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Osteoarthritis and Its Management: Impact of Wearable Technologies – A Systematic Review

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Abstract

Background: Wearable technology plays a significant role in disease management for individuals diagnosed with osteoarthritis.

Aim: This review aims to assess the impact of wearable technologies on disease management in patients with osteoarthritis.

Methods: The researchers searched relevant databases between March 4 and April 4, 2024. Randomized and quasi-experimental studies published in Turkish or English between 2000 and 2024 were included, provided they had full text availability and involved the use of wearable technology in individuals aged 18 years and older diagnosed with osteoarthritis. A total of 472 studies were reviewed, and five articles met the inclusion criteria. The Cochrane Risk of Bias tool was used to evaluate the quality of the included studies.

Results: Wearable technologies were found to help manage physiological symptoms and increase physical activity. However, the optimal duration and specific techniques of wearable technology interventions for osteoarthritis management are unclear.

Conclusion: Wearable technology interventions have been shown to improve disease control and increase physical activity. Therefore, these products can be recommended for inclusion in healthcare plans to support both disease management and the promotion of physical activity.

Keywords: ***Disease management, nursing care, osteoarthritis, wearable technology***

Introduction

Osteoarthritis (OA) is one of the most common rheumatic diseases, characterized by the progressive and irreversible loss of joint cartilage, accompanied by synovial inflammation, pain, and dysfunction in weight-bearing joints such as hands, knees, hips, feet, and vertebrae. This condition often leads to significant disability, particularly among the elderly.[1,2] Although the incidence of OA increases with age, it is most prevalent in women over the age of 60. The prevalence rate is 42.1% in women and 31.2% in men.[3] According to 2019 data from the Turkish Statistical Institute, the prevalence of OA in the Turkish population was estimated at 11.2%.[4] In the United States (USA), the prevalence of radiographic hand OA is 27.2%, knee OA is 19.2%, and hip OA is 27%.[5] Risk factors for OA include age, genetic predisposition,[6] gender, occupational and sports activities,[7] obesity, nutrition,[8,9] joint disorders and trauma,[10] osteoporosis, and smoking.[11] The most typical symptom experienced by OA patients is pain, often described as aching and gradually worsening. It is frequently one of the primary reasons for seeking medical attention. Other common symptoms include morning stiffness, limited joint movement, crepitus, swelling, redness, and other related issues. These symptoms lead to disability, reduced physical capacity, and a diminished quality of life.[11] As with all rheumatic diseases, integrative management approaches, such as patient education and exercise, are recommended for OA.[2] Due to their symptoms, OA patients are particularly prone to physical inactivity. However, physical activity offers numerous benefits and is one of the most critical components of symptom management. Wearable technologies (WATs) can assist in managing symptoms such as pain and stiffness, while also promoting increased physical activity.[12–15]

Wearable technology, also referred to as “wearable devices” or simply “wearables,” includes technological devices that can be worn, attached, or carried on the body. These devices perform many of the same functions as computers and smartphones.[16] To be classified as a wearable device, the product typically includes smart sensors and the ability to transmit data to a computer or smartphone.[17] The use of WATs has grown rapidly in recent years and is increasingly popular due to their blend of fashion and functionality.[16] They provide users with mobile access to real-time information, eliminating the need to remain in a fixed location. WAT products come in various forms, including smartwatches, smart clothing, and smart glasses.[18] Wearable technology used in healthcare helps individuals lead healthier lifestyles by continuously recording physiological parameters and monitoring metabolic status, providing a steady stream of health data for disease diagnosis and treatment. These devices allow healthcare professionals to remotely access patients’ health data, enabling the planning of health-related behaviors, such as medication, exercise, and diet programs, even before the individual visits a healthcare facility. With WAT devices, various types of health data can be

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accessed, including habits, sleep duration, medical history, diagnostic test results, daily step count, heart rate, blood pressure, blood glucose levels, and blood oxygen concentration.[19] Physical activity and maintaining a healthy body weight are crucial for controlling the progression of OA.[20] Physical activity enables patients to carry out their daily activities and reduces the risk of symptom progression. Therefore, increasing physical activity through the use of wearable devices is essential for OA patients. Given these benefits, the use of wearable devices is recommended for individuals with OA.[19] The role of WAT in healthcare is becoming increasingly prominent. With advances in wearable health technologies, individuals are now more empowered to take an active role in managing their own health. These devices offer continuous access to personal health data anytime and anywhere, and enable the monitoring of physical activity levels. The data collected by wearable devices not only provide individuals with insights into their health but also hold significant potential in clinical settings, particularly in diagnosis and treatment processes. It is promising that wearable technologies, now a part of everyday life, are increasingly gaining attention and making life easier, while also offering potential benefits for human health.[18–20] In light of this, the present study was conducted to highlight the effect of wearable technologies on disease management in individuals diagnosed with osteoarthritis, particularly as they age. The aim of this systematic review was to determine the impact of WAT on symptom control and physical activity in OA patients experiencing symptoms such as pain, stiffness, and rigidity.

Research Questions

- Is WAT effective in the symptom management of individuals diagnosed with OA?
- Is WAT effective in increasing the physical activity of individuals diagnosed with OA?
- What types of WAT products are used by individuals diagnosed with OA?
- Which WAT interventions are recognized for managing the physiological symptoms of OA?
- Which WAT interventions are used to increase physical activity in individuals with OA?

Materials and Methods

This study was designed as a systematic review. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA-P) guideline was followed[20] to ensure accurate and comprehensive conduct and reporting of the review.

Search Strategy

Articles published between 2000 and 2024 in the following databases were searched between March 4 and April 4, 2024: DergiPark, Cochrane Central Register of Controlled Trials, PubMed, ScienceDirect, Web of Science Core Collection, and Google Scholar. 'Medical Subject Headings (MeSH)' were used for English keywords and 'Turkish Science Terms (TST)' for Turkish keywords. A detailed search strategy was developed using these terms (Table 1).

Inclusion and Exclusion Criteria

Inclusion and exclusion criteria were determined based on the PICOS framework (Population, Intervention, Comparison, Outcome, Study Design).[21] This systematic review included only randomized controlled trials published in peer-reviewed international scientific journals between 2000 and 2024. Eligible studies investigated the effects of WAT applications on symptom management and physical activity in patients aged 18 years and older diagnosed with OA. Studies were excluded if they did not meet the inclusion criteria, were written in languages other than Turkish or English, or lacked full-text availability.

Selection of Literature Included in the Review

The literature review was conducted by the researchers. To document the number of articles retrieved from the selected databases, a PRISMA-P flowchart was created (Fig. 1). A total of 472 studies were initially identified and imported into the Mendeley Library for categorization and selection of relevant manuscripts for the review. Duplicates (n=47) were identified by importing references from the Mendeley Library into the Rayyan Intelligent Systematic Review program.[22] After excluding studies based on inappropriate subject matter, study type, or lack of access to the full manuscript, five randomized controlled trials were included in the review (Fig. 1). No quasi-experimental studies meeting the inclusion criteria were found during the search.

Study Selection and Data Extraction

The researchers (FA, TE, GBA) were involved at every stage of the review process. The search strategy, search dates for each database, search terms used, and the number of articles retrieved were all documented. A PRISMA-P flowchart was created to record journal selection and to document the total number of articles considered. All retrieved articles were imported from the Mendeley Library into the Rayyan database, where duplicates were identified and removed. One researcher (FA) initially screened article titles and abstracts to apply the inclusion and exclusion criteria. A second researcher (TE) reviewed the titles and abstracts categorized under the exclusion criteria for accuracy. Full texts of potentially eligible studies were independently assessed for adequacy by all three researchers (FA, TE, GBA). Reasons for excluding studies were detailed in the PRISMA-P flowchart. One researcher (FA) summarized the data from the included articles and finalized the literature review. The other researchers (TE, GBA) reviewed the extracted data and independently verified the accuracy and consistency of the database.

Evaluation of Methodological Quality of Included Studies

The methodological quality of the included studies (n=5) was assessed by the researchers using a checklist developed by the Joanna Briggs Institute (JBI) (Table 2). The JBI checklist includes 13 questions that evaluate selection bias, performance bias, reporting bias, and neglect bias. Each question is scored as "Yes=1," "No=0," "Unclear=0," or "Not Applicable=0." For randomized controlled experimental trials, the maximum score is 13. A higher total score indicates a higher methodological quality (Table 3).[23]

Evaluation of Risk of Bias

The quality of the studies was also assessed using the Cochrane Risk of Bias tool (RoB 2), which evaluates six categories of potential bias. Based on these criteria, studies were classified as having a "high risk of bias," "suspected risk of bias," or "low risk of bias" (Table 4).[24]

Ethical Considerations

Since the findings of this study were derived from previously published articles retrieved from databases, ethics committee approval was not required. All studies included in the review have been properly cited and referenced. This review has been registered with the PROSPERO (International Prospective Register of Systematic Reviews) database, which provides a platform for registering systematic and meta-analysis reviews, under registration number CRD42024522145.

Results

Five randomized controlled trials published between 2000 and 2024 were included in the review (Fig. 1).

Table 1. Keywords

Keywords	English: Osteoarthritis, Wearable Technology, Wearable Electronic Device, Symptom, Symptom Management Turkish: Osteoartrit, Giyilebilir Teknoloji, Giyilebilir Elektronik Cihazlar, Semptom, Semptom Yönetimi
Search strategy using english keywords	((Osteoarthritis[Title]) AND (Wearable Technology[Title]) OR (Wearable Electronic Device[Title]) AND ((Symptom[Title/Abstract]) OR (Symptom Management[Title/Abstract]))
Search strategy using turkish keywords	((Osteoartrit[Title]) AND (Giyilebilir Teknoloji[Title]) OR (Giyilebilir Elektronik Cihazlar[Title]) AND ((Semptom[Title/Abstract]) OR (Semptom yönetimi[Title/Abstract]))

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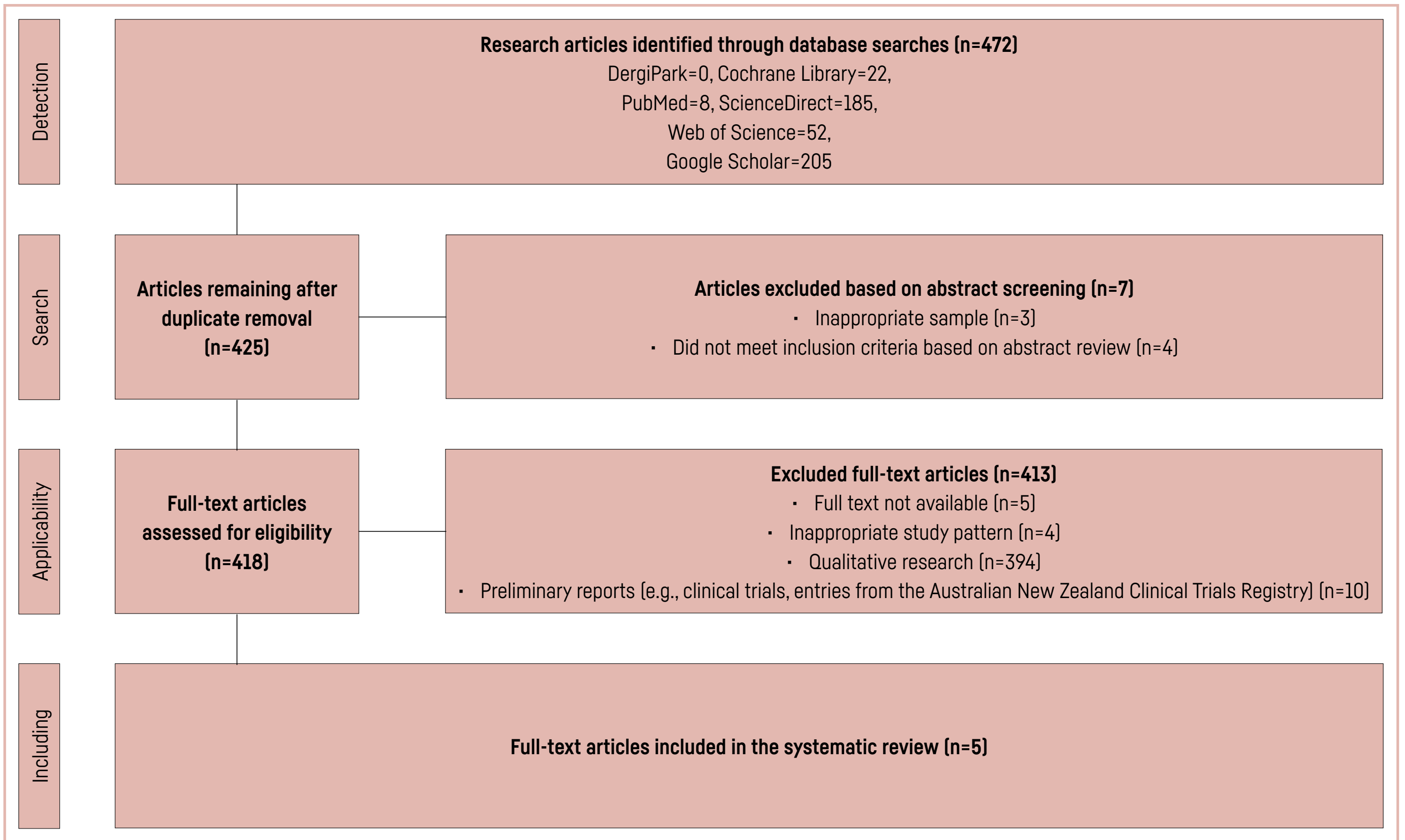

Figure 1. PRISMA-P (preferred reporting items for systematic review and meta-analysis protocols) flowchart of the study selection process.

Table 2. Methodological quality assessment of included studies

Study	Criteria 1	Criteria 2	Criteria 3	Criteria 4	Criteria 5	Criteria 6	Criteria 7	Criteria 8	Criteria 9	Criteria 10	Criteria 11	Criteria 12	Criteria 13	n	%
Menz et al.,[25] 2014	+	?	+	+	?	?	+	+	+	+	+	+	+	10/13	76.9
Skrepnik et al.,[26] 2017	+	+	+	+	-	?	+	+	+	+	+	+	+	11/13	84.61
Li et al.,[27] 2020	+	-	+	-	-	-	+	+	+	+	+	+	+	9/13	69.2
Östlind et al.,[28] 2022	+	?	+	-	-	-	+	+	+	+	+	+	+	9/13	69.2
Hsu et al.,[29] 2022	+	-	+	-	-	?	+	+	+	+	+	+	+	9/13	69.2

+: Yes, -: No, ?: Uncertain/not applicable, Criteria 1-13: Criteria from the Joanna Briggs Institute (JBI) systematic review checklist for randomized controlled trials, n: Number, %: Percentage.

Table 3. Risk of bias assessment of randomized controlled trials included in the review based on the cochrane risk of bias tool, version 2 (ROB-2)

Risk of bias criteria	Studies included in the review				
	Menz et al.,[25] 2014	Skrepnik et al.,[26] 2017	Li et al.,[27] 2020	Östlind et al.,[28] 2022	Hsu et al.,[29] 2022
Risk of bias due to randomization process	+	+	+	+	+
Risk of bias due to deviations from intended interventions (effect of assignment to intervention)	?	+	?	?	?
Risk of bias due to deviations from intended interventions (effect of adherence to intervention)	?	?	−	+	+
Risk of bias due to missing outcome data	+	+	+	?	+
Risk of bias in measurement of the outcome	+	+	+	+	?
Risk of bias in selection of the reported result	+	+	?	+	+

+ : Low risk of bias, ? : Some concerns, − : High risk of bias

Table 4. Randomized controlled trials on wearable assistive technology (WAT) interventions for disease management in patients with osteoarthritis

Author, year (Country)	Study design	Department	Sample size	Participant characteristics	Symptoms/ outcomes assessed	Assessment tools	Intervention	Follow-up period	WAT product
Menz et al.,[25] 2014 (Australia)	RCT	University of Sydney	n=80	OA patients	Pain, stiffness, foot health, physical activity	Visual analog scale (VAS), foot health status questionnaire (FHSQ), planned activity questionnaire	Participants were fitted with custom prefabricated foot orthoses designed to reduce pain associated with first metatarsophalangeal joint osteoarthritis (OA). Outcomes were evaluated using a wireless wearable motion analysis system and an in-shoe plantar pressure system.	Baseline, weeks 4, 8, 12	Personalized footwear, wireless wearable motion system, and in-shoe plantar pressure system
Skrepnik et al.,[26] 2017 (USA)	RCT	Multicenter	n=318	Knee OA patients	Pain, mobility	6-minute walk test	Participants wore a wearable activity monitor/pedometer continuously for 90 days.	Baseline, day 90	Wearable activity monitor/ pedometer
Li et al.,[27] 2020 (Canada)	RCT	University of British Columbia	n=51	Knee OA patients	Physical activity, time spent in physical activity, pain, quality of life	Knee Injury and osteoarthritisoutcome score (KOOS), Step count per day	Participants received 30 minutes of face-to-face training on the use of a wristband, along with physical activity counseling. Their activity data were recorded using FitViz, a Fitbit-compatible web-based platform.	Baseline, weeks 13, 26, 39	Smart wristband
Östlind et al.,[28] 2022 (Sweden)	RCT	28 health centers in Southern Sweden	n=160	Hip and knee OA patients	Physical activity, work efficiency, work ability	Work ability index (WAI), International physical activity questionnaire, activity impairment scale	Participants engaged in an osteoarthritis self-management program supported by technology. Data collected by the device were transmitted via Bluetooth to smartphones, tablets, or computers and could be accessed through a dedicated application in real time.	Baseline, Months 3, 6, 12	Smart wristband
Hsu et al.,[29] 2022 (Taiwan)	RCT	Asian University Hospital	n=27	Knee OA patients	Pain, stiffness, physical function, plantar pressure	VAS, western ontario and McMaster Universities osteoarthritis index (WOMAC), plantar-pressure test	Using a foot evaluation system, thermoplastic polyurethane insoles customized for foot compatibility were placed in the participants' shoes. They were instructed to wear them for at least four hours per day.	Baseline, Week 20	Wearable sensor insole

RCT: Randomized controlled trial.

Methodological Quality and Risk of Bias Assessment

The average methodological quality score of the included articles was 9.6, with scores ranging from a minimum of 9 to a maximum of 11 (Table 2). Risk of bias assessments for each study are presented in Table 3.

Characteristics of Included Studies and Participants

The five randomized controlled trials were conducted between 2000 and 2024. The studies took place in Australia,[25] the USA,[26] Canada,[27] Sweden,[28] and Taiwan,[29] primarily in departments and institutions such as university clinics and health centers. The included articles involved a total of 636 participants, all diagnosed with OA, including knee OA, hip OA, or generalized OA. Participants were aged 18 years and older (Table 4).

Intervention Method and Scope

The included studies used various wearable technology interventions for patients diagnosed with osteoarthritis, including knee and hip osteoarthritis. The technologies used were: personalized footwear, a wireless wearable motion system, and an in-shoe plantar pressure system,[25] wearable activity monitors or pedometers,[26] smart wristbands,[27,28] and wearable sensing insole technology.[29] Most devices were worn on the wrist or foot. The duration of interventions ranged from a minimum of three months[25] to a maximum of 12 months.[28] The studies reviewed primarily analyzed physiological parameters and physical activity levels. Secondary outcomes included foot health,[25] mobility,[26] time spent in physical activity, quality of life,[27] work productivity, work ability,[28] physical function, and plantar pressure[29] (Table 4).

Effects of WAT Interventions on Disease Management

The included studies assessed the effectiveness of WAT interventions in managing OA and evaluated their impact following the intervention period (Table 4). In conclusion, outcomes such as work efficiency, plantar pressure, and quality of life were also evaluated following interventions using wearable technology products. In the studies included in this systematic review, WAT products were generally found to reduce physiological symptoms[25–29] and increase physical activity.[25,27] However, one study reported no effect of wrist-worn WAT devices on physical activity, work efficiency, or work ability[28] (Table 5).

Discussion

While conducting this systematic review, we observed that WAT interventions are most commonly applied in populations such as individuals who are overweight or obese,[30] those with type II diabetes mellitus,[31] stroke,[32] dementia,[33] or cardiovascular conditions.[34] However, there is limited literature, both nationally and internationally, focusing on the use of wearable technologies in individuals with rheumatological conditions. With advancing technology, WATs are emerging as a new approach to improving disease management in individuals diagnosed with OA, and they have the potential to be integrated into nursing care. This review discusses the findings of five articles analyzing the impact of WAT on disease management in individuals with OA.

Among the interventions included in the review, WAT products were specifically developed and tested for the management of pain symptoms in individuals diagnosed with osteoarthritis. To address pain, patients were treated using devices such as an ankle-worn smart wristband,[27,28] a wearable sensing insole,[29] a wearable activity monitor,[26] a wireless wearable mo-

Table 5. Effects of wearable assistive technology (WAT) interventions on disease management outcomes in included studies

Study	Physical activity	Work efficiency	Work ability	Pain	Stiffness	Physical function	Plantar pressure	Quality of life	Mobility (steps/day)
Menz et al.,[25] 2014	↑			↓	↓		↓		
Skrepnik et al.,[26] 2017				↓					↑
Li et al.,[27] 2020	↑			↓				↑	
Östlind et al.,[28] 2022	↔	↔	↔	↓					
Hsu et al.,[29] 2022				↓	↓	↑	↓		

tion system, and an in-shoe plantar pressure system.[25] Each of these studies found WAT products to be effective in managing pain symptoms.[25–29] In the broader literature, a study that designed a wearable therapeutic ultrasound device for individuals with chronic myofascial pain reported reduced use of painkillers and improved pain management.[35] Similarly, another study on patients with chronic knee pain found that a wearable transcutaneous electrical nerve stimulation device was effective in reducing pain.[36] These findings suggest that WAT is effective in managing pain not only in OA patients but also in individuals with other conditions, and that a variety of devices can be developed depending on the location of the pain. However, when examining the characteristics of the studies, it is unclear how frequently wearable devices should be used for effective pain management.

In the interventions included in the review, WAT products were developed to address stiffness symptoms, and their effectiveness in symptom management was tested. A wireless wearable motion system and an in-shoe plantar pressure system were used to manage stiffness.[25] Additionally, to address stiffness, insoles made of thermoplastic polyurethane were placed in patients' shoes, and participants received a wearable sensing insole.[29] These wearable technology products were found to be effective in managing stiffness symptoms. In the broader literature, a study reported that a wearable device applied to shoulder stiffness reduced symptoms of stiffness.[37] However, the literature review reveals a lack of sufficient studies focused specifically on managing stiffness symptoms. While all three studies in this review indicate that wearable technologies can be effective for stiffness management, the limited number of studies prevents a conclusive evaluation of their overall effectiveness.

The importance of lifestyle changes is often emphasized by health professionals following a diagnosis of osteoarthritis. Among these, individuals with obesity are commonly advised to lose weight, increase their physical activity, and follow a healthy diet. Studies have shown that disease management is more effective in patients who follow these recommendations.[13] In the studies included in our review, wearable activity monitors were used to track daily step counts.[26] It was found that these WAT products increased the number of steps taken by individuals with OA. In the literature, a study that tested the step count levels of a wearable activity monitor on young adults over a two-week period found that the device visibly increased step count.[38] Similarly, a meta-analysis involving individuals with overweight and obesity found that wearable technology products contributed to a reduction in body mass index, an increase in step count, and a decrease in waist circumference. In addition, it was noted that such devices allow users to access numerical feedback, which can help motivate individuals to reach their goals when they observe they have taken fewer steps.[30]

Another study reported that, over a three-month period, breast cancer survivors who used wearable technology products increased their physical activity and reduced sedentary behavior.[39] In the studies included in our review, wearable technology interventions promoting physical activity were generally conducted over periods ranging from 2 to 10 months. As a result, increased physical activity levels were observed.[25,27] However, the variation in the WAT products used across studies prevented direct comparisons in terms of the duration or frequency of application. It is unclear which specific WAT interventions should be applied, and for which symptoms in individuals diagnosed with OA.

The wearable sensing insole used to improve physical function was found to be effective in enhancing physical function in OA patients.[29] When examining the research outcomes, WAT methods generally appear to increase physical activity in individuals with OA.[25,27] Only one study reported no effect on physical activity.[28] Analyzing the included studies individually, WAT products were found to be effective in treating OA-related symptoms. However, it is still unclear which product is more effective for which specific symptom, or which products should be used in combination. There is considerable heterogeneity among the studies reviewed, and notably, similar symptoms are not evaluated using consistent criteria. This makes it difficult to accurately assess the true impact of WAT products. However, overall, the studies suggest that WAT offers individuals the ability to monitor themselves objectively. In this way, individuals can make the necessary lifestyle changes to support activity motivation and disease management.

One study included in the review found that wearable sensing insoles improved the quality of life in individuals with osteoarthritis.[29] Another study, which examined the impact of pain on the quality of life in fibromyalgia patients, concluded that a wearable device (a millimeter wave-emitting wristband) improved quality of life by reducing pain.[40] These findings highlight the importance of managing physiological symptoms. When such symptoms are effectively controlled, an indirect improvement in patients' quality of life is often observed.

Limitations of the Research

This study has several limitations. First, only six databases were searched, and gray literature was not included. The review was limited to studies conducted between 2000 and 2024, published in English or Turkish, and with accessible full texts. No Turkish studies were identified among the reviewed articles. Another limitation is that while the review intended to include both randomized controlled and quasi-experimental studies, only randomized controlled trials were ultimately included.

Conclusion

In conclusion, interventions using WAT products were found to be effective strategies for reducing physiological symptoms and increasing physical activity levels in individuals diagnosed with OA. Although WAT products appear to be effective in symptom management, most studies had small sample sizes. Therefore, future research should include larger sample groups to strengthen the evidence base. Currently, no WAT interventions specific to OA patients are being applied in our country. In this systematic review, we emphasize that individuals diagnosed with OA can manage their condition using emerging technology products. We believe that further research should be conducted to raise awareness of such technologies in our country. It is unclear which WAT products are most suitable for specific symptoms and the optimal duration of their use in symptom management for individuals with OA. Therefore, more randomized controlled trials are needed to address these gaps. Finally, WAT products are known to be costly. We believe that these interventions should undergo cost analysis and be used effectively in the disease management of individuals through state-supported healthcare programs.

Ethics Committee Approval: Since the findings of this study were derived from previously published articles retrieved from databases, ethics committee approval was not required.

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References

1. Özdemir L. Kas-iskelet sistemi hastalıkları ve hemşirelik bakımı. In: Bedük T, edt. İç Hastalıkları Hemşireliği Akıl Notları. Ankara:Güneş Tıp Kitabevi;2019:S299–311.
2. Parlar Kılıç S. Eklem ve bağ dokusu hastalıkları. In: Ovayolu N, Ovayolu Ö, eds. Temel İç Hastalıkları Hemşireliği ve Farklı Boyutlarıyla Kronik Hastalıklar. Ankara:Nobel Tıp Kitabevi;2016:S425–431.
3. Karataş T, Yılmaz E, Polat Ü. Osteoartrit yönetimi, yaşam kalitesi ve hemşirenin destekleyici rolü. Med J SDU. 2022;29(2):265–271. [CrossRef]
4. Türkiye İstatistik Kurumu. Türkiye sağlık araştırması, 2019. Accessed May 13, 2025. https://data.tuik.gov.tr/Bulten/Index?p=Turkiye-Saglik-Arastirmasi-2019–33661
5. Babadağ Savaş B. Osteoartrit ve bakım. In: Oksel E, Balcı Alparslan G, ed. Romatoloji hemşireliği hastalıklar ve bakım. Ankara:Nobel Tıp Kitabevi;2019:S1–9.
6. Palazzo C, Nguyen C, Lefevre-Colau MM, Rannou F, Poiraudeau S. Risk factors and burden of osteoarthritis. Ann Phys Rehabil Med. 2016;59(3):134–138. [CrossRef]
7. Allen KD, Golightly YM. State of the evidence. Curr Opin Rheumatol. 2015;27:276–283. [CrossRef]
8. Yılmaz Demiriz S, Sarıkaya S. Diz osteoartriti hastalarında tanı ve kılavuzlar ışığında güncel tedavi. Med J West Black Sea. 2021;5(2):115–124. [CrossRef]
9. Bortoluzzi A, Furini F, Scirè CA. Osteoarthritis and its management-epidemiology, nutritional aspects and environmental factors. Autoimmun Rev. 2018;17(11):1097–1104. [CrossRef]
10. Vina ER, Kwoh CK. Epidemiology of osteoarthritis: Literature update. Curr Opin Rheumatol. 2018;30(2):160–167. [CrossRef]
11. Bilge A, Ulusoy RG, Üstebay S, Öztürk Ö. Osteoartrit. Kafkas J Med Sci. 2018;8(1):133–142. [CrossRef]
12. Wang Y, Liu X, Wang W, Shi Y, Ji X, Hu L, et al. Adherence, efficacy, and safety of wearable technology-assisted combined home-based exercise in Chinese patients with ankylosing spondylitis: Randomized pilot controlled clinical trial. J Med Internet Res 2022;24(1):e29703. [CrossRef]
13. Li LC, Feehan LM, Xie H, Lu N, Shaw CD, Gromala D, et al. Effects of a 12-week multifaceted wearable-based program for people with knee osteoarthritis: Randomized controlled trial. JMIR Mhealth Uhealth. 2020;8(7):e19116. [CrossRef]
14. Labat G, Hayotte M, Bailly L, Fabre R, Brocq O, Gerus P, et al. Impact of a wearable activity tracker on disease flares in spondyloarthritis: A randomized controlled trial. J Rheumatol. 2022;49(10):1109–1116. [CrossRef]
15. Östlind E, Eek F, Stigmar K, Sant'Anna A, Hansson EE. Promoting work ability with a wearable activity tracker in working age individuals with hip and/or knee osteoarthritis: A randomized controlled trial. BMC Musculoskelet Disord. 2022;23(1):112. [CrossRef]
16. Demirci Ş. Giyilebilir teknolojilerin sağlık hizmetlerine ve sağlık hizmet kullanıcılarına etkileri. Anemon Mus Alparslan Univ J Soc Sci. 2018;6(6):985–992.
17. Dursun N, Yılmaz E. Cerrahi hemşireliği alanında giyilebilir teknoloji kullanımı. Istanbul Gelisim Univ J Health Sci. 2021;15:646–656. [CrossRef]
18. Thierer A. The internet of things and wearable technology: Addressing privacy and security concerns without derailing innovation. Richmond J Law Technol. 2015;21(2):1–118. [CrossRef]
19. U.S. Food&Drug Administration. Vital Connect HealthPatch MD Biosensor Receives FDA. [Internet]. Accessed May 16, 2025. https://www.accessdata.fda.gov/cdrh_docs/pdf19/K192757.pdf
20. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. BMJ. 2021;372:n71. [CrossRef]
21. Amir-Behghadami M, Janati A. Population, Intervention, Comparison, Outcomes and Study (PICOS) design as a framework to formulate eligibility criteria in systematic reviews. Emerg Med J. 2020;37:387. [CrossRef]
22. Ouzzani M, Hammady H, Fedorowicz Z, Elmagarmid A. Rayyan-a web and mobile app for systematic reviews. Syst Rev. 2016;5:1–10. [CrossRef]
23. Hür G, Zengin H, Suzan ÖK, Kolukısa T, Eroğlu A, Çınar N. Joanna Briggs Enstitüsü (JBI) randomize kontrollü çalışmalar için kalite değerlendirme aracı'nın Türkçe'ye uyarlaması. Sağlık Bilimlerinde İleri Araştırmalar Derg. 2021;5(2):112–117. [CrossRef]
24. Higgins JP, Thompson SG, Deeks JJ, Altman DG. Measuring inconsistency in meta-analyses. BMJ. 2003;327(7414):557–560. [CrossRef]
25. Menz HB, Levinger P, Tan JM, Auhl M, Roddy E, Munteanu SE. Rocker-sole footwear versus prefabricated foot orthoses for the treatment of pain associated with first metatarsophalangeal joint osteoarthritis: Study protocol for a randomised trial. BMC Musculoskelet Disord. 2014;15:1–13. [CrossRef]
26. Skrepnik N, Spitzer A, Altman R, Hoekstra J, Stewart J, Toselli R. Assessing the impact of a novel smartphone application compared with standard follow-up on mobility of patients with knee osteoarthritis following treatment with Hylan GF 20: A randomized controlled trial. JMIR mHealth uHealth. 2017;5(5):e7179. [CrossRef]
27. Li LC, Feehan LM, Xie H, Lu N, Shaw CD, Gromala D, et al. Effects of a 12-week multifaceted wearable-based program for people with knee osteoarthritis: Randomized controlled trial. JMIR Mhealth Uhealth. 2020;8(7):e19116. [CrossRef]
28. Östlind E, Eek F, Stigmar K, Sant'Anna A, Hansson EE. Promoting work ability with a wearable activity tracker in working age individuals with hip and/or knee osteoarthritis: A randomized controlled trial. BMC Musculoskelet Disord. 2022;23(1):112. [CrossRef]
29. Hsu WC, Chou LW, Chiu HY, Hsieh CW, Hu WP. A study on the effects of lateral-wedge insoles on plantar-pressure pattern for medial knee osteoarthritis using the wearable sensing insole. Sensors. 2022;23(1):84. [CrossRef]
30. Wong SH, Tan ZYA, Cheng LJ, Lau ST. Wearable technology-delivered lifestyle intervention amongst adults with overweight and obese: A systematic review and meta-regression. Int J Nurs Stud. 2022;127:104163. [CrossRef]
31. Chua REC, Lau Y, Ang WW, Boey AAYF, Lau ST. Effectiveness of wearable technology-based physical activity interventions for adults with type 2 diabetes mellitus: A systematic review and meta-regression. J Diabetes. 2024;16(10):e70002. [CrossRef]
32. Parker J, Powell L, Mawson S. Effectiveness of upper limb wearable technology for improving activity and participation in adult stroke survivors: Systematic review. J Med Internet Res. 2020;22(1):e15981. [CrossRef]
33. Weizman Y, Tirosh O, Beh J, Fuss FK, Pedell S. Gait assessment using wearable sensor-based devices in people living with dementia: A systematic review. Int J Environ Res Public Health. 2021;18(23):12735. [CrossRef]
34. Prasitlumkum N, Cheungpasitporn W, Chokesuwattanaskul A, Thangjui S, Thongprayoon C, Bathini T, et al. Diagnostic accuracy of smart gadgets/wearable devices in detecting atrial fibrillation: A systematic review and meta-analysis. Arch Cardiovasc Dis. 2021;114(1):4–16. [CrossRef]
35. Lewis GK Jr, Langer MD, Henderson CR Jr, Ortiz R. Design and evaluation of a wearable self-applied therapeutic ultrasound device for chronic myofascial pain. Ultrasound Med Biol. 2013;39(8):1429–1439. [CrossRef]
36. Yamada K, Shimizu H, Doi N, Harada K, Ishizuka-Inoue M, Yamashita R, et al. Usefulness and safety of a wearable transcutaneous electrical nerve stimulation device for promoting exercise therapy in patients with chronic knee pain: A randomized controlled trial. Arch Phys Med Rehabil. 2025;106(2):167–176. [CrossRef]
37. Sawada T, Okawara H, Nakashima D, Iwabuchi S, Matsumoto M, Nakamura M, et al. Effects of alternating heat and cold stimulation using a wearable thermo-device on subjective and objective shoulder stiffness. J Physiol Anthropol. 2022;41:1–10. [CrossRef]
38. Tayler WB, LeCheminant JD, Price J, Tadje CP. The effect of wearable activity monitor presence on step counts. Am J Health Behav. 2022;46(4):347–357. [CrossRef]
39. Lynch BM, Nguyen NH, Moore MM, Reeves MM, Rosenberg DE, Boyle T, et al. A randomized controlled trial of a wearable technology-based intervention for increasing moderate to vigorous physical activity and reducing sedentary behavior in breast cancer survivors: The ACTIVATE Trial. Cancer. 2019;125(16):2846–2855. [CrossRef]
40. Maindet C, Minier L, Chipon E, Véloso M, Dumolard A, Barmaki M, et al. Millimetre wave-based neuromodulation combined with coaching improves quality of life in fibromyalgia patients: A 9-month prospective, multicenter, open, randomized, controlled trial. Medicine. 2025;104(10):e41706. [CrossRef]