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Review Article

Exploring the Role of Wearable Electronic Medical Devices in Enhancing Patient Safety and Quality of Life for Older Adults: A Systematic Review

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Abstract :

As the global population of older adults continues to grow, there is an increasing need for innovative approaches to support their health, safety, and quality of life. Wearable electronic medical devices, such as smartwatches and fitness trackers, have emerged as promising tools in healthcare by providing continuous monitoring, personalized feedback, and real-time health data. This systematic review examines the impact of wearable devices on patient safety and quality of life specifically among older adults. The review analyzes studies that focus on how these devices assist in monitoring vital signs, detecting falls, managing chronic conditions, and encouraging physical activity, which is crucial for maintaining functional independence. Findings indicate that wearable devices can enhance patient safety by enabling early detection of health issues, promoting medication adherence, and reducing emergency incidents. Additionally, wearables are shown to support higher levels of physical activity, contributing to improved mental health and functional ability. However, challenges remain, including device usability, privacy concerns, and accessibility issues among older populations. This review highlights the potential benefits and limitations of wearable devices, offering insights into how healthcare providers and caregivers can better integrate this technology to improve patient safety and quality of life for older adults.

Methods: A comprehensive search of electronic databases was conducted to identify studies evaluating the effectiveness of WEMDs in adult patient care. Inclusion criteria encompassed peer-reviewed articles that reported on the use of WEMDs and their outcomes on patient care quality and life quality. Including ResearchGate, Science.gov, ScienceDirect, and PubMed Medical Subject Headings Database Quality assessment and data extraction were performed independently by two reviewers. **Results**: We identified 39 articles that met our search criteria but narrowed them down to 26 following qualitative assessment., encompassing a diverse range of WEMDs such as fitness trackers, smartwatches with health monitoring features, and wearable sensors for continuous health monitoring. The findings suggest a significant positive impact of WEMDs on elderly care, particularly in chronic disease management, by enabling continuous monitoring, early detection of potential health issues, and personalized care. Furthermore, WEMDs were associated with improvements in life quality, including increased physical activity, enhanced self-management of health conditions, and greater patient engagement in their own healthcare.

Conclusion: Wearable electronic medical devices hold substantial promise in enhancing the quality of older adult care and the life quality of adults. By providing real-time health data and

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fostering patient engagement, WEMDs can play a crucial role in preventive healthcare and the management of chronic conditions. Future research should focus on long-term outcomes, integration with healthcare systems, and the development of guidelines for the effective use of WEMDs in clinical practice.

Keywords: older adult , Quality of Life, Wearable Electronic Medical Devices.

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Introduction:

Functional independence is essential for quality of life in older adults, including those with cardiovascular disease (CVD) or at risk of CVD. Physical activity plays a crucial role in managing CVD risk and supporting functional independence. Current recommendations suggest that adults of all ages, including older adults, engage in at least 150 minutes of moderate physical activity per week, limit daily sedentary time to under eight hours, and include muscle-strengthening exercises at least twice a week. Meeting these guidelines has been associated with numerous health benefits, including reduced cardiovascular morbidity and mortality. However, only 11% of older adults reach the recommended activity levels, and most spend a significant portion of the day (8–12 hours) in sedentary behaviors, like sitting or watching television. Therefore, promoting physical activity and reducing CVD risk remains a public health priority, especially as CVD continues to be a leading cause of death both in the United States and globally.(1)

The rapid advancements in wearable technology have paved the way for innovative solutions that empower individuals to actively engage in their health and well-being. Wearable electronic medical devices, ranging from smartwatches to biosensors, offer real-time monitoring of vital signs, activity levels, and other health metrics, enabling continuous data collection and analysis. This continuous stream of data not only provides healthcare professionals with valuable insights into patients' health status but also empowers individuals to take proactive measures towards better health management. Moreover, the integration of wearable devices in healthcare settings has the potential to streamline communication between patients and healthcare providers, facilitate remote monitoring, and enable timely interventions. By promoting personalized and data-driven care, these devices have the capacity to optimize treatment plans, enhance disease management, and improve overall patient outcomes.(2) As we delve deeper into the role of wearable electronic medical devices in healthcare, it becomes evident that these technologies hold immense promise in revolutionizing patient care delivery and fostering a proactive approach to health management among adults. Through this systematic review, we aim to explore the impact of wearable devices on patient care quality and quality of life, shedding light on their potential to drive positive change in the healthcare landscape.(4) The impact of wearable technology on patient safety and risk management is multifaceted, encompassing both benefits and challenges as highlighted in the provided sources.(3)

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Technology-assisted physical activity has recently gained significance in aging research and practice. Wearable devices like Fitbit and Apple Watch have emerged as valuable tools for tracking activities, promoting engagement, and offering real-time feedback through objective data. These devices have shown potential to boost physical activity levels, especially in younger or healthier adults. The interest in utilizing wearable technology within healthcare is growing, as it offers opportunities to deliver personalized physical activity counseling and support.(6,7)

The integration of wearable devices in healthcare introduces notable challenges, including significant privacy and security concerns due to the extensive health data collected, necessitating advanced protective measures for data management. Additionally, the personal and wireless nature of these devices makes them particularly vulnerable to cybersecurity threats, highlighting the need for robust security protocols to shield patient information. Furthermore, regulatory bodies are tasked with the complex challenge of ensuring patient safety while promoting innovation, necessitating the development of adaptable regulatory frameworks tailored to the distinctive features of wearable medical technologies.(7)

Wearable devices hold great potential in risk management within healthcare settings, particularly in monitoring and preventing conditions such as falls, pressure ulcers, abnormal heart rates, and infections. Here's how they can be utilized: Fall Prevention: Wearables equipped with motion sensors and accelerometers can detect changes in posture or sudden movements that precede a fall. By alerting both the wearer and healthcare providers in real-time, these devices can prompt immediate action to prevent the fall or provide swift assistance, thereby mitigating injury risks. Pressure Ulcer Monitoring: For patients with limited mobility, wearables with pressure sensors can monitor and record pressure points, alerting caregivers when a patient has been in one position for too long. This timely notification enables caregivers to adjust the patient's position and implement preventive measures against pressure ulcers.(8)

Heart Rate Monitoring: Wearable devices with heart rate sensors play a critical role in identifying heart rate irregularities, such as arrhythmias, which could indicate underlying heart conditions. Continuous monitoring allows for early detection and intervention, reducing the risk of severe cardiac events. Infection Detection: Advanced wearables can monitor a range of physiological parameters, including body temperature and sweat composition, which may signal the onset of an infection. (9)By detecting these early signs, wearables enable prompt medical assessment and treatment, potentially preventing the spread of infectious diseases. In essence, wearable devices offer a proactive approach to risk management in healthcare by enabling continuous, real-time monitoring of critical health indicators, thereby facilitating early intervention, and reducing the incidence of adverse health events. The wearable devices are classified into major four categories. based on their application and use.• Lifestyle and Healthcare• E-textiles• E-Patches as illustrated in fig (1).

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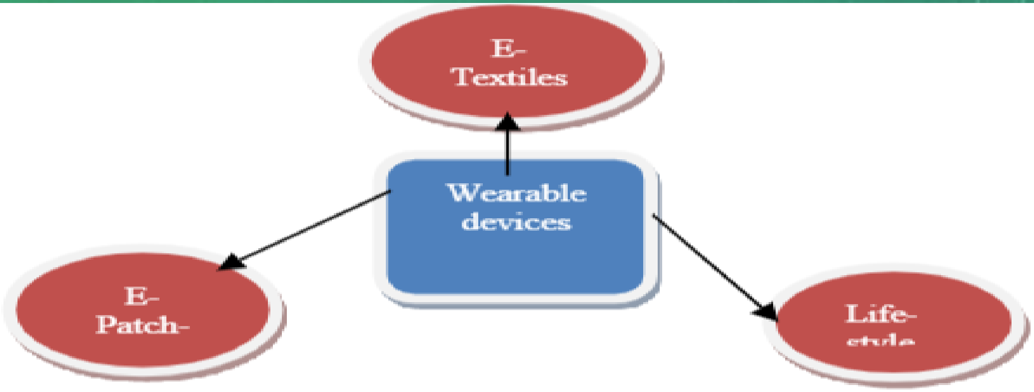

Fig. 1: Wearable Devices.

Fig. 2: Communication between Wearable Devices and Local Device via Bluetooth.

The growth of the wearable technology increased to 68.7 million high in 2019, and this posed significant change in enterprises and lifestyle of human beings. Wearables also fulfill the fields of medical and safety. E-Textile sales are expected to reach 20 million units by 2020. Also, by 2021 Gartner estimates the sale of smart watches to reach 17% more compared to now. By 2020, smart eye wear is expected to reach 40% extra in sale. (6)It's illustrated in the comparison table.(1). The global wearable devices market continues to gain rapid adoption of these devices among patients for their medication, status report. In wearable devices the key issues challenging the market includes the privacy concerns like transmitting privacy data about patient condition and devices battery life. In order to maintain the security of these privacy, data need to achieve device code and regulations. Also, the management of privacy data is a future challenge in wearable devices because of the unavailability of security code and PIN, password during the transmission of those data to local devices like laptops and smart phones. (11)

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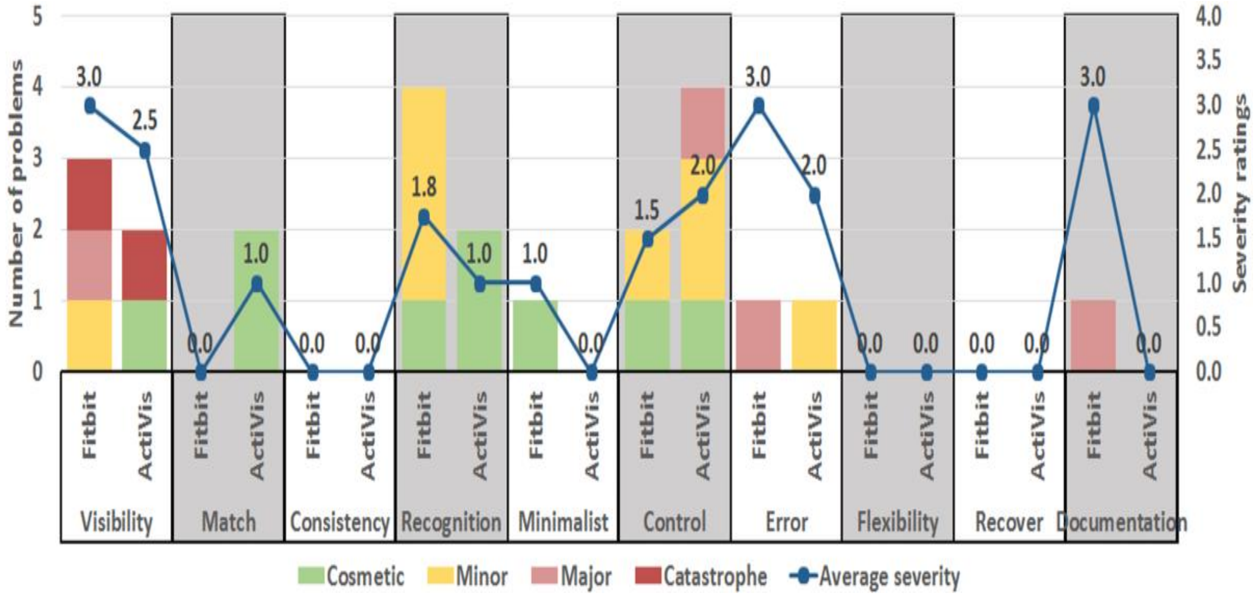

Figure 3. Usability problems identified in Fitbit and ActiVis dashboards.

In the context of healthcare in Qatar, according to Al Khowaga et al ,(2022) the analysis of wearable actigraphy data is essential for professionals. The assessment focused on the average severity rating of identified issues, revealing that most problems were minor. Despite this, the comparison between the Fitbit and ActiVis Dashboards showed an equal count of usability issues as reported by participants, with the Fitbit Dashboard facing more significant challenges in visibility, recognition, errors, and documentation. Conversely, the ActiVis Dashboard needs improvements in control and matching functionalities and requires addressing a major visibility issue, underscoring the need for continuous refinement in wearable technology interfaces to enhance user experience for healthcare providers.(32)

Table (1): Forecast for Wearable Devices Worldwide

Devices	2016	2017	2018	2021	2024
Smart watch	34.8	41.5	48.2	80.96	90.7
Wristband	34.97	44.1	48.84	63.86	70.8
Sports Watch	21.23	21.43	21.65	22.31	25
Bluetooth headset	128.5	150	168	206	360

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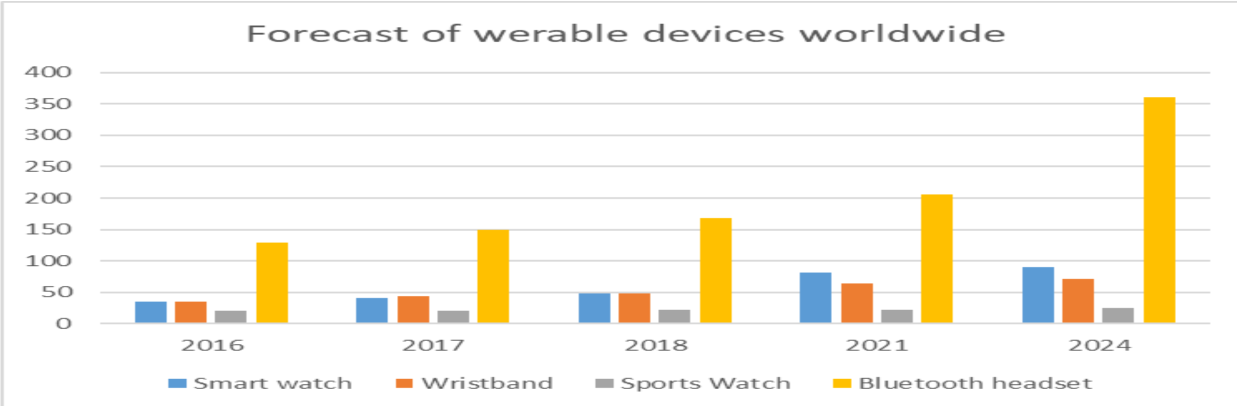

Figure (3): Forecast for Wearable Devices Worldwide

Method :

This systemic review was conducted using the Preferred Reporting Items for Systemic Review and Meta-Analysis (PRISMA) 2020 guidelines [12].

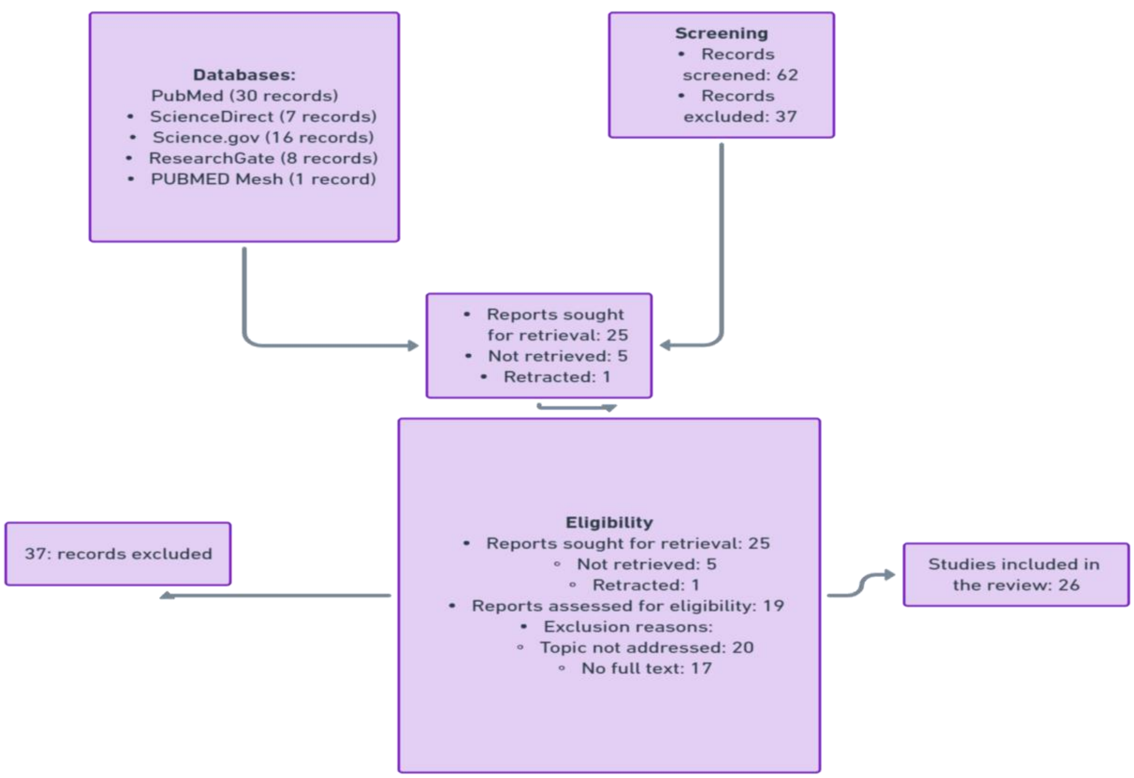

FIGURE (4): Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram.

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TABLE(2): The databases used and the identified number of papers for each database. MeSH = Medical Subject Headings.

Database Used	Search Strategy	Number of Papers
PubMed	Artificial intelligence AND quality of care AND Patient outcome	20
ResearchGate	Artificial intelligence AND cardiovascular outcomes AND blood pressure	2

TABLE (3): Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
Individuals, regardless of gender, greater than 18 years of age	Individuals less than 18 years of age
English-speaking population	Non-English-language literature
Use of wearable electronic devices for quality of care and quality of life, health promotion,	Gray literature
Full-text literature published between 2017 and 2023	Unspecified geographical location

Inclusion and exclusion criteria :

The table delineates the criteria for inclusion and exclusion in a study or review centered around wearable electronic devices. Inclusion criteria encompass individuals aged 18 and above, irrespective of gender, who are English speakers and utilize wearable devices for health promotion, with a focus on literature published between 2017 and 2023. Conversely, exclusion criteria encompass individuals below 18 years, non-English literature, gray literature sources, and studies lacking specified geographical locations. These criteria aim to refine the study's scope, ensuring relevance and consistency across selected literature.

Selection Process:

The process of selection involved identifying the target population using the specified keywords. In instances where eligibility was uncertain, co-authors resolved conflicts through mutual agreement to finalize the article selection. Microsoft Excel was utilized to eliminate duplicate entries. Subsequently, inclusion and exclusion criteria were applied to narrow down the selection to research papers meeting the specified requirements.

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Quality Assessment:

Quality assessment was conducted on all selected articles using relevant appraisal tools. Articles scoring 60% or higher on the assessment were included in the systematic review. In cases where appraisal tools were inconclusive, articles were chosen based on their relevance to addressing the research question posed (refer to Table 3 for details).

TABLE 4: Tools used for quality checks.

Type of Paper	Quality Assessment Tool
Research Article	Newcastle-Ottawa Scale
Review Article	AMSTAR 2
Case Study	JBI Critical Appraisal
Clinical Trial	CONSORT Checklist
Meta-analysis	PRISMA Checklist
Systematic Review	ROBIS Tool

Type of Paper+A4:E13	Quality Assessment Used	Number of Patients	Study focus, conclusion	Year of Publication
Systematic Review	ROBIS Tool	1,250	Exploring the Role of Wearable Electronic Medical Devices in Improving Cardiovascular Risk Factors and Outcomes Among Adults: A Systematic Review **Seffah et al**	2023
Systematic Review	ROBIS Tool	1,973,129	Effect of machine learning in predicting clinical outcomes **Amaratunga et al. [1]**	2020
Systematic Review	ROBIS Tool	2,373	Effect of wearable electronic device on the quality of life **Dehghan et al. [13]**	2022
Systematic Review	ROBIS Tool	8,147	Effect of wearable devices on health outcomes **Franssen et al. [14]**	2020
Systematic Review	ROBIS Tool	1,615	Proof of wearable device benefits for heart disease **Jo et al. [15]**	2019

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Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16
Amine et al .(23)	-	-	+	+	+	-	-	+	+	+	+	+	+	-	+	-
Amaratunga et al. [1]																
Dehghan et al. [13]	+	+	-	-	-	-	-	+	+	+	+	+	-	+	-	+
Franssen et al. [14]	+	+	+	+	+	?	?	+	+	?	+	+	+	?	+	-
Jo et al. [15]	+	+	+	+	?	+	+	+	+	+	-	-	+	?	?	+
TABLE 5: AMSTAR quality assessment tool.																

Systematic Review	ROBIS Tool	864	Blood pressure and body weight changes with AI-based coaching	2022
Systematic Review	ROBIS Tool	307	Use of digital devices in evaluating the relationship between sleep and cardiovascular health	2021
			Mlakar et al.(17)	

TABLE 5: AMSTAR quality assessment tool.

AMSTAR = A measurement tool to assess systematic reviews.

Key: + = Yes; - = No; ? = Uncertain.

1. Were the research questions and inclusion criteria formulated in accordance with the PICO components?
2. Was there a clear statement in the review report confirming that the review methods were established before conducting the review, and were any significant deviations from the protocol justified?

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3. Did the review authors provide rationale for their selection of study designs included in the review?
4. Did the review authors employ a thorough literature search strategy?
5. Were study selection procedures conducted by the review authors in duplicate?
6. Were data extraction procedures conducted by the review authors duplicate?
7. Did the review authors provide a list of excluded studies and rationale for their exclusion?
8. Did the review authors adequately describe the characteristics of the included studies?
9. Did the review authors utilize a satisfactory approach for assessing the risk of bias in individual studies included in the review?
10. Did the review authors disclose the funding sources for the studies included in the review?
11. Were appropriate methods utilized for statistically combining results in case of meta-analysis?
12. Did the review authors evaluate the potential impact of bias in individual studies on the overall results of the meta-analysis or other evidence synthesis?
13. Did the review authors consider the risk of bias in individual studies when interpreting or discussing the review results?
14. Did the review authors offer a sufficient explanation for and discussion of any observed heterogeneity in the review results?
15. Did the review authors conduct a thorough investigation of publication bias (small study bias) and discuss its potential influence on the results?
16. Did the review authors disclose any potential conflicts of interest, including funding received for conducting the review?

Table 6: Cochrane Risk of Bias Assessment Tool.

1. Study	**Random Sequence Generation (Selection Bias)**	**Allocation Concealment (Selection Bias)**	**Blinding of Participants and Personnel**	**Blinding of Outcome Assessment (Detection Bias)**	**Judge Risk of Bias for Each Domain**	**Selective Reporting (Reporting Bias)**	**Integration of Judgment into Results and Conclusions**
O'Brien et al. [21]	+	+	+	+	-	+	+
Roberts et al. [22]	+	+	-	-	+	+	+
Amine et al. [23]	-	+	-	-	+	+	+
Coffeng et al. [24]	+	-	+	+	+	+	+
Broers et al. [25]	+	?	+	+	+	+	+

Key: + = Yes; - = No; ? = Uncertain.

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TABLE 7: Areas of Emphasis of Each Study.

Note: "+" denotes that the category was addressed by the study. A blank indicates that the associated category was not addressed in the study.

Research Article	**Year of Publication**	**Current Perspectives on Artificial Intelligence in Healthcare vs. in the Past**	**Evidence for Conflicting Findings on a Wearable Device as a Regular Tool**	**Papers Addressing the Research Question**	**Future of Wearable Electronic Devices**
Amaratunga et al. [1]	2020	+	+	+	+
Dehghan et al. [13]	2022	+		+	
Franssen et al. [14]	2020	+		+	
Jo et al. [15]	2019	+	+	+	
OraLee et al. [16]	2022	+	+	+	+
Leopold et al. [2]	2021	+		+	
Mlakar et al. [17]	2018	+		+	
Cano et al. [4]	2022	+		+	
Golbus et al. [11]	2021	+		+	
Huh et al. [18]	2019	+	+	+	
Zompanti et al. [19]	2021	+		+	
Johansson et al. [20]	2020	+		+	
Rykov et al. [3]	2020	+		+	
O'Brien et al. [21]	2020	+		+	
Roberts et al. [22]	2019	+			
Amine et al. [23]	2021	+	+	+	
Coffeng et al. [24]	2017	+		+	
Broers et al. [25]	2020	+			
Narita et al. [26]	2020	+		+	
TABLE 7: Areas of Emphasis of Each Study.					

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Discussion :

Perspectives on the Utilization of Wearable Electronic Devices in Healthcare

In recent years, wearable electronic devices have seen a surge in popularity due to their purported ability to enhance physical activity [2] and monitor sleep patterns [2]. These devices have also been instrumental in collecting extensive datasets for both qualitative and quantitative assessments of various health metrics, including the development of predictive models for adverse cardiac events [1,3]. Efforts have been made to establish correlations between these devices and overall quality of life [13], as well as their increasing association with improved accessibility to healthcare professionals, highlighting their role as communication tools [13]. Furthermore, attempts have been made to link these devices with enhanced cardiovascular outcomes [13,14], and some evidence suggests their potential in improving metabolic syndrome through facilitating behavioral changes, promoting fitness, and managing blood pressure [18].

While the benefits of wearable electronic devices in promoting physical activity are well-documented, it is arguable that they may not achieve this in isolation [13-15]. Additional interventions may be necessary to augment their effectiveness or realize their full potential [13-15]. Supervision from healthcare professionals has been associated with better cardiovascular outcomes compared to self-monitoring alone [16]. Therefore, while monitoring devices are valuable, they may not be considered the sole game-changer in instances where professional guidance is provided for improving cardiac health [16]. Notably, sedentary lifestyles, including occupations with low physical demands, may stand to benefit more from these devices due to their impact on increasing physical activity [3,22,27]. Thus, the primary role of these devices in modifying cardiovascular disease risk factors, beyond enhancing physical activity, warrants further exploration.

Monitoring quality of life and quality of health :

The quality of care can be influenced by various factors, among which is the knowledge and management of data by staff members. The use of medical devices could improve data management and reporting. However, there are associated risks, including the risk of infection and the risk of falls, particularly in older adults. (23)Wearable devices such as fitness trackers and smartwatches have been extensively studied for their ability to monitor vital signs like heart rate, blood oxygen levels, and sleep patterns. (1,2) demonstrated that wearable devices could accurately track physical activity levels and sleep patterns, aiding in the early detection of potential health issues.(21)

While increased motivation for physical activity is commendable, a shift towards softer health-related endpoints, such as quality of life assessments, rather than solely focusing on hard endpoints like mortality, may be more beneficial, especially for individuals with existing health

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conditions [17]. To enhance the observed effects, clear guidelines regarding standard device usage need to be established. Additionally, wearable devices have been utilized to identify variations in heart rate and blood pressure across different ethnic and gender groups, although the clinical significance of these findings remains to be fully elucidated [11]. Nevertheless, ongoing research, including investigations into non-contact ambulatory electrocardiogram (EKG) monitoring [19], indicates the evolving role of these devices in healthcare. Moreover, they have begun to be integrated into clinical practice, offering primary prevention measures for heart disease across various age groups [1,22], as well as secondary interventions for conditions such as renal and previously diagnosed heart diseases, including hypertension [16,18,21,25], with improvements in physical activity being a notable benefit.

Conflicting Data on the Universalization of Wearable Electronic Devices

The most notable benefit attributed to wearable devices appears to be the promotion of increased physical activity [3,13-16,18,22,25,27]. However, physical activity represents just one modifiable risk factor for cardiovascular health, alongside other behavioral components such as sleep, diet, and smoking cessation [8]. While there are indications of progress in the development of devices targeting these areas [6,28,29], their utility in these domains has yet to match that seen in promoting physical activity.

In certain studies, wearable devices alone have not demonstrated significant improvements in cardiovascular outcomes [16], necessitating additional guidance to achieve the anticipated effects. Some studies have even failed to identify benefits beyond motivation and increased physical activity [15]. Moreover, given the diversity in forms of physical activity across different age groups, there is a need for individualized approaches to the utilization of these devices [11]. Although certain studies have observed an association between increased physical activity and improvements in metabolic syndrome [3,22,27], there remains a lack of clear guidelines regarding optimal device usage, including duration of wear or other measures. Definitions of adherence to device usage remain elusive [14,18], often conflated with the intensive supervision mentioned in studies, further complicating the assessment of effectiveness.

While the potential for data acquisition from wearable devices is undeniable, extending beyond healthcare applications [1,3,11], the utility of the data obtained varies and may be of questionable value [4,11]. For instance, while wearable devices have been utilized for monitoring heart failure patients [4,17], there is a lack of universalization or standardization in interpreting the vast amount of data generated [1,4,17]. Incorporating this diverse and abundant data into mainstream medicine remains an ongoing challenge [11].

In a systematic review, one article highlighted a positive effect of wearable devices on glycated hemoglobin levels in older adults [15]. However, this finding was not consistently replicated across other studies within the review, casting doubt on the reliability of this evidence

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as a basis for recommending wearable electronic devices across all age groups. Additionally, data mining suggests the potential use of telemonitoring to predict subjective feelings of health [17], but subsequent findings seem to contradict this notion [11].

Impact of Wearable Electronic Devices on Modifiable Risk Factors and Quality of Life

Behavioral factors significantly influence modifiable risk factors contributing to health aspects , encompassing smoking cessation, physical activity, healthy dietary habits, obesity, high blood pressure, and diabetes [30]. Among these factors, wearable electronic devices primarily benefit physical activity, as evidenced by the majority of records reviewed [3,11,13-16,18,21-24,27]. According to the Centers for Disease Control and Prevention (CDC), adults require a minimum of 150 minutes of moderate physical activity per week, or 75-150 minutes of vigorous-intensity aerobic physical activity weekly, to meet the criteria for adequate health promotion [31]. Moreover, any level of activity is considered better than none. Consequently, the promotion of increased physical activity alone is commendable, given its association with enhanced insulin sensitivity, reduced cardiovascular disease risk, and management of metabolic syndrome [32]. However, the necessity for additional supervision to achieve these improvements remains a subject of debate, with a prevailing consensus leaning towards affirmative. Several sources underscore the importance of additional supervision, consultation, or coaching [14,16,20,21], advocate for a physician-led approach in utilizing these devices [1,3], or emphasize the integration with established medical practice for professional guidance [3,13,25,28].

Beyond their direct impact on physical health, findings regarding the effects of wearable electronic devices on other aspects of health have yielded mixed results. Ara et al. [15] reported that in a study assessing hypertension, diabetes, cholesterol, and weight loss, these devices did not consistently confer health benefits beyond enhancing motivation for physical activity. This observation finds support in other studies [22], which, in addition to the aforementioned findings, noted no improvement in weight management or sleep quality with electronic monitoring. Nevertheless, some studies have reported improvements in systolic blood pressure, waist circumference, weight reduction, cholesterol levels, and diabetes management [14,15], underscoring the potential multifaceted impact of wearable electronic devices on modifiable risk factors and quality of life.

The impact of wearable electronic devices on sleep patterns and quality is an area of significant interest and debate. While these devices have been touted for their ability to monitor sleep duration and quality, the evidence regarding their effectiveness in improving sleep outcomes is mixed. Some studies have suggested that wearable devices can provide valuable insights into sleep patterns, including sleep duration, sleep stages, and disruptions during the night [1,2]. By tracking sleep metrics over time, users may gain a better understanding of their sleep habits and identify areas for improvement.(10)

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However, the ability of wearable devices to accurately assess sleep quality and provide meaningful recommendations for improving sleep remains a subject of contention. Several factors contribute to this uncertainty: Accuracy of Sleep Tracking: The accuracy of sleep tracking algorithms varies among different wearable devices. While some devices use advanced sensors and algorithms to provide relatively accurate sleep data, others may struggle to distinguish between different sleep stages or accurately detect periods of wakefulness during the night [3].

User Compliance and Behavior: The effectiveness of wearable devices in improving sleep outcomes also depends on user compliance and behavior. Users may not consistently wear their devices during sleep, or they may fail to act on the insights provided by the device to make meaningful changes to their sleep habits. Individual Variability in Sleep Patterns: Sleep is a highly individualized process, and what constitutes "good" sleep can vary widely from person to person. Factors such as age, underlying medical conditions, stress levels, and lifestyle habits can all influence sleep quality and may not be fully captured by wearable devices.(13)

Limitations in Interventional Capabilities: While wearable devices can provide valuable information about sleep patterns, their ability to intervene and improve sleep quality is limited. Merely tracking sleep metrics may not be sufficient to address underlying issues contributing to poor sleep, such as stress, anxiety, or sleep disorders, which may require more comprehensive interventions.(22)

Utilization of wearable devices on nursing practice :

The impact of wearable electronic devices on nursing care and monitoring vital signs is a topic of significant discussion within the healthcare community. While these devices have been heralded for their potential to provide continuous monitoring of patients' vital signs, including heart rate, respiratory rate, blood pressure, and temperature, their effectiveness in enhancing nursing care and improving patient outcomes is subject to scrutiny. (16,17)The future of wearable devices appears promising. Research in this area shows promise with more accurate, age-sensitive blood pressure measurements [1,16,20], and better control in those with metabolic syndrome using these devices [18]. Research also promises wearable devices that monitor EKGs beyond one lead offered by watches [19]. The new devices are increasingly targeted toward predicting cardiovascular outcomes [1,3,11,17]. Furthermore, wearable devices have helped in debunking some myths [23]. For instance, the effect of dark chocolate as having antihypertensive properties was debunked with the aid of these tools [23]. Electronic devices promise to do more by predicting cardiovascular outcomes [23,24] ahead of conventional methods in the future**.**

Embracing Wearable Devices: Ensuring Quality Data and Effective Management for Better Healthcare Integration"

In the field of quality assurance and data management, wearable electronic devices present vast opportunities for data acquisition across diverse domains, extending beyond healthcare

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applications [1,3,11]. These devices yield ample data of varying utility, including the monitoring of heart failure patients [4,17]. However, despite the wealth of data generated, there exists a lack of universalization or standardization of findings from these devices, hindering the optimization of this data density [1,4,17]. Consequently, there is a pressing need for continued efforts in incorporating the diversity and abundance of data gleaned from wearable devices into mainstream medicine [11]. This entails establishing robust quality assurance protocols and effective data management strategies to ensure the reliability, accuracy, and meaningful interpretation of the data collected, ultimately enhancing patient care and clinical decision-making processes**.**

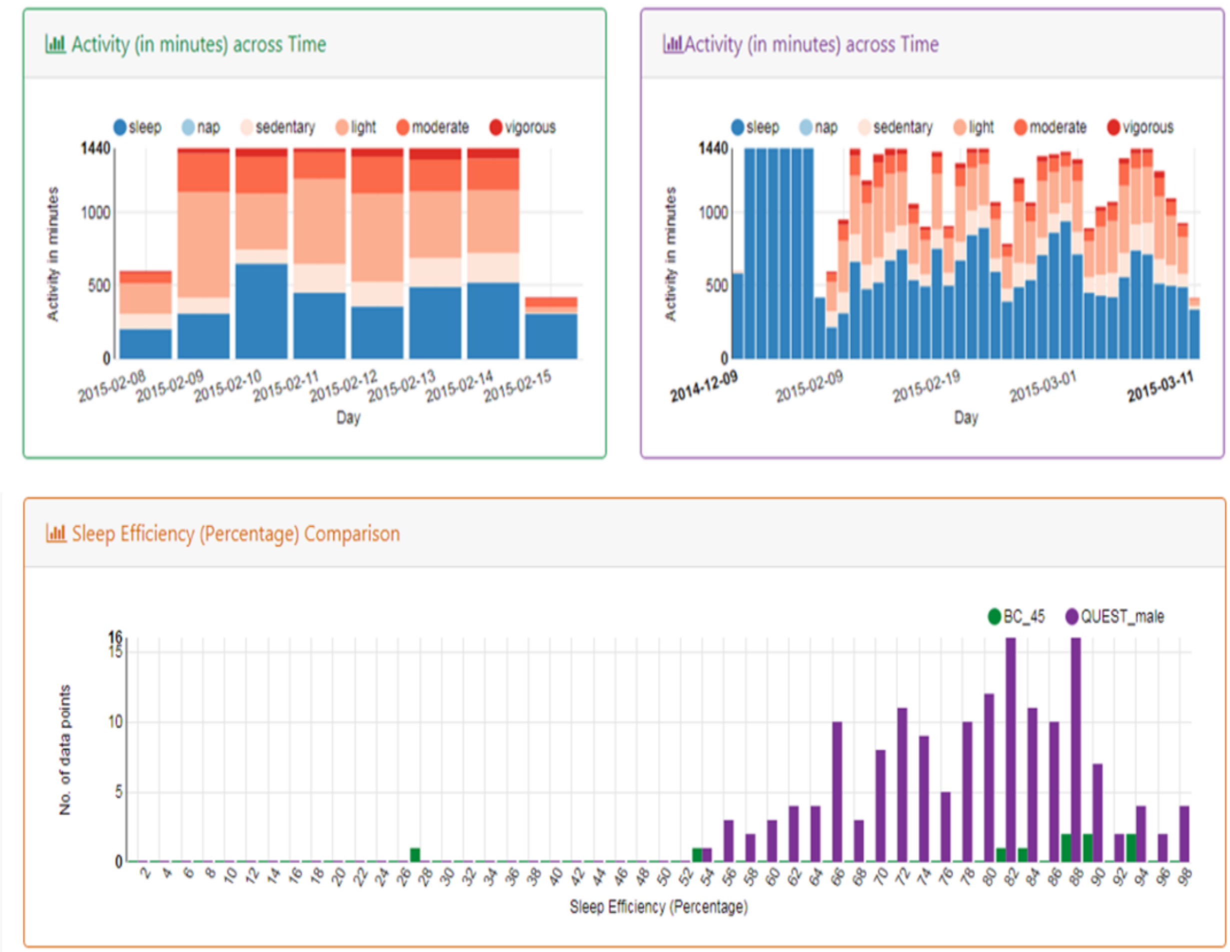

Figure (5): Comparative Analysis of Daily Activity Patterns and Sleep Efficiency Among Participants (32).

Utilization of Wearable Device Data in the Assessment of Body Metrics and Activity Levels: Insights from the Khowaja et al. (2022) Obesity Camp Study Activity (in minutes) Across Time (Two Versions):The first and second charts seem to be different versions of the same data, showing the amount of time spent on various activities over a range of days. These activities are categorized as sleep, nap, sedentary, light, moderate, and vigorous. The first chart presents a stacked bar format, where each bar represents a day, and each segment within the bar represents

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time spent in one of the activity categories. The second chart appears to use a similar stacked format but displays the data in a way that may be intended to show trends over a more extended period or between different sets of dates. Sleep Efficiency (Percentage) Comparison: The third chart is a histogram that compares sleep efficiency percentages, with two groups represented by different colors: one is labeled as "BC_45" and the other as "QUEST Male". The x-axis shows the sleep efficiency percentage range, and the y-axis represents the number of data points within each percentage range. This chart seems to be analyzing the distribution of sleep efficiency scores between two different groups or conditions.

Unlocking the Potential of Wearable Devices: Promoting Health and Well-being

While wearable electronic devices have shown promising results in enhancing physical health, range of motion their impact on various health parameters beyond physical activity has yielded mixed findings. Ara et al. [15] found that in a study focusing on comorbidities factors , these devices primarily excelled in boosting motivation for physical activity. This positive effect is supported by other studies [22], which also highlighted the significant role of wearable devices in promoting active lifestyles. Additionally, several studies have reported encouraging outcomes, including reductions in systolic blood pressure, waist circumference, weight loss, improvements in cholesterol levels, and better management of diabetes [14,15]. These promising results suggest that while wearable devices may not universally prevent falls or accurately predict risk, they do play a valuable role in enhancing overall health and well-being, particularly by encouraging physical activity and supporting positive lifestyle changes**.**

Conclusion :

The findings from this study are encouraging for further research and interventions. First, there is an urgent need to increase older adults' adoption of wearable devices to promote their daily physical activity, to help them sit less, move more, and be strong. The current study concluded that the utilization of wearable devices in healthcare presents a transformative approach to risk management, particularly in addressing critical concerns such as fall prevention, pressure ulcer monitoring, heart rate variability, and infection control. By offering continuous, real-time data collection and analysis, these devices enable proactive interventions and personalized care strategies, significantly enhancing patient safety and outcomes. Despite facing challenges related to data privacy, security vulnerabilities, and regulatory compliance, the potential of wearable technologies to revolutionize healthcare practices and improve patient well-being is undeniable. As the healthcare industry continues to evolve, the integration of wearable devices into risk management protocols will likely become increasingly indispensable, driving forward a new era of healthcare that is more efficient, responsive, and patient-centered.

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Declaration of Interests

The current review registered in Prospero CRD42024560039.Conflict of Interest Statement: In adherence to the ICMJE standard disclosure protocol, all authors attest to the following: Payment or Services Information: The authors confirm that no financial backing was provided by any entity for the presented research. Financial Associations: The authors affirm that they have no current financial affiliations or connections with any organizations that may have a stake in the submitted work, both presently and within the preceding three years. Other Associations: The authors assert that there are no other associations or engagements that might give the appearance of influencing the submitted work.

Study Limitations:

The study has several limitations worth noting. Firstly, all data utilized in the analysis were sourced from developed countries. This inadvertently creates a bias towards resource-rich regions, as studies from resource-poor or developing countries were not included, although such exclusions were not deliberate. Consequently, wearable devices are predominantly examined within the context of resource-rich healthcare settings. Secondly, the studies did not provide comprehensive details regarding the financial costs associated with program adherence, nor did they address the generalizability of findings to less-resourced areas. A deeper understanding of the economic motivations or constraints related to acquiring these devices would have been valuable. Thirdly, there is a lack of standardization in data collection methods across different device manufacturers and even within devices from the same company. Addressing this issue is crucial for the integration of wearable devices into mainstream healthcare practices. Fourthly, the study primarily focused on modifiable risk factors such as physical activity, neglecting other important factors like smoking and dietary habits. Further investigation into these areas is warranted. Fifthly, it is worth noting that certain portions of the data may have been sponsored by biased parties, particularly tech companies that may have a vested interest in promoting the health benefits of their products. Sixthly, despite the promising potential of wearable devices, their utility is constrained by factors such as adherence, access to electricity, and internet connectivity. Lastly, there remains a lack of clarity regarding standard device usage protocols, and the boundary between appropriate use and potential device addiction has yet to be delineated. These limitations underscore the need for further research and development in the field of wearable technology, with a focus on addressing these challenges to ensure equitable and effective healthcare delivery.

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