

**ARTIFICIAL INTELLIGENCE-ENABLED WEARABLE  
TECHNOLOGIES FOR PHYSICAL ACTIVITY MONITORING  
AND HEALTH BEHAVIOUR PROMOTION: A THEMATIC  
REVIEW WITH IMPLICATIONS FOR AFRICA**

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**Abstract**

*Inactivity and sedentariness continue to pose great public health problems leading to the need for effective strategies for the continuous monitoring of physical activities and health behaviour promotion. The present thematic review seeks to investigate the application of AI-enabled wearables in the monitoring of physical activities and behaviour promotion with relevance to Africa. Peer-reviewed articles from June 2019 to July 2025 were sought using PubMed/MEDLINE, Scopus, Web of Science Core Collection, IEEE Xplore, CINAHL, and PsycINFO, Google Scholar being used as a supplemental source. The studies were screened according to specific inclusion and exclusion criteria. Data were abstracted regarding the characteristics of the study, its geographical context, wearable devices, application of AI, results, and key findings. Thirty-four articles were included in the thematic analysis of which three themes emanated. These were AI-enabled wearables for physical activity monitoring; AI-based wearable sensing for health monitoring and behaviour promotion; and challenges and ethical issues. The findings indicate that AI-enabled wearables support activity tracking, self-monitoring, personalised feedback, physiological monitoring, disease management, and predictive health assessment. However, concerns about accuracy, privacy, cybersecurity, algorithmic bias, affordability, digital health literacy, interoperability, and environmental sustainability may limit their use. Context-sensitive implementation, equitable access, appropriate regulation,*

*and user-centred design are needed to maximise their contribution to physical activity and health behaviour promotion in Africa.*

**Keywords:** *Artificial intelligence; Wearable technology; Physical activity; Social Cognitive AI-Driven Healthcare.*

### **Introduction**

One of the major characteristics of human beings is the ability to move for many reasons including for general health and wellness and this makes it obvious that human beings are inherently designed to move (Moronkola, 2024a). Physical activity (PA) is described as any type of body movement carried out by the skeletal muscles and resulting in energy expenditure essentially both for health and athletic objectives and this includes walking, jogging, jumping, gardening, among others. Often times, carried out gradually or in phases (Moronkola, 2024b). As a determinant of health, it may help in preventing many diseases, improving physical condition, psychological condition, and overall quality of life especially when done on regular basis. Assessment of physical activity is thus important in assessing health status, coming up with interventions, and monitoring behavioural changes. There are various ways of measuring physical activity, which include direct observation, measuring of energy metabolism through indirect calorimetry and doubly labelled water, and wearable sensors among others. While all these methods have their strengths, they are different in a number of ways in terms of feasibility, cost, and resolution (Hammond-Haley et al., 2021). Okanlawon, Moronkola and Iyanda (2025) believed that the fusion of artificial intelligence (AI) into the health sector has revolutionised the landscape of healthcare, health education and health promotion, transforming the way we learn, interact and engage with health information. AI is influencing almost every sector including the healthcare sector.

Technological advancements in digital health technology have led to the emergence and use of wearable health devices that monitor physical activity and other health measures. Wearable health technology can be defined as technological gadgets worn on the body or embedded in clothes and accessories that continuously measure and transmit physiological and behavioural data (Yetisen et al., 2018). This type of technology employs miniaturised sensors, wireless technology, and predictive analytics to

automatically measure, interpret, and analyse biometric information (Metcalf et al., 2016). Therefore, wearable devices have evolved from simple fitness trackers to health monitors that can facilitate diagnosis (Jo et al., 2019; Sequeira et al., 2020), treatment, and health promotion (Zhang et al., 2024). They keep records of physiological parameters while monitoring metabolic states, thus offering useful data for individual health management and clinical decision making (Takei et al., 2015). In addition, wearable devices become increasingly significant tools for remote patient monitoring and disease management because they offer real-time information about physiological processes and therefore help to detect health problems earlier, live independently, and lead healthier lifestyles (Lewczak & Mitchell, 2024).

In light of the above, the present thematic review explores the available literature on AI and wearable technologies for physical activity monitoring and promotion of healthy behaviour. Firstly, the review considers how artificial intelligence and wearables are employed for tracking physical activities, paying special attention to developments in the field of sensor technology and activity recognition using AI., AI data analysis, continuous physiological measurements, and personalised health interventions. Further, the review investigates the efficacy of the technologies in terms of self-monitoring, self-efficacy, increased physical activity, chronic disease management, predictive medicine, and personalised health outcomes. Finally, this review explores the ethical, technical, and implementation challenges posed by the use of the technologies such as data privacy, cybersecurity, algorithmic bias, accuracy of devices, digital health literacy, cost and health equity, accountability, and environmental sustainability. Through the integration of various empirical evidences, the review provides insights into current trends, identifies knowledge gaps, and makes evidence-based suggestions towards future academic research, policy development, technology development and implementation, and healthcare practice with respect to the potentials of AI-powered wearable technologies for physical activity monitoring and health behaviour promotion.

## Social Cognitive Theory: A Theoretical Perspective

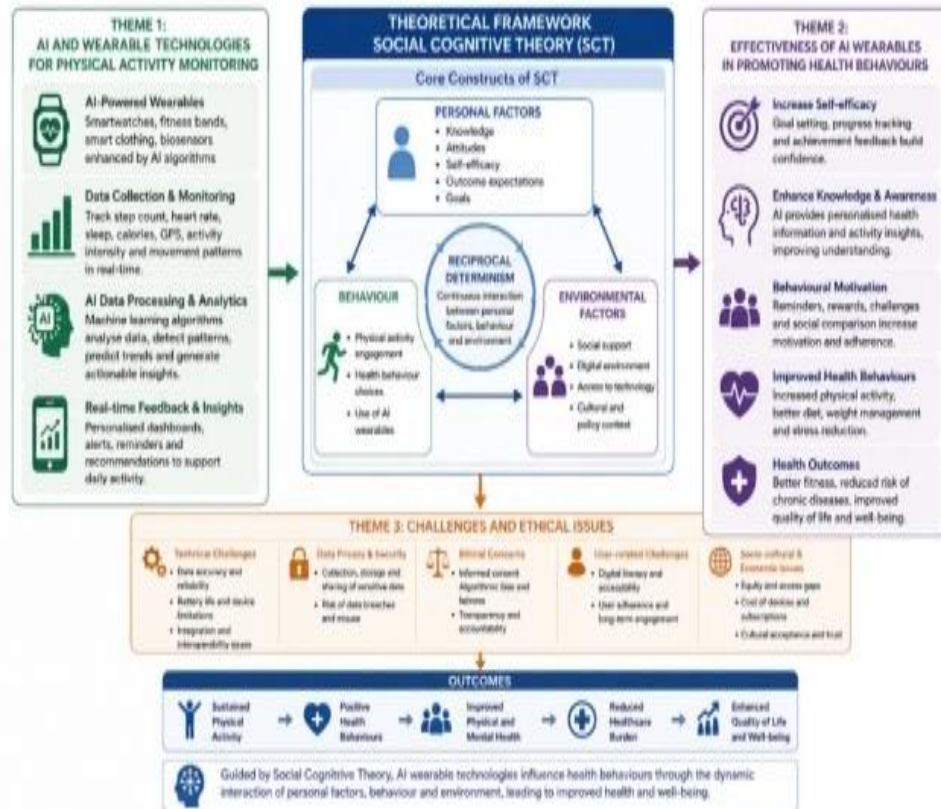


**Figure 1.** Conceptual Framework Based on Social Cognitive Theory for Understanding the Role of Artificial Intelligence and Wearable Technologies in Promoting Health Behaviours.

**Source:** Developed by the authors based on Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice-Hall, and evidence synthesised from the reviewed literature.

The model depicts the use of Social Cognitive Theory (SCT) in the analysis of the manner in which wearable technologies based on AI play a role in tracking and encouraging physical activity and positive health behaviours. The model uses the three central themes of the review, including AI and wearable technology for physical activity tracking, the effectiveness of AI wearable technology in encouraging health behaviours, and the difficulties

and ethical concerns of using AI wearable technology. The model shows that AI-based wearable technology affects health behaviours through the interplay of personal, behavioural, and environmental factors, as suggested by SCT.

The SCT developed by Bandura (1986) serves as the underlying theory that seeks to demonstrate the impact of these technologies on human. The theory shows that behaviour is established through a bidirectional interplay among personal, behavioural, and environmental factors. Personal factors comprise knowledge, attitudes, self-efficacy, outcome expectations, and personal goals. AI-powered wearable technologies boost the personal factors by offering people with necessary health information, making them aware of the physical activity level, promoting goal setting, and building confidence in adopting new behaviours. Behavioural factors have to do with the execution and sustaining of physical activity whereas environmental factors include family support, peer encouragement, health care professionals, workplace environment, digital technology infrastructure, and general health policies. The diagram, depicts that AI-driven wearable devices operate beyond being mere monitoring tools. Based on the tenets of SCT, they enhance healthy behaviours by enhancing the knowledge, self-efficacy, motivation, and behavioural intention of users in an environment that is favourable to this end. Combining the three themes helps to explain how AI and wearables help in the monitoring of physical activity, adoption of healthier lifestyles, and improvements in health through technology. It also helps to take into account the ethical issues and contexts surrounding the use of the technology.

### **Objectives of the Study**

To analyse and synthesise evidence published in peer-reviewed articles between 2019 and 2025 about the application of AI-driven wearable devices to track physical activities and improve health behaviour of adults, older adults, adolescents, and people with chronic illnesses like diabetes and cancer, within communities, clinics, and remote care sites, as well as the implications of this technology for Africa. This paper reviews (i) the use of wearable sensing, AI analytics and continuous monitoring of physical activities and physiology; (ii) their role in self-monitoring, self-efficacy, physical activity, chronic disease management and predictive health assessment; and (iii) the issues associated with their adoption.

## **Methodology**

### **Review Design**

A thematic review was conducted to identify existing literature on the use of AI-based wearable technology to monitor physical activities and influence health behaviours. The theoretical framework for this review included SCT that explains health behaviour by examining the interaction of three factors.

### **Search strategy**

Peer-reviewed studies from June 2019 to July 2025 were obtained from PubMed/MEDLINE, Scopus, Web of Science Core Collection, IEEE Xplore, CINAHL, and PsycINFO databases, with Google Scholar being a complementary database (last search July 2025). A combination of keywords for artificial intelligence (AI), wearable devices (wearable\*, smartwatch\*, biosensor\*), and outcomes (physical activity, behaviour change, health monitoring) using Boolean operators was used in each database search, with adaptation to each database. No geographic limitations were imposed, and reference lists were hand searched.

### **Eligibility criteria and selection**

Peer-reviewed English language articles with physical activity monitoring, health behaviour promotion, physiological monitoring, disease management, and health prediction outcomes by AI-powered wearables were included. Excluded were conference abstracts, commentaries, and non-peer reviewed articles. Title and abstract screening followed by full text review was performed, with exclusion criteria listed. Thirty-four articles were included.

### **Data extraction and analysis**

Information regarding author, year, country, research design, population, wearables technology, application of AI, results, conclusions and limitations was compiled. Similar ideas were classified into three main themes: (1) AI-enabled wearables for monitoring physical activities, (2) AI-powered wearables sensors for health monitoring and behaviour change, and (3) Challenges and ethics. The geography of evidence guided the discussion on implications for Africa and Nigeria.

**Theme 1: Artificial Intelligence and Wearable Technologies for Physical Activity Monitoring**

The primary theme that comes out from the studies review is the evolution of wearable technologies used for continuous health monitoring. From the seventeen reviewed papers for theme one, it can be seen that wearable devices have evolved from basic tracking gadgets to complex health care technologies that allow for continuous health monitoring. As stated by Chidambaram et al. (2022), today's wearables allow for continuous monitoring of heart rate, blood pressure, electrical activities of the heart, through electrocardiograms (ECGs), electroencephalograms (EEGs), body temperature, sweat markers, and movement patterns. This way, wearable technology allows for the diagnosis and management of various conditions. Therefore, it can be concluded that wearables have allowed for expanding the field of health care as they offer opportunities for continuous health monitoring that is non-invasive.

The second common thread relates to the innovation of sensors and the collection of physiological data. The advancement in the technology of wearable sensors has greatly enhanced the precision, variety, and amount of physiological data that can be gathered outside healthcare facilities. Legner et al. (2019) and Sharma et al. (2021) noted that modern-day smartwatches use sophisticated sensors like PPG (photo plethysmography), EDA (electrodermal activity), IMU (inertial measurement units), GPS (Global Positioning System), and sweat sensors for capturing comprehensive physiological and behavioural data. The wrist-worn devices usually have a number of sensors to help them monitor different things related to the wearer's health and fitness. The inertial measurement unit (IMU) sensors are among the sensors that are usually used in the wrist-worn devices in healthcare to monitor the motion and orientation of the device in three-dimensional space. The IMU sensors usually consist of a set of accelerometer, gyroscope, and magnetometer sensors. Collectively, the sensors provide useful data on the wearer's physical activities that may be used in healthcare applications like step counting, distance covered, calories burnt, and fall detection (Fotouhi-Ghazvini, & Abbaspour, 2020;Pham et al.,2020). Furthermore, Zhao et al. (2019) highlighted the innovation of biosensors that work through electrochemical and optical approaches for estimating glucose and electrolytes from sweat. Moreover, Auepanwiriyaikul et al. (2020) indicated that wearable devices can help

gather enormous amounts of physiological information including heart rate variability, sleeping behaviour, blood pressure, physical activities, and energy expenditure. Taken together, these findings suggest that innovations in sensors have improved diagnostic and monitoring capacity of wearable devices significantly. However, there is evidence in the literature that accuracy of measurements may be influenced by movement artefacts, inappropriate sensors placement, ambient environment, skin condition, and calibration of the devices.

Another theme derived from the literature review is the connection between the Internet of Things and remote healthcare. The combination of wearables with IoT technology greatly increases possibilities of continuous remote monitoring of patients' health status and personalized treatment. According to Ozaslan et al. (2020), daily physical activity, which is quantified using wearable gadgets that are easy to access, can help maintain glucose levels during meals among people with type 1 diabetes. Marasco et al. (2023), Concheiro-Moscoso et al. (2023), Paulauskaite-Taraseviciene et al. (2023), and Saliba Thorne et al. (2023) add that IoT systems include smartwatches, activity trackers, smart scales, and environmental sensors that allow getting real-time feedback, remote supervision and personalised suggestions. This points to the growing capabilities of IoT-based health care in regard to its availability, continuity, and personalisation. In contrast, the issues of interoperability among devices, cybersecurity, health data privacy, digital divide, and insufficient digital literacy among patients and providers are referred to as the major impediments to implementing IoT-based health care solutions in the scientific sources. This means that technology integration on its own is not sufficient for the successful implementation of innovations under consideration. It is clear therefore, that wearables have evolved to become an intelligent health system that facilitates continuous monitoring of the physiology of an individual, collection of data through advanced sensors, making decisions using AI and clinical assessment in addition to provision of health care in a remote way using IoT.

## **Theme 2: Artificial Intelligence-Based Wearable Sensing Technologies for Health Monitoring**

According to the literature review, the employment of wearable sensing technology powered by AI has brought about a revolution in health surveillance using continuous physiological monitoring, diagnostics,

prediction, disease management, and personalization. A major theme that can be extracted from the literature review is continuous physiological monitoring and early disease detection. AI application has proven useful in enhancing the potential of wearable technologies through ensuring fast analysis and interpretation of large amounts of physiological information hence leading to early recognition of abnormalities compared to conventional monitoring methods. According to observations made by Sharma et al. (2022), AI enhances the potential of wearable technology since it is capable of recognising patterns in physiological data, comparing them to reference datasets and identifying health issues in good time. This view has also been supported by the findings of Lu et al. (2024), Zhu et al. (2025) and Li et al. (2025b) who demonstrated the effectiveness of AI in enhancing intelligent diagnosis and physiological monitoring in real-time. From the above discussion, it is clear that continuous non-invasive monitoring has proven to be more developed than the traditional health care practices which relied on periodic clinical assessments. Nevertheless, from the studies review, there is evidence of the fact that very few AI algorithms have been validated clinically in multiple centres, thus limiting their generalisability.

According to Ferguson et al. (2022), in the umbrella review of 39 systematic reviews and meta-analyses, wearable activity trackers were shown to be connected with increased levels of physical activity in various populations with self-monitoring and goal-setting as important behavioural change components. Similarly, in their systematic review and meta-analysis of 23 randomised control trials with a total number of 4,566 community-dwelling older adults, Li et al. (2025a) have proven that wearable activity tracker interventions increase the level of physical activity time and daily step counts when compared with the control group. Moreover, they make it easier for people to become more aware and knowledgeable because they offer customised health information which helps to make informed decisions. Customised reminders, motivational messages, progress tracking and virtual coaching motivate users to take part in physical activities regularly and practice healthy behaviours. Therefore, regular wearing of such AI-powered devices including, accelerometer, pedometer have been found to lead to greater physical activity levels, less sedentary behaviour, better eating habits, proper weight management, mental well-being, as well as decreased risks of developing chronic conditions including obesity,

diabetes, and cardiovascular diseases. It shows that AI-powered wearables are an effective tool to promote health behaviour change rather than only monitor physical activity

The second most popular theme relates to chronic disease management and personalised medicine. Indeed, the literature demonstrates that nowadays, the application of AI to wearable devices is not only about monitoring physical activities but also about management of chronic and infectious diseases. Research works of Alshuhri et al. (2024), and Aadil et al. (2025) demonstrated that the use of wearable systems integrated with AI technology enables continuous monitoring of the health state of patients with such diseases as cancer, diabetes, and even COVID-19, which allows timely treatment and personalised care. Moreover, the developments proposed by Lu et al. (2024), Zhu et al. (2025), and Li et al. (2025b) illustrate the ways in which wearables enable personalised care because of intelligent diagnostics and monitoring of patients' physiology. Therefore, one may say that AI-enabled wearables allow the implementation of precision medicine by providing personalized data about the health condition of the patient.

The other important aspect worth mentioning is related to the technological innovations in the field of wearables sensing. Innovations in the field of sensor technologies have led to more than just activity monitoring through wearable devices. For instance, Li et al. (2025b) provided an account of the development of the wearable photonic wristbands, which not only monitor the cardiorespiratory system but also are useful in biometric identification of the patients. From the above examples, it becomes clear how technology has converged with the fields of AI and biomedical engineering in order to develop adaptive healthcare systems.

The third theme emerging from the reviewed literature relates to predictive analytics and AI-driven decision support. Combining AI with the information gathered through wearable sensors has made significant advances possible in terms of disease prediction, risk stratification, and decision making in a clinical setting. As noted by Liu et al. (2023), the supervised machine learning models trained based on physiological data gathered from a smartwatch could predict the mortality of terminal cancer patients with an accuracy of 93%. In the same way, Torrente et al. (2022)

gathered physiological data from wearable and large clinical datasets and used them to develop neural network models predicting the outcome of cancer patients. These two studies highlight the move towards the transformation of AI-powered wearables into healthcare predictive systems. Anjum et al. (2024) found that continuous physiological feedback helps people make rational decisions about their diet intake, exercise, medicine adherence, and other behaviours. All the abovementioned studies confirm the effectiveness of AI-assisted wearables in improving the health status of people. This thematic analysis indicates that the introduction of AI in wearable sensing technology has brought a revolution in the health monitoring field because of continuous physiological monitoring, chronic disease management, improved predictive models, healthcare personalisation, and technological development in wearable sensing technology.

### Theme 3: Challenges and Ethical Issues in AI-Enabled Wearable Technologies

There are several issues that have arisen with the introduction of the technology in question, which are mainly ethical, technological, social, and environmental rather than the fact that the benefits it provides are not in doubt. The issue of physical safety emerges as another notable disadvantage, especially when it comes to vulnerable groups. Inadequate and poorly-designed devices, which do not meet the needs of people with physical illnesses such as arthritis, decrease the level of user satisfaction and adherence to the use of wearable technology. For example, rings used in monitoring can be uncomfortable or inappropriate for people with joint deformation (Gladiš et al., 2024). If the usage of these devices is discontinued due to discomfort or impracticality, health monitoring is interrupted, which negatively impacts the efficiency of AI-based intervention. This problem is especially pertinent to elderly and disabled individuals who could greatly benefit from constant health monitoring but who might encounter problems while using wearables (Canali et al., 2022). Accuracy and reliability of information gathered by wearables represent yet another significant issue. To provide reliable health information, the AI algorithms need the accuracy and representative nature of the data collected. Research has found that some wearable devices do not operate as reliably on people with darker skin due to the fact that they use cheaper green light sensors compared to amber light sensors (Rudd & Igbrude,

2023). In addition, AI algorithms that were taught using information collected from a particular ethnic group may be unable to provide accurate health predictions regarding people belonging to other groups. Thus, such biased algorithms can negatively affect health assessment of people belonging to minority groups and result in the provision of poor health care to them.

Privacy and confidentiality are some of the commonest concerns associated with wearable technology use. Since the wearable devices capture highly confidential physiological, behavioural and locational data, they are a target for many cyber-attacks and unauthorised access. The existing research highlights a number of security challenges, which include data breach, data leak, data loss, unauthorised access of data by third-party companies, data theft, unauthorised interception and capturing of personal health information without proper consent from patients (Qu & Gao, 2020; Ulrich et al., 2020; Grigorovich & Kontos, 2020; DeClue, 2023; Psihogios et al., 2024). These security threats have a negative impact on people's perception of wearable devices, which leads to the reluctance to use devices that involve the continuous sharing of highly private personal data.

The environmental sustainability aspect has equally become another key issue that is being considered in relation to the wearable technology issue. These aspects include electronic waste, energy usage, and natural resource depletion that arise from the manufacturing, upcycling, and disposal of wearable gadgets (Canali et al., 2022; Flores-Castañeda et al., 2025; Capulli et al., 2025; Ratti et al., 2025). Low income population groups may also not be able to afford high quality wearable gadgets, while those with low level of digital literacy will have difficulties in understanding or dealing with health information generated by the gadgets. Inadequate internet connectivity in rural areas may limit timely data transfer especially in developing countries.

### **Conclusion**

It is clear from the studies reviewed that in addition to helping people monitor their PA, wearables can also help people adopt healthier PA. but also increase their self-efficacy and self-management skills, detect any diseases in the early stages, and produce behavioural changes in different areas related to their health. In spite of all benefits described above, the

universal implementation of the technology is impeded by limitations related to some factors, namely; the precision of the devices, the compatibility of the technologies, the cost, bias algorithms, the privacy and security of data, digital health literacy, ethical regulation, accountability, and unequal access to technology. the introduction of wearable devices into the healthcare system presupposes not only technological advancements in the field but also an ethical approach to implementation and regulation.

### **Recommendations**

Based on the findings of the review, the following recommendations are made:

1. Development of AI-enabled wearables should have features that can track physical activities continuously, provide instant feedback, set goals, and prompt the users as a way of promoting self-monitoring and involvement in exercise.
2. Developers of AI-enabled wearable devices need to use sensors and algorithms that will be able to measure PA, physiological parameters, and behaviours within different population groups. Real-life testing and representation of different users' population will minimise errors in measurements and biases in algorithms.
3. Users should receive practical guidance on the appropriate use, interpretation, and limitations of wearable-generated health information. Health education and digital health literacy initiatives should therefore equip users with the skills required to interpret feedback, respond appropriately to health alerts, and make informed decisions about physical activity and other health behaviours.
4. Steps should be taken in order to increase privacy and security by ensuring informed consent, secured data transfer, secured data storage and sharing, and individual control over personal health information.
5. In adopting the use of wearable technologies which make use of AI in Africa, factors such as cost, internet availability, digital skills, and technical support need to be considered.

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