American Journal of Biomedical Science & Research

www.biomedgrid.com
ISSN: 2642-1747

Review Article

Exploring the Potential of Wearable Technology to Enhance Physical Activity in Cancer Patients

Hajer Alhinai* and Zakariya S Alamrani

Department of Holistic Care, Sultan Qaboos Comprehensive Cancer Care and Research Centre, University Medical City, Oman

***Corresponding author:** Hajer Alhinai and Zakariya S Alamrani, Department of Holistic Care, Sultan Qaboos Comprehensive Cancer Care and Research Centre, University Medical City, Muscat 112, Oman, Email: h.alhinai@cccrc.gov.om; z.alamrani@cccrc.gov.om, ORCID: https://orcid.org/0009-0002-3507-4571

To Cite This Article: *Hajer Alhinai* and Zakariya S Alamrani. Exploring the Potential of Wearable Technology to Enhance Physical Activity in Cancer Patients. Am J Biomed Sci & Res. 2024 25(2) AJBSR.MS.ID.003293,* DOI: 10.34297/AJBSR.2024.25.003293

Received: December 10, 2024; **Published:** December 16, 2024

Abstract

Background: Cancer patients experience various symptoms throughout their treatment, negatively affecting their quality of life. Exercise is beneficial in managing fatigue, reducing pain, and improving physical well-being. Wearable trackers offer a promising approach to support physical activity in these patients. The primary objective of this review was to assess the effectiveness of wearable trackers in enhancing physical activity among cancer patients undergoing chemotherapy. The secondary objectives examined the impact of wearable trackers on physical activity, quality of life, performance, sedentary lifestyle, psychological status, and other relevant outcomes in this population.

Methods

- A search strategy was conducted across PubMed, Cochrane Library, and ScienceDirect databases from 2017 to 2024, using keywords related to wearable trackers, physical activity, and chemotherapy in cancer patients.
- The Critical Appraisal Skills Programme (CASP) checklist was used to assess the methodological quality of the included studies.

Results

- Eight articles met all inclusion criteria.
- The studies involved a total of 336 participants with various cancer types, including breast, colorectal, lung, and mixed diagnoses.
- The studies were observational and controlled trials with varying sample sizes (27-127 participants).
- All studies reported that wearable trackers monitored patients' daily physical activities during chemotherapy.
- Wearable trackers showed promise in increasing physical activity levels among cancer patients.

Conclusion: Wearable activity trackers can significantly enhance physical health outcomes in cancer patients undergoing chemotherapy. Their integration into cancer care shows promise in improving physical activity levels, aiding rehabilitation, and supporting overall well-being throughout cancer treatment.

Keywords: Wearable activity Tracker, Cancer patients, Chemotherapy, Physical activity

Introduction

There were an estimated 19.3 million new cancer cases diagnosed worldwide in 2020 [1]. Cancer patients may experience various symptoms from diagnosis through treatment and into the end of life, which can result from either the cancer itself or its treatment. These symptoms include diarrhea, vomiting, chest pain, constipation, dyspnea, and fatigue [2]. These symptoms can negatively affect their quality of life [2]. Cancer patients may complain of permanent issues in the cardiovascular system, endocrine system, digestive system, immune system, nervous system, and respiratory system [3].

Exercise can be very helpful in managing fatigue brought on by cancer, reducing pain, enhancing bone density, and preserving tissue elasticity [4]. The World Health Organization distinguishes between two types of physical activity: aerobic physical activity and anaerobic physical activity [5]. However, higher levels of physical activity have been reported to reduce recurrence rates and cancer mortality by 40–50% among patients with colorectal, breast, and prostate cancers [6]. Generally, 150 minutes a day, spread over three to five days of moderate-intensity aerobic activity is advised by the Physical Activity Guidelines [7-9]. Although maintaining an active lifestyle can be challenging for cancer patients, several factors influence their ability to engage in physical activity, including the type and stage of cancer, treatment side effects, and the presence of metastases. Correspondingly, the patient's motivation and quality of life are greatly impacted by attitude toward the condition, coping mechanisms, and social and family support [9,10].

Chemotherapy works on reducing or halting the rapid development and division of cancer cells, and can be used as a curative, palliative, or adjuvant treatment to boost the effectiveness of other therapies like radiation therapy [11]. Chemotherapeutic treatments have numerous side effects. The most common side effects are fatigue, nausea, vomiting, mucositis, hair loss, dry skin, skin rash, bowel changes, anemia, and an increased risk of acquiring infection [12].

One of the most popular wireless activity trackers available to consumers is the wearable tracker or Fitbit® and other commercial names. It meets reasonable validity and reliability standards, enabling primary care providers to objectively measure their patients' physical activity between clinic visits [13]. With the help of physical activity monitoring devices, researchers and professionals can evaluate adherence and apply long-term follow-up [14,15]. Moreover, it is easier to provide accurate, objective assessments that can be compared to cancer outcomes [14,15]. Wearable device interventions are effective in increasing physical activity and supporting individuals with various health conditions, including overweight or obesity, cardiovascular disease, diabetes, COPD, stroke, Alzheimer's disease, musculoskeletal pain, and Parkinson's disease [16].

Wearable trackers offer a promising approach to supporting physical activity in cancer patients undergoing chemotherapy [17]. Also, they can be utilized to evaluate the toxicity of the chemotherapy and its side effects from the step count, heart rate, and ECG data, whereas the step counts decreased by 15% or more helped to identify chemotherapy toxicity [18-25]. Several studies monitor various health metrics of the wearable tracker and provide personalized feedback to the sleep quality, physiological, cognitive, and emotional, calorie expenditure, and level of activity for pre- and postoperative cancer patients, in addition to improving adherence, enhancing safety, and facilitating communication between the patient and his care provider [18-22].

Although preliminary research and anecdotal evidence suggest potential advantages and limitations of wearable trackers for cancer patients, a comprehensive systematic evaluation is needed to establish a robust evidence base. The primary objective of this systematic review is to assess only the recent scientific evidence (2017-2024) focusing on the effectiveness of wearable trackers in enhancing physical activity levels among cancer patients undergoing chemotherapy as there is a lack of recent review studies that have reviewed the recent clinical findings. Secondary objectives examine the impact of wearable trackers on physical activity, quality of life, performance, sedentary lifestyle, psychological status and another vital outcomes and other relevant outcomes in this population. The study eventually seeks to inform oncology practitioners about the latest evidence regarding wireless activity trackers.

Methodology

Search Strategy

The search process of articles started from 2017-2024. It was conducted electronically using the following databases: PubMed, Cochrane Library and ScienceDirect which contain different medical literatures.

Inclusion and Exclusion Criteria

The following inclusion criteria were (1) English language articles with sufficient data for analysis; (2) Studies published from 2017 to 2024 were included to capture the most recent research, reflecting the ongoing updates and changes in the medical field (3) articles involving adult patients of both genders, aged 18 years or older; (4) studies involving solid cancer patients who were undergoing only palliative or adjuvant chemotherapy during the study period; (5) articles that evaluated the use of wearable activity trackers and reported outcomes related to physical activity. However, the exclusion criteria were (1) unpublished articles; (2) articles which did not provide enough data for analysis; (3) articles which involved non-cancer patients; (4) articles focusing on non-wearable interventions or those using technology that is not primarily an activity tracker of physical metrics will also be excluded. (5) In addition, articles focused on post-chemotherapy will be excluded to ensure adequate assessment of physical activity level during chemotherapy; (6) articles that analyzed fewer than 20 patients were excluded to avoid increased risk of bias and low statistical power.

Study Selection and Extraction

The search was conducted across various databases by combining relevant keywords associated with the PICO framework. (P) Solid Cancer Patients. (I) Wearable Tracker (ie, activity monitor). (C) Not defined (searching all compared interventions). (O) Physical activity (i.e., steps taken, calories burned, munities of activity and heart rate). Duplicated articles were eliminated and relevant articles were identified after screening the titles and abstracts and reading full text articles. Finally, the selected articles in this review were involved based on the mentioned inclusion and exclusion criteria. The following Boolean operators were used. Initially, a search was conducted in PubMed using the following advanced search keywords: (((((Cancer) OR (malignancy)) OR (tumor)) AND ((((((Wearable tracker) OR (wearable technology)) OR (smartwatch)) OR (body-worn technology)) OR (mHealth tracker)) OR (eHealth tracker))) AND (((((Physical activity) OR (exercise)) OR (workout)) OR (training)) OR (active lifestyle))) AND (Chemotherapy). The same keywords were also applied in both the Cochrane Library and ScienceDirect databases: "Cancer AND Wearable Activity AND Physical Activity AND Chemotherapy." This initial search yielded a total of 3,119 articles: PubMed (n=62), Cochrane Library (n=21), and ScienceDirect (n=4,036). A custom publication year filter was then applied in each database, restricting results to articles published from 2017 to 2024. In ScienceDirect, the research article type was selected to ensure access to the most relevant evidence for our PICO, which includes detailed methodologies, results, and conclusions. After filtering, the results were as follows: a total of 594 articles—PubMed (n=60), Cochrane Library (n=20), and ScienceDirect (n=514). Next, duplicate articles were removed—14 duplicates identified through intra-database checks and inter-database comparisons—resulting in 580 articles for initial screening of titles and abstracts. After this screening process, 570 articles were excluded due to differing interventions, populations, or outcomes that did not meet the inclusion and exclusion criteria. For the final selection, only 10 articles were assessed for eligibility through full-text review. Two of these articles were subsequently excluded: one for having a sample size below the inclusion criteria and another for employing treatments other than chemotherapy. Ultimately, 8 articles were included in this review as they met all inclusion and exclusion criteria. The entire process is detailed in Figure 1 (PRISMA).

Quality Assessment of the Studies

The Critical Appraisal Skills Program (CASP) checklist is an appraisal tool formed to systematically assess the validity, reliability and applicability of results of published research [23]. This checklist is available for appraisal of different types of articles like systematic reviews, randomized trials, cohort studies, and case control studies [23]. In this review, CASP was used to critiquing the methodological quality of the article discussed in this review. By using this structured approach, the review ensured a critical evaluation of study design, helping to identify potential biases and improve the overall quality of the findings [23].

Results

Literature Search

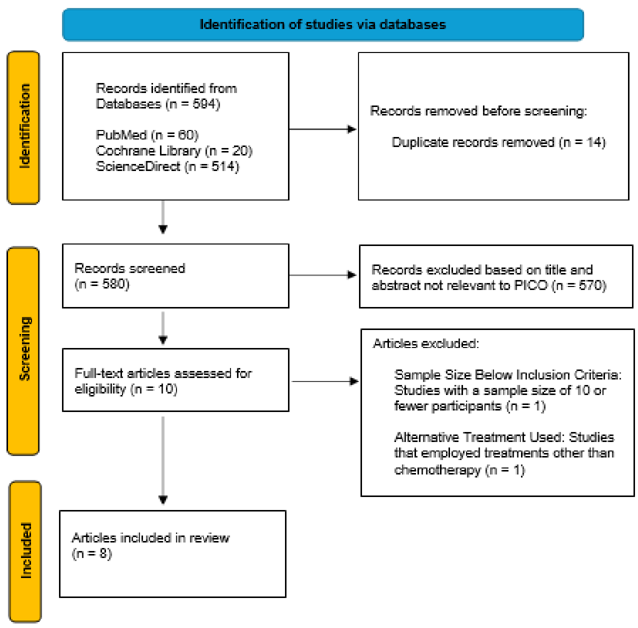

Figure 1: PRISMA 2020 Flow Diagram.

The search strategy encompassed several databases: PubMed, Cochrane Library, and ScienceDirect. On October 1, 2024, a total of 594 articles were identified. After removing 14 duplicate records, 580 articles remained for further screening. Titles and abstracts were reviewed, resulting in 10 articles selected for full-text evaluation. Of these, 570 articles were excluded for not meeting the inclusion criteria, leaving 8 articles included in this review. The study selection process is illustrated in a PRISMA flow chart (Figure 1). A Critical Appraisal Skills Programme (CASP) checklist was applied to assess the quality of the included studies. None were rated as low risk of bias; all studies were classified as having high to moderate risk of bias in the domains of performance and reporting bias. Among the eight studies [24-31], three were clinical trials [25,29,31], while the remaining five were observational studies [24,26,27,28,30]. All studies monitored patients' daily physical activities during chemotherapy and employed a variety of methodologies. Two controlled trials and one observational prospective cohort study assessed the feasibility and acceptability of wearable trackers [25,28,29]. One study examined adherence to exercise regimens and factors associated with it. Additionally, two studies explored the understanding and application of wearable technology in oncology and its potential to improve patient outcomes [26,30]. Only four studies [25,29,30,31] compared interventions between two patient groups (using device trackers versus usual care). The publication dates of these studies range from 2017 to 2024.

Study and Participant Characteristics

Sample Size: The median sample size was 336 participants. The seven studies include varied sample sizes ranging from 27-127 patents. All studies include smaller samples 72, 32, 65, 41, 44,27,60 respectively [25-31]. Except one observational, non-controlled intervention study includes 127 participants, which is larger size but still considered a small samples number [24] (Table1).

Cancer Type: Three studies were designed to serve a diverse breast cancer patient population [24-26], one study involve patients with a wide range of mixed cancer diagnoses [28], one study designed to involve lung and gastrointestinal cancer [30], and three trials involve colorectal cancer [25,29,31]. All studies were conducted during adjuvant or palliative chemotherapy (Table 1).

Table 1: Characteristics of included studies, n=8.

Study (Year)	Country	Primary Cancer Site	Treatment Type	Sample Size, n	Age Group (Range)	Study Design
(Nyrop et al., 2018) [24]	USA	Breast	Adjuvant or neo-adjuvant chemo-therapy	127	21–64	Observational, non- controlled intervention study
(Cheong et al., 2018) [25]	South Korea	Colorectal cancer	Chemotherapy	72	>20	A single- arm, pre-post intervention study
(Nelson et al., 2019) [26]	UK	Breast	Different chemo-therapy regimen	32	49.6 (10.72)	Observational study
(Dreher et al., 2019) [27]	USA	Breast	Adjuvant or neo-adjuvant chemo-therapy	65	29-72	Observational study
(Nilanon et al., 2020) [28]	USA	Solid tumors	Highly emetogenic palliative or adju-vant chemotherapy	41	40-60	An observational, prospective cohort study.
(Van Blarigan et al., 2022) [29]	USA	Colorectal Cancer	Chemotherapy	44	45-62	Pilot randomized controlled trial
(Cay et al., 2024) [30]	USA	Lung or gastroin-testinal cancer	Chemotherapy	27	64.6±12.9	Observational, pro-spective, non-con-trolled study
(Kanzawa-Lee et al., 2024) [31]	USA	GI cancer	The second FOLF-OX/FOL FIRINOX cycle	60	+18	Pilot RCT

Age of Participants: All studies specify participant ages. The mean patients age was 51 years ranged from 20-76. Two studies reported varied age groups from 20 and above [25,27]. On the other hand, two studies involved patients above 70 years old [27,30] (Table 1).

Intervention Characteristics: In two of the eight studies, the planned wear time was 20 and 60 days respectively [26,28]. Four studies utilized the tracker for durations exceeding 8 weeks [24,25,29,31], and the longest duration period reposted as 270 days [27] (Table 2). The valid wear time was different. Five studies involved Fitbit- based interventions [24,26,27,29,31]. One study uses Korean wearable tracker [25]. Another study involves other wearable physical activity trackers called Microsoft Band 2 [28]. Last study involves water-resistant pendant sensor PAMSys™, BioSensics LLC which is a neck tracker [25].

Intervention goals involved performing low to moderate intensity exercises (walking only) the median was 225 Steps per hour exhibited a decrease with age high physical activity [30] or 15-minute averages per hour considered sufficient for the chemotherapy patients [27]. Four studies prescribed moderate to vigorous-intensity physical activity [25,26,29,31]. The participants were encouraged to work up to 150 mins\week [24,29]. One study doesn't report the type of intensity of exercises [30]. Only three studies provided baseline physical activity instructions, support, or contact during the intervention, such as educational materials [24,25,31] or SMS text messages [29]. Four studies did not include any in-person, phone, or email-based counseling or support during the intervention after the baseline [26,27,28,30].

Study Outcomes: Study outcomes were divided into three groups of outcomes (Table 2,3) wearable outcome, health related outcomes and patient reported outcomes: all studies included step count monitoring as a common outcome. The second most frequent topics among the study outcomes were heart rate [25,26,27,28,29], performance [24,26,28], and energy expenditure [24,26,28]. Two studies examined sleep [26,28], BMI [25,26,29]. Two had purpose of monitoring Sedentary or non-sedentary lifestyle [24,28], Psychological and mental status [24,30] and Functional assessment [19,25]. Other vitals outcomes were involved in 2 studies [24,30] Metabolic Equivalents of Task and Vitals blood pressure respectively. Table 2 and 3 show the studies' outcomes.

Table 2: Description of wearables.

Study(Year)	Hardware\Soft Wear	Planned Wear Time\Valid Days	Device Outcome
(Nyrop et al., 2018) [24]	Fitbit Zipa/not reported	6-12 weeks>3 weeks	- Step count
(Cheong et al., 2018) [25]	Wearable device (Urban S; Partron Co, Seoul, Korea)\mobile application	12 weeks	- Steps - Walking distance - Heart rate
(Nelson et al., 2019) [26]	Fitbit Charge HR\Fitabase	20 days-24hr\>5 min of wear	- Physical activity - Heart rate - Sleep
(Dreher et al., 2019) [27]	Fitbit Charge HR or Fitbit Charge 2 /Fitabase	Up to 270 days/≥10 hours	- Step count
(Nilanon et al., 2020) [28]	Microsoft Band 2\Microsoft smartphone	60 days\10 AM to 8 PM period	- Step counts - Heart rate - Energy expenditure
(Van Blarigan et al., 2022) [29]	Fitbit Flex 2 Fitness Wristband\ mobile phone with email and SMS text messaging	Every day during the 12-week. minimum of 3 days\at least 10 hours.	- Step count
(Cay et al., 2024) [30]	Water-resistant pendant sensor (PAMSys™, BioSensics LLC, Newton, MA, USA)\built-in data storage	14 days-24hs\not reported	- Postures (sitting, standing, lying, walking) with a time resolution of every second, - Locomotion metrics (e.g., cadence, step count, longest walking bout) - Postural transitions (e.g., number of sit- to-stand and stand-to-sit movements) - Energy expenditure
(Kanzawa-Lee et al., 2024) [31]	Fitbit Charge 2	>6 weeks\<2 weeks	- Physical activity - Sleep count

Table 3: Study and patient reported outcomes.

Study (Year)	Study Outcomes	Patient Reported Outcome
(Nyrop et al., 2018) [24]	-Physical activity (PAAM) -Performance status (KPS-SPPB- TUG) -Sedentary lifestyle	1- Functional assessment of cancer therapy-breast (FACT-B Version 4). 2- Functional assessment of chronic illness therapy- fatigue (FACIT-F Version 4). 3- Mental health index-13 (MHI-13). 4- Medical outcomes survey (MOS) physical function. 5- Instrumental activities of daily living (IADL) 6- MOS social support, and MOS social activity 7- Participants also completed questionnaires pertaining to their outcome expectations from exercise (OEE) 8- Perceived self-efficacy for fatigue self-management (PSEFSM)

(Cheong et al., 2018) [25]	- 2- minute walk test - 30- second chair stand test - Grip strength test - Patients' nutritional status - Weight - European Organization for Research and Treatment of Cancer Quality of Life Questionnaire C30	1- International Physical Activity Questionnaire short-form. 2- Metabolic equivalents 3- Minutes and how many days they spent at a specific activity category.
(Nelson et al., 2019) [26]	- ActiGraph GT3X-measured moderateto-vigorous physical activity (MVPA) - Physical activity, heart rate, and sleep - Another outcome measurs: (cancer stage at diagnosis, receptor status, date of each in - fusion), height, and weight (to calculate body mass index	1. Information System (PROMIS) short form questionnaires
(Dreher et al., 2019) [27]	- Physical activity (step count, heart rate) - Sleep hours	1. Baseline survey
(Nilanon et al., 2020) [28]	- Physical activity - Metabolic Equivalents of Task (METs). - Non-sedentary Physical Activity Hours - Performance status (ECOG) - Unplanned health care encounters (UHEs)	1. Home scale and daily questionnaires (Patient-Reported Outcomes Measurement Information System (PROMIS))
(Van Blarigan et al., 2022) [29]	- Physical activity (slowness, inactivity cardiorespiratory fitness (through 6- MWT) - Body weight - Blood pressure	1- Investigator-created questionnaire
(Cay et al., 2024) [30]	- Physical activity (step, posture transition, metrics, energy expenditure) - Epidemiologic Studies Depression Scale (CES-D) - Chemotherapy Resilience Index (CRI) - Functional Assessment of Cancer - Therapy-General (FACT-G) - Mini-Mental State Examination (MMSE)	1- Not reported
(Kanzawa-Lee et al., 2024) [31]	- 3 metabolic equivalents of tasks - Total PA - Step counts	1- E-Scale 2- Physical Activity Survey for the Elderly (PASE) questionnaire 3- Physical Activity Vital Sign (PAVS)

Note*: 6-MWT- six minutes' walk test.

Adherence: The adherence varied across the studies, The research tracked the adherence data, i.e. how many patients were able to utilize or obtain data from the wearable device and the number of days it was worn for evaluating physical activity and other outcomes. Two studies reported low adherence results 45% and 52% [27,30] respectively. Four studies reported high adherence data from 64%-84% [24,25,26,28,29,31] (Table 4).

Table 4: Adherence to wearable tracker.

Study (Year)	Adherence
(Nyrop et al., 2018) [24]	79% (100/127) of the patients provided evaluable sensor data.
(Cheong et al., 2018) [25]	The withdrawal rate was 26% for several reasons, including patient choice. And 74% were committed.
(Nelson et al., 2019) [26]	84% of women wore the Fitbit in their chemotherapy days.

(Dreher et al., 2019) [27]	Evaluable sensor data were available in 45% of the days across 9 months.
(Nilanon et al., 2020) [28]	28 patients (68%) were band-wear adherent. The median percentage of days adherent was 92%.
(Van Blarigan et al., 2022) [29]	A total of 6 participants had >80 days of wear time. a median of 67 out of 84 study days.
(Cay et al., 2024) [30]	14 participants (52%) completed a four-week chemotherapy cycle without encountering any adverse events during the cycle and survived up to six months post initiation.
(Kanzawa-Lee et al., 2024) [31]	64% of participants adhered to averaging at least 127 min MVPA per week.

Discussion

There is growing interest in using wearable health technology, such as smartwatches, patches, and clothing, to monitor and record health data in the fields of medicine and oncology [32]. In this review, we examine the impact of wearable trackers on improving physical activity during chemotherapy treatment. In our literature search, we initially identified 594 studies, but after careful review, only 8 met the criteria for inclusion in our analysis. The selected studies comprised both observational and clinical trial designs.

Breast cancer and gastrointestinal cancer were the most commonly represented conditions in these studies. Chemotherapy was the primary treatment in all cases. The sample sizes of the studies ranged from 27 to 127 participants, with monitoring periods varying from 14 days to 12 weeks. Various types of wearable trackers were used to assess physical activity as an outcome measure, with all studies reporting moderate to high adherence to the use of these devices.

However, we identified significant inconsistencies in how wearable health technology studies were designed, defined, and measured outcomes. This inconsistency was evident in the broad range of terms used to describe both the technology and the specific devices [32]. In the field of cancer treatment, there is a growing interest in empowering patients to take greater control of their healthcare. Wearable technology could play a significant role in this by providing valuable health insights. However, before widespread adoption can occur, its practicality and effectiveness must be thoroughly established [33].

In this review, we focused on the feasibility of wearable trackers in improving physical activity by recording various metrics. Physical activity plays a critical role in influencing health outcomes and can aid in predicting patient prognosis. The studies examined the relationship between physical activity levels and related factors to categorize patients and assess their potential health outcomes. These outcomes included physical health indicators such as body composition, physical capacity, motor abilities, functional recovery, symptom severity or pain, and overall quality of life. A study was done by Nilanon in 2020 to assess physical activity in cancer patients undergoing chemotherapy for 60 days tracking period. and found that over 65% of patients were able to adhere to the activity tracker wear protocol. The study also found that higher average metabolic equivalents of task and higher non-sedentary physical activity hours are associated with lower unplanned health care encounters. The study concludes that data from activity trackers can potentially be used to evaluate a patient's risk of unplanned health care encounters. The study suggests that wearable activity trackers can provide valuable insights into the physical activity levels of cancer patients. While further research is needed, these devices have the potential to improve patient care and clinical decision-making in oncology [28].

Wearable fitness trackers can also serve as motivational tools, encouraging physical activity and potentially improving these outcomes. Wearable devices can significantly motivate patients to increase physical activity during cancer treatment through both direct and indirect mechanisms. Directly, they encourage activity through features like step trackers, reminders, and progress tracking. Indirectly, they provide valuable data to both patients and healthcare providers. This data enables the assessment of the effectiveness of fitness plans and lifestyle changes, facilitating adjustments and ultimately leading to improved outcomes [34].

The studies encompassed by this review focused on exploring the relationship between individuals' physical activity levels and their subsequent health outcomes. These outcomes encompassed a wide range, including physical health indicators, psychological well-being, and other relevant health factors. By analyzing the results of device usage, we can identify the most successful intervention strategies, guiding future efforts to optimize their impact on patient care.

There is considerable variation in how often patients use their devices and for how long. Several studies explained the factors influencing device usage duration or withdrawal from treatment. Most studies reported validation periods for device wear time, while wearable devices show promise in improving cancer patient outcomes, their integration into care faces significant challenges. These include adherence issues stemming from psychological, physical, cognitive, technical, and financial factors [35-37].

Wearable activity trackers have proven to be valuable tools in oncological clinical management, particularly for cancer patients undergoing chemotherapy. They offer insights into a patient's overall well-being by continuously tracking physical metrics such as steps taken, calories burned, sleep patterns, and heart rate. Moreover, these devices have demonstrated positive impacts by motivating patients to stay active, setting personalized activity goals, and making adjustments based on daily performance. Another significant advantage is the ability of healthcare providers to utilize the collected data to detect early signs of chemotherapy-related complications and tailor treatment plans to meet the individual needs of patients, thereby promoting better adherence to physical activity guidelines.

This research highlights several key clinical implications of wearable activity trackers for cancer patients undergoing chemotherapy. Wearables provide continuous and objective data on physical activity levels, sleep patterns, and other vital signs. This real-time information can help clinicians monitor patient progress, identify potential complications early, and adjust treatment plans accordingly. By tracking physical activity, wearables can motivate patients to adhere to recommended exercise regimens. Features like step trackers, personalized goals, and progress tracking can enhance patient engagement and encourage consistent activity. The data collected from wearable devices can be used to personalize treatment plans. Besides, clinicians can tailor exercise recommendations, manage side effects, and optimize treatment strategies based on individual patient data and activity levels. Also, Continuous monitoring can help identify early signs of chemotherapy-related complications, such as fatigue, muscle weakness, and cardiac issues. This early detection allows for prompt intervention and potentially improved patient outcomes. Wearable data can facilitate communication between patients and clinicians. As well as patients can share their activity data with their healthcare providers, enabling more informed discussions about treatment progress and lifestyle modifications. By leveraging the data generated by wearable trackers, clinicians can provide more personalized and effective care for cancer patients undergoing chemotherapy, ultimately improving patient outcomes and quality of life.

The findings of this review, when considered alongside the anticipated future uses of wearable devices, demonstrate their potential to collect a wealth of clinically relevant patient data not typically captured in current healthcare practices. However, this potential is accompanied by substantial security and privacy challenges that require careful consideration and mitigation.

This review is subject to several limitations. Firstly, the included studies were limited in number (n=8), with relatively small sample sizes (ranging from 27 to 127 participants). This small sample size and limited number of studies may not be representative of the broader population of cancer patients undergoing chemotherapy. Secondly, the duration of the studies varied significantly (from 14 days to 12 weeks), making it difficult to draw consistent conclusions across different timeframes. Thirdly, the heterogeneity of study designs, including both observational studies and clinical trials, and the diversity of wearable devices used, may have introduced bias and limited the ability to draw robust comparisons across studies. Finally, this review primarily focused on the feasibility and impact of wearable trackers on physical activity levels. It did not delve deeply into the potential benefits or drawbacks of using these devices for other health outcomes, medication adherence in cancer patients.

Future research should prioritize the development of standardized definitions and methodologies for wearable health technology studies in oncology. This includes establishing clear criteria for device selection, data collection, and outcome measurement. A standardized terminology for describing wearable devices and their features will enhance data comparability and facilitate meta-analyses. Furthermore, future studies should include larger and more diverse populations of cancer patients, encompassing a wider range of cancer types, treatment modalities, and sociodemographic characteristics, to improve the generalizability of findings. Addressing adherence challenges is crucial, requiring further investigation into factors influencing tracker usage and the development of strategies to improve long-term adherence, such as personalized support programs and the integration of wearable technology into existing care pathways. Finally, studies with longer follow-up periods are needed to evaluate the long-term impact of wearable trackers on patient outcomes, including overall survival, quality of life, and long-term health.

In conclusion, recent evidence suggests that wearable activity trackers can motivate patients to increase their daily steps, exercise duration, and overall physical activity. Studies have shown that patients using trackers often achieve recommended activity levels more consistently, increased physical activity has been linked to better treatment outcomes, reduced side effects, and improved quality of life in cancer patients. Also, it can enhance rehabilitation by giving real-time feedback on activity levels can help patients and healthcare providers adjust rehabilitation plans as needed, this personalized approach can lead to faster recovery and improved functional outcomes. Some trackers can monitor vital signs like heart rate and sleep patterns, which can help identify potential side effects or complications of cancer treatment early on, this allows for timely interventions and adjustments to treatment plans, potentially improving patient safety and overall well-being.

Acknowledgement

We would like to express our sincere gratitude to the Sultan Qaboos Comprehensive Cancer Care and Research Center for their unwavering support and guidance throughout this research endeavor. Their encouragement and mentorship have been invaluable in shaping this work. We are also deeply grateful to department of holistic care for their invaluable contributions.

Also, we extend our heartfelt thanks to all those who provided support and encouragement during this research journey.

Conflict of Interest

None.

References

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, et al. (2021) Global cancer statistics 2020: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin 71(3): 209-249.
2. Katta B, Vijayakumar C, Dutta S, Dubashi B, Ramakrishnaiah VPN (2023) The incidence and severity of patient-reported side effects of chemotherapy in routine clinical care: a prospective observational study. Cureus 15(4): e38301.
3. Campbell KL, Winters Stone K, Wiskemann J, May AM, Schwartz AL, et al. (2019) Exercise guidelines for cancer survivors: consensus statement from international multidisciplinary roundtable. Med Sci Sports Exerc 51(11): 2375-2390.

4. Cramp F, Byron Daniel J (2012) Exercise for the management of cancer-related fatigue in adults. Cochrane Database Syst Rev 11(11): CD006145.
5. Strain T, Flaxman S, Regina Guthold, Elizaveta Semenova, Melanie Cowan, et al. (2024) National, regional, and global trends in insufficient physical activity among adults from 2000 to 2022: a pooled analysis of 507 population-based surveys with 5·7 million participants. Lancet Glob Health 12(8): e1232-e1243.
6. Bethesda. SEER Cancer Stat Facts: Colorectal Cancer. National Cancer Institute.
7. Schmitz KH, Campbell AM, Stuiver MM, Pinto BM, Schwartz AL, et al. (2019) Exercise is medicine in oncology: engaging clinicians to help patients move through cancer. CA Cancer J Clin 69(6): 468-484.
8. Arem H, Moore SC, Patel A, Hartge P, De Gonzalez AB (2015) Leisure time physical activity and mortality: a detailed pooled analysis of the dose-response relationship. JAMA Intern Med 175(6): 959-967.
9. Misiąg W, Piszczyk A, Szymańska Chabowska A, Chabowski M (2022) Physical activity and cancer care—A review. Cancers 14(17): 4154.
10. World Health Organization (2022) Physical activity and sedentary behaviour: a brief to support people living with type 2 diabetes. World Health Organization.
11. Qazi AS, Tariq K (2023) Therapeutic Approaches in Cancer Treatment. Springer.
12. Amjad MT, Chidharla A, Kasi A (2024) Cancer Chemotherapy [Updated 2023 Feb 27] In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing.
13. Diaz KM, Krupka DJ, Chang MJ, Peacock J, Ma Y, et al. (2015) Fitbit®: An accurate and reliable device for wireless physical activity tracking. Int J Cardiol 185: 138-140.
14. Beg MS, Gupta A, Stewart T, Rethorst CD (2017) Promise of wearable physical activity monitors in oncology practice. J Oncol Pract 13(2): 82-89.
15. Helbrich H, Braun M, Hanusch C, Mueller G, Falk H, et al. (2021) Congruence and trajectories of device-measured and self-reported physical activity during therapy for early breast cancer. Breast Cancer Res Treat 188(2): 351-359.
16. Soto Perez De Celis E, Kim H, Rojo Castillo MP, Sun CL, Chavarri Guerra Y, et al. (2018) A pilot study of an accelerometer-equipped smartphone to monitor older adults with cancer receiving chemotherapy in Mexico. J Geriatr Oncol 9(2): 145-151.
17. Nguyen NH, Vallance JK, Buman MP, Moore MM, Reeves MM, et al. (2021) Effects of a wearable technology-based physical activity intervention on sleep quality in breast cancer survivors: the ACTIVATE Trial. J Cancer Surviv 15(2): 273-280.
18. Blount DS, McDonough DJ, Gao Z (2021) Effect of wearable technology-based physical activity interventions on breast cancer survivors' physiological, cognitive, and emotional outcomes: A systematic review. J Clin Med 10(9): 2015.
19. Wu JM, Ho TW, Chang YT, Hsu C, Tsai CJ, et al. (2019) Wearable-based mobile health app in gastric cancer patients for postoperative physical activity monitoring: focus group study. JMIR Mhealth Uhealth 7(4): e11989.
20. Zhou W, Shang S, Cho Y (2024) Associations of Wearable Activity Tracker Use With Physical Activity and Health Outcomes in Patients With Cancer: Findings from a Population-Based Survey Study. J Med Internet Res 26: e51291.
21. Chow R, Drkulec H, Im JH, Tsai J, Nafees A, et al. (2024) The Use of Wearable Devices in Oncology Patients: A Systematic Review. Oncologist 29(4): e419-e430.
22. Ferguson T, Olds T, Curtis R, Blake H, Crozier AJ, et al. (2022) Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses. Lancet Digit Health 4(8): e615-e626.
23. Critical Appraisal Skills Programme (CASP) (2018) CASP Checklists.
24. Nyrop KA, Deal AM, Choi SK, Wagoner CW, Lee JT, et al. (2018) Measuring and understanding adherence in a home-based exercise intervention during chemotherapy for early breast cancer. Breast Cancer Res Treat 168(1): 43-55.
25. Cheong IY, An SY, Cha WC, Rha MY, Kim ST, et al. (2018) Efficacy of mobile health care application and wearable device in improvement of physical performance in colorectal cancer patients undergoing chemotherapy. Clin Colorectal Cancer 17(2): e353-e362.
26. Nelson SH, Weiner LS, Natarajan L, Parker BA, Patterson RE (2019) Continuous, objective measurement of physical activity during chemotherapy for breast cancer: the Activity in Treatment pilot study. Transl Behav Med 10(4): 1031-1038.
27. Dreher N, Hadeler EK, Hartman SJ, Wong EC, Acerbi I, et al. (2019) Fitbit usage in patients with breast cancer undergoing chemotherapy. Clin Breast Cancer 19(6): 443-449.
28. Nilanon T, Nocera LP, Martin AS, Kolatkar A, May M, et al. (2020) Use of wearable activity tracker in patients with cancer undergoing chemotherapy: toward evaluating risk of unplanned health care encounters. JCO Clin Cancer Inform 4: 839-853.
29. Van Blarigan EL, Dhruva A, Atreya CE, Kenfield SA, Chan JM, et al. (2022) Feasibility and acceptability of a physical activity tracker and text messages to promote physical activity during chemotherapy for colorectal cancer: pilot randomized controlled trial (Smart Pace II). JMIR cancer 8(1): e31576.
30. Cay G, Sada YH, Dehghan Rouzi M, Uddin Atique MM, Rodriguez N, et al. (2024) Harnessing physical activity monitoring and digital biomarkers of frailty from pendant based wearables to predict chemotherapy resilience in veterans with cancer. Sci Rep 14(1): 2612.
31. Kanzawa Lee GA, Larson JL, Resnicow K, Ploutz Snyder R, Krauss JC, et al. (2024) Home-based aerobic exercise feasibility in oxaliplatin-receiving newly-diagnosed cancer survivors. Eur J Oncol Nurs 71: 102649.
32. Chow R, Drkulec H, Im JH, Tsai J, Nafees A, et al. (2024) The Use of Wearable Devices in Oncology Patients: A Systematic Review. Oncologist 29(4): e419-e430.
33. Beauchamp UL, Pappot H, Holländer Mieritz C (2020) The use of wearables in clinical trials during cancer treatment: systematic review. JMIR Mhealth Uhealth 8(11): e22006.
34. Ferguson T, Olds T, Curtis R, Blake H, Crozier AJ, et al. (2022) Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses. Lancet Digit Health 4(8): e615-e626.
35. van de Wiel HJ, Stuiver MM, May AM, van Grinsven S, Aaronson NK, et al. (2021) Effects of and Lessons Learned from an Internet-Based Physical Activity Support Program (with and without Physiotherapist Telephone Counselling) on Physical Activity Levels of Breast and Prostate Cancer Survivors: The PABLO Randomized Controlled Trial. Cancers 13(15): 3665.
36. Sabiston CM, Fong AJ, O Loughlin EK, Meterissian S (2019) A mixed-methods evaluation of a community physical activity program for breast cancer survivors. J Transl Med 17(1): 206.
37. Rahimy E, Usoz M, von Eyben R, Fujimoto D, Watanabe D (2021) Phase II trial evaluating efficacy of a Fitbit program for improving the health of endometrial cancer survivors. Gynecol Oncol 161(1): 275-281.