown that smart devices such as the Apple Watch are reliable in monitoring certain physiological indicators that can, in turn, provide indirect insights into mental health [3].

The utilisation of the Apple Watch for mental health monitoring has notably increased.

Mental health has many aspects, but mainly refers to an individual's emotional, psychological, and social well-being [4]. These factors of mental health can be assessed via the monitoring of certain physical health indicators such as heart rate (HR), respiratory rate, and sleep duration. Recently, research has been conducted to examine the potential use of the Apple Watch for monitoring mental health. Lui et al. [5] effectively determined its effectiveness as a proficient wearable device for measuring overall health and well-being by monitoring various physiological markers. These physiological markers included heart rate variability (HRV), HR, energy expenditure (EE), and sleep cycle. According to the Diagnostic and Statistical Manual of Mental Disorders (DSM) criteria, variations in sleep cycle are strongly indicative of depressive disorders. Thus, accurate monitoring of people's sleep cycles may help specialists identify these disorders without delay [6]. Lui et al. [5] also assessed the surveillance of HRV, which indicates significant changes in physical and emotional states. However, they found that some physical factors determined using the Apple Watch, such as EE and activity expenditure, are overestimated and thus cannot be considered reliable for follow-up. Similarly, Falter et al. [7] observed that, although the Apple Watch accurately measures HR, it overestimates EE. Moreover, a comparative analysis with the Polar A370 fitness tracker suggested that both devices are inaccurate for measuring EE [8].

One possible reason for HRV being a key indicator of mental well-being is its relation to neurological function. Increased HRV levels signify a positive balance between the body's sympathetic and parasympathetic nervous systems, with an increase in sympathetic activity being associated with stress and anxiety. Abnormal HRV has been recorded in various mental disorders such as major depressive disorder, schizophrenia, and PTSD [9]. In 2018, Hernando et al. [10] compared HRV measures derived from the Apple Watch RR interval series to those obtained using a Polar H7 band as a reference; they found that HRV metrics from the former device effectively

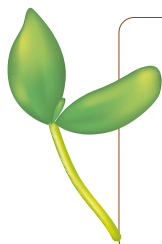
While acknowledging the merits of its application, we discuss in detail the advantages and disadvantages of this approach.

reflected changes caused by mild mental stress. Furthermore, Dooley et al. [11] found the Apple Watch to be more reliable than devices such as Fitbit and Forerunner for recording EE and HR, while Nelson et al. [12] recorded an error margin of less than 10% when measuring HR and HRV. Similarly, Thomson et al. [13] observed that the Apple Watch displayed lower relative error rates in comparison to Fitbit for the measurement of HR across a range of exercise intensity levels when using ECG as a control. Conversely, another study suggested that both Fitbit and the Apple Watch, at times inaccurately measured HR and EE [14].

Regardless, the use of the Apple Watch is not limited to its diagnostic capability; it can also be used to maintain mental well-being through the use of mindfulness and meditation applications which allow users to perform 'mindfulness' sessions comprising deep breathing and reflection. Studies have shown that these sessions can reduce anxiety related symptoms and stress by nearly 50%, while mindful meditation also significantly improves sleep quality, which may aid in mood regulation [15,16]. For example, the 'Health' application allows people to record their daily moods and have constant access to depression and anxiety tests that are used in clinical settings. These test results can then help users determine their risk levels for certain conditions and help them connect to resources available in their vicinity or generate a PDF of their results that they can share with a doctor [17]. While there are ways to assess mental health such as psychometric scales, therapy visits, and self-check lists, many individuals hesitate to use them due to financial constraints, fear of social abandonment, or denial [18]. The Apple Watch thus provides an easily accessible and widely acceptable method for people to monitor mental health and maintain mental well-being [19].

Nevertheless, the device cannot be used for the direct diagnosis and assessment of mental health conditions, given their complex nature; this process requires the expertise of medical professionals, such as psychiatrists or psychologists, who apply multiple diagnostic tests to skillfully evaluate a person's mental state. Furthermore, certain psychological conditions may require treatment with therapy or medication that only a qualified medical practitioner is equipped to provide, rather than with mental health applications. Consequently, wearables like the Apple Watch can play a supportive role in monitoring mental health and overall well-being, but should not be viewed as replacements for professional medical advice, diagnosis, or treatment. While wearable technology can complement the efforts of medical professionals in monitoring and improving mental health, it cannot substitute professional health care services [20].

It should also be noted that the accuracy of certain diameters such as HR and EE obtained during monitoring can vary during different levels of physical activity intensity. Additionally, the Apple watch may at times overestimate sleep duration and misclassify the sleep stages [12]. Moreover, the correlation between mental and physical health is complex, and individuals' responses may differ according to environmental and genetic factors. A recent study found a mere 54% accuracy in associating neural and physiological markers with mental states, thus supporting the hypothesis that mental health conditions are multifaceted, and that not all aspects can be effectively quantified through physiological indicators [21]. It can be challenging to identify if a physical symptom is related to a mental issue or an underlying physiological issue. For instance, an increase in HR may either be attributed to panic attacks, characterised by abrupt surges of intense discomfort and involuntary arousal [22], or a physiological instability, such as a metabolic disturbance or raised blood pressure [23]. Similarly, HRV is influenced by various factors, making it an unreliable indicator of mental health without further investigation. For example, Licht et al. [24] concluded that, although they noted a strong correlation between depression and reduced HRV, these reductions were actually attributable to the use of antidepressants. Thus, individuals cannot solely rely on the Apple Watch for monitoring mental health and should always consult a specialist as well. Researchers focussing on this topic should strive to conduct more studies on the use of the Apple Watch for monitoring mental health conditions.



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- 1 Bouza E, Arango C, Moreno C, Gracia D, Martín M, Pérez V, et al. Impact of the COVID-19 pandemic on the mental health of the general population and health care workers. *Rev Esp Quimioter.* 2023;36:125–43. [Medline:36800778](#) [doi:10.37201/req/018.2023](#)
- 2 Balcombe L, De Leo D. An Integrated Blueprint for Digital Mental Health Services Amidst COVID-19. *JMIR Ment Health.* 2020;7:e21718. [Medline:32668402](#) [doi:10.2196/21718](#)

- 3 Binsch O, Wabeke T, Valk P. Comparison of three different physiological wristband sensor systems and their applicability for resilience- and work load monitoring. 2016 IEEE 13th International Conference on Wearable and Implantable Body Sensor Networks (BSN) (2016): 272–276.
- 4 Manwell LA, Barbic SP, Roberts K, Durisko Z, Lee C, Ware E, et al. What is mental health? Evidence towards a new definition from a mixed methods multidisciplinary international survey. *BMJ Open*. 2015;5:e007079. [Medline:26038353](#) [doi:10.1136/bmjopen-2014-007079](#)
- 5 Lui GY, Loughnane D, Polley C, Jayarathna T, Breen PP. The Apple Watch for Monitoring Mental Health-Related Physiological Symptoms: Literature Review. *JMIR Ment Health*. 2022;9:e37354. [Medline:36069848](#) [doi:10.2196/37354](#)
- 6 Hasin D, Hatzenbuehler ML, Keyes K, Ogburn E. Substance use disorders: Diagnostic and Statistical Manual of Mental Disorders, fourth edition (DSM-IV) and International Classification of Diseases, tenth edition (ICD-10). *Addiction*. 2006;101:59–75. [Medline:16930162](#) [doi:10.1111/j.1360-0443.2006.01584.x](#)
- 7 Falter M, Budts W, Goetschalckx K, Cornelissen V, Buys R. Accuracy of Apple Watch Measurements for Heart Rate and Energy Expenditure in Patients With Cardiovascular Disease: Cross-Sectional Study. *JMIR Mhealth Uhealth*. 2019;7:e11889. [Medline:30888332](#) [doi:10.2196/11889](#)
- 8 Sun X, Wang Z, Fu X, Zhao C, Wang F, He H. Validity of Apple Watch 6 and Polar A370 for monitoring energy expenditure while resting or performing light to vigorous physical activity. *J Sci Med Sport*. 2023;26:482–6. [Medline:37517888](#) [doi:10.1016/j.jsams.2023.07.005](#)
- 9 Jung W, Jang KI, Lee SH. Heart and Brain Interaction of Psychiatric Illness: A Review Focused on Heart Rate Variability, Cognitive Function, and Quantitative Electroencephalography. *Clin Psychopharmacol Neurosci*. 2019;17:459–74. [Medline:31671483](#) [doi:10.9758/cpn.2019.17.4.459](#)
- 10 Hernando D, Roca S, Sancho J, Alesanco Á, Bailón R. Validation of the Apple Watch for Heart Rate Variability Measurements during Relax and Mental Stress in Healthy Subjects. *Sensors (Basel)*. 2018;18:2619. [Medline:30103376](#) [doi:10.3390/s18082619](#)
- 11 Dooley EE, Golaszewski NM, Bartholomew JB. Estimating Accuracy at Exercise Intensities: A Comparative Study of Self-Monitoring Heart Rate and Physical Activity Wearable Devices. *JMIR Mhealth Uhealth*. 2017;5:e34. [Medline:28302596](#) [doi:10.2196/mhealth.7043](#)
- 12 Nelson BW, Allen NB. Accuracy of Consumer Wearable Heart Rate Measurement During an Ecologically Valid 24-Hour Period: Intraindividual Validation Study. *JMIR Mhealth Uhealth*. 2019;7:e10828. [Medline:30855232](#) [doi:10.2196/10828](#)
- 13 Thomson EA, Nuss K, Comstock A, Reinwald S, Blake S, Pimentel RE, et al. Heart rate measures from the Apple Watch, Fitbit Charge HR 2, and electrocardiogram across different exercise intensities. *J Sports Sci*. 2019;37:1411–9. [Medline:30657025](#) [doi:10.1080/02640414.2018.1560644](#)
- 14 Nuss K, Thomson E, Comstock A, Reinwald S, Blake S, Pimentel RE, et al. Heart rate and energy expenditure validity for the Fitbit Charge HR 2 and Apple Watch. USA: Department of Health & Exercise Science, Colorado State University; 2017. Available: <https://mountainscholar.org/items/d8e6971b-5e58-4f23-a83a-3e8cc237468b>. Accessed: 24 January 2024.
- 15 Green AA, Kinchen EV. The Effects of Mindfulness Meditation on Stress and Burnout in Nurses. *J Holist Nurs*. 2021;39:356–68. [Medline:33998935](#) [doi:10.1177/08980101211015818](#)
- 16 Rusch HL, Rosario M, Levison LM, Olivera A, Livingston WS, Wu T, et al. The effect of mindfulness meditation on sleep quality: a systematic review and meta-analysis of randomized controlled trials. *Ann N Y Acad Sci*. 2019;1445:5–16. [Medline:30575050](#) [doi:10.1111/nyas.13996](#)
- 17 Holden BA, Fricke TR, Wilson DA, Jong M, Naidoo KS, Sankaridurg P, et al. Global Prevalence of Myopia and High Myopia and Temporal Trends from 2000 through 2050. *Ophthalmology*. 2016;123:1036–42. [Medline:26875007](#) [doi:10.1016/j.ophtha.2016.01.006](#)
- 18 Ebert DD, Mortier P, Kaelhke F, Bruffaerts R, Baumeister H, Auerbach RP, et al. Barriers of mental health treatment utilization among first-year college students: First cross-national results from the WHO World Mental Health International College Student Initiative. *Int J Methods Psychiatr Res*. 2019;28:e1782. [Medline:31069905](#) [doi:10.1002/mpr.1782](#)
- 19 Miller DJ, Sargent C, Roach GD. A Validation of Six Wearable Devices for Estimating Sleep, Heart Rate and Heart Rate Variability in Healthy Adults. *Sensors (Basel)*. 2022;22:6317. [Medline:36016077](#) [doi:10.3390/s22166317](#)
- 20 National Institutes of Health (US), Biological Sciences Curriculum Study. Information about Mental Illness and the Brain. 2007. Available: <https://www.ncbi.nlm.nih.gov/books/NBK20369/>. Accessed: 10 December 2023.
- 21 Chesnut M, Harati S, Paredes P, Khan Y, Foudeh A, Kim J, et al. Stress Markers for Mental States and Biotypes of Depression and Anxiety: A Scoping Review and Preliminary Illustrative Analysis. *Chronic Stress (Thousand Oaks)*. 2021;5:24705470211000338. [Medline:33997582](#) [doi:10.1177/24705470211000338](#)
- 22 Aslam N. Management of panic anxiety with agoraphobia by using cognitive behavior therapy. *Indian J Psychol Med*. 2012;34:79–81. [Medline:22661814](#) [doi:10.4103/0253-7176.96166](#)
- 23 Rogowski O, Steinvil A, Berliner S, Cohen M, Saar N, Ben-Bassat OK, et al. Elevated resting heart rate is associated with the metabolic syndrome. *Cardiovasc Diabetol*. 2009;8:55. [Medline:19828043](#) [doi:10.1186/1475-2840-8-55](#)
- 24 Kemp AH, Quintana DS. The relationship between mental and physical health: Insights from the study of heart rate variability. *Int J Psychophysiol*. 2013;89:288–96. [Medline:23797149](#) [doi:10.1016/j.ijpsycho.2013.06.018](#)

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