The Impact of Wearable Devices on Public Health Outcomes in The Treatment of Chronic Diseases Through Continuous Physiological Monitoring

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KEYWORDS

Wearable Devices, Public Health, Chronic Diseases, Physiological Monitoring

ABSTRACT

Chronic illnesses contribute to elevated levels of disability and death. The active involvement of patients in the treatment of chronic diseases is a crucial element of healthcare systems that are focused on chronic diseases. Wearable devices provide real-time health information focused on the patient, enabling them to make informed decisions about self-management. Although wearables are believed to offer advantages in enhancing the self-management of chronic illnesses, their impact on healthcare outcomes still needs to be well comprehended. This study sought to investigate the effect of wearables on healthcare results in adults with chronic conditions by conducting a comprehensive analysis of existing evidence for physiological monitoring. A narrative systematic literature review was performed by searching six databases for randomized and observational research published from January 2018 to July 2023. These studies focused on utilizing a wearable intervention in a group of individuals with chronic diseases to evaluate its effect on a predetermined end measure. The outcomes were defined as any impact on patient or practitioner experience, cost-effectiveness, or healthcare outcomes resulting from the wearable intervention. The findings from the research included in the analysis were gathered according to 6 main themes, which were used as the foundation for a qualitative summary. This research adhered to the requirements outlined in the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) declaration.

1. Introduction

Chronic illnesses are responsible for 76% of global fatalities [1]. The World Health Organization classifies chronic illnesses into four primary categories: cardiovascular diseases, malignancies, chronic respiratory disorders, and diabetes. Approximately 52% of individuals with chronic diseases encounter impairment, which is characterized as a constraint that hampers their everyday activities and lasts for a minimum of 6 months. Disability leads to heightened reliance on social assistance and worse quality of life. Chronic disease incurs a substantial financial burden due to the expenses of healthcare and the loss of production resulting from sickness and death [2]. Approximately 38% of the healthcare spending is committed to assisting those suffering from chronic conditions for physiological monitoring [3].

Empirical research has repeatedly shown that prompt medical action is crucial; failure to recognize sickness leads to worse outcomes and higher expenses [4]. Enhancing frontline healthcare providers to identify and refer sick people effectively is essential. Preserving patient referral channels safeguards the provision of urgent medical treatment by strengthening public health collaboration.

Constant client physiological monitoring entails the measurement of variables such as pulse, electrocardiography, arterial pressure, oxygen consumption, and respiration rate using a mix of invasive and non-invasive techniques [5]. These metrics guide clinical decision-making in several advanced healthcare contexts. Costly machinery needs operator instruction, and insufficient clinical personnel make a literal conversion impractical [6].

Readily accessible technology, such as wearable devices and smartphone applications, can offer individuals input about their physiological indicators, enhancing public health awareness. Wearables are sensory gadgets affixed to clothes or worn as accessories [7]. They enable public health data collection using various built-in sensors without causing any obstruction for physiological monitoring.

Initially developed for the public health and fitness sector to monitor well-being, most wearables available for purchase are utilized for recording necessary health-related measurements such as heart percentage, sleep effectiveness, consumption of energy, and step counts [9].

Wearable devices can be used on the body's outermost layer for extended periods [8]. This is especially promising for managing infectious diseases in clinical settings due to their affordable cost and ability to link to other devices. When used along with quick diagnostic methods, their application can enhance local public health and provide decentralized treatment while providing valuable information for public health authorities during outbreaks [10].

This study conducted a comprehensive examination that specifically investigates the impact of wearable devices on enhancing public health in individuals with chronic illnesses. The theory posits that a qualitative analysis of the currently limited data provides first indications that wearables can impact health care results favorably. This study is pertinent to public health researchers and physicians investigating the possibility of wearables in medical care, medical facility management, and the wearable gadget business [12].

2. Methodology

Design

A systematic review was conducted utilizing qualitative research methodologies. The research followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. This review was registered in the Worldwide Prospective Registry for Systematic Studies in April 2023.

Search Strategy

A systematic literature review was conducted using the Web of Science, Scopus, and Cochrane Central Registry of Clinical Trials to identify papers published from January 2018 to July 2023. Research released before 2018 should have been included to accurately represent the pace of technical progress in wearables study and development. The method was designed in collaboration with a healthcare research librarian. The study used a mix of Medical Subject Headings, phrases, and accessible text search terms, such as chronic illness, wearable electronic gadgets, health care results, and specific chronic disorders like asthma.

Eligibility Criteria

Chronic disease is characterized as a public health problem that persists for a minimum of three months, potentially resulting in further health concerns and being linked to functional limitations or impairment. A public health care result refers to any measurable factor that impacts the patient's well-being, the effectiveness of medicinal care (such as better management of blood sugar levels in people with diabetes), the expertise of the medical professional, or the financial aspect of public health care provision.

The conditions for admission were as follows: (1) Randomized Controlled Trials (RCTs) and observational research [11], (2) feasibility investigations that observed the impact of wearables on predetermined public health, and (3) research that appeared in peer-reviewed publications in the English language. The research included both adult and pediatric populations. The following conditions were used to exclude specific research: (1) pregnant patients, (2) studies that focused on the reliability or technical feasibility of wearables, (3) studies that primarily reported the precision of wearables, (4) book segments, (5) conference descriptions, and (6) review articles.

Screening

The screening process for suitable studies included eliminating duplicates, screening titles and abstracts, and screening full-text articles. The use of EndNote and Covidence accomplished the elimination of

duplicates. Any remaining duplicates that weren't eliminated throughout this procedure were manually deleted for physiological monitoring. Two review authors thoroughly examined the titles and abstracts to see whether they met the predetermined criteria for being included or excluded, as outlined earlier. After the first screening, all papers that were not excluded were subjected to a thorough assessment to determine which research should be included. The process of extracting, categorizing, and labeling documents was completed and verified for accuracy.

Risk of Bias Assessment

A comprehensive evaluation of potential bias was performed for all RCTs [13]. The Cochrane Collaboration utilized its risk of bias assessment method to evaluate each randomized trial for potential biases related to the randomization procedure, biased selection, missing outcome information, assessment of the result, and any additional biases that were not explicitly discussed. The Risk of Bias in Nonrandomized Research of Measures tool was employed to evaluate bias in nonrandomized research. This tool assessed various sources of bias, including confounding, biased selection, bias in classifying actions, bias due to variations from wanted interventions, bias caused by insufficient information, bias in measuring outcomes, and prejudice in outcome selection.

Data Extraction and Synthesis

The information from the selected papers was extracted based on six major themes most relevant to the original study topic [14]. A diverse subheading was chosen considering the significant variability in disease populations and result metrics for physiological monitoring. A narrative qualitative analysis was performed on the papers that were selected. The meta-analysis could not be completed due to the extensive variation in research designs, illness groupings, patient groups, and outcome measurements. The data we obtained are derived from the specific illness group, and the research has included all relevant findings from other research within that particular disease group. All results were classified as either a part of patient expertise, clinician expertise, medical results, or cost

3. Results and discussion

The wearables utilized in these investigations were intended to be worn consistently or periodically on the body. Of the 30 studies, 20 focused on wearables positioned on the waist (n=7) and wrist (n=9), whereas four publications examined wearables on different body areas for physiological monitoring. Various wearables were discussed, such as pedometers, smartbands, virtualized and Augmented Reality (AR) structures, flash glucose tracking devices, and intelligent shoe inserts.

Study Selection

The process of selecting studies is described in a PRISMA diagram, as seen in Figure 1. The research found 2050 articles via the search, and an additional seven items were discovered through snowballing. Out of a total of 2050 articles, 380 were found to be duplicated and were eliminated. 1670 studies were eliminated after reviewing their abstracts in July and August 2023. This left 103 studies evaluated through a full-text review to determine their eligibility. Out of these, 97 studies were ultimately eliminated. A single research study was conducted using the process of snowballing. 32 research fulfilled the inclusion criteria. After undergoing peer review, one research was excluded, resulting in a total of 28 papers that were incorporated into the quantitative analysis.

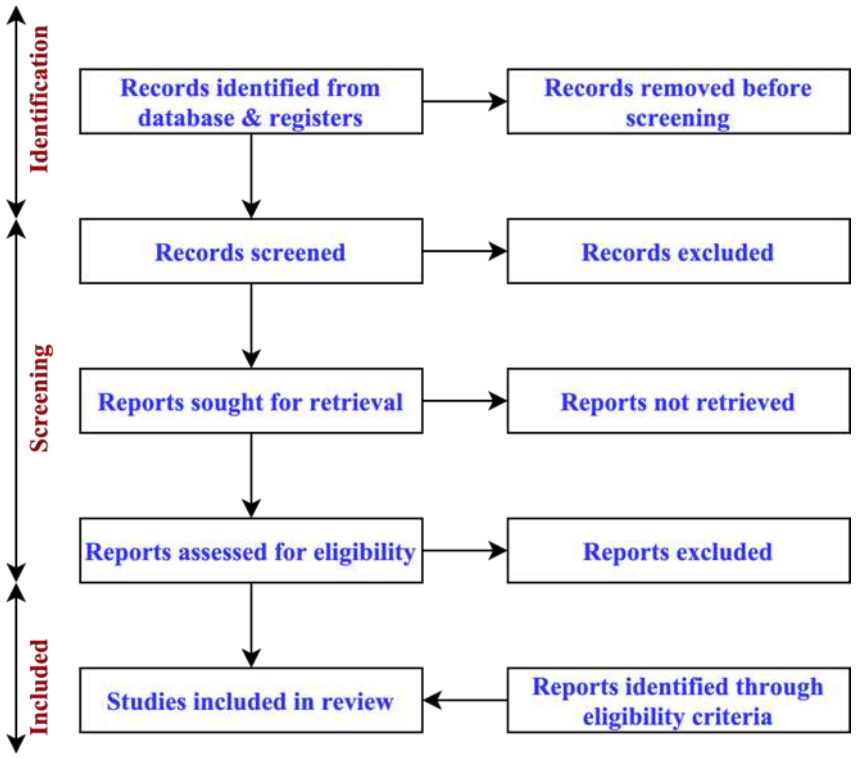

Figure 1. PRISMA structure of the research

Study Characteristics

There were a total of 2500 respondents from 10 different nations. The respondent's ages ranged from 11.2 to 75.6 years, with a mean age. Of the total respondents (2500), 50% were female. Out of the 35 investigations, three focused on a pediatric population (under 20), 23 examined adults with an average age ranging from 41 to 60 years, and seven assessed persons aged beyond 65 years. Half of the investigations recruited individuals from specialized tertiary clinics. The other half attracted people from neighborhoods such as primary care and rehabilitation facilities. Out of 35 investigations, 25 were randomized, while the remaining 8 used a nonrandomized approach for physiological monitoring. Due to the nature of the wearable intervention, all randomized studies had a potential for bias in blinding participants. One study stood out as it utilized Virtual Reality (VR) headphones, which had the same hardware but distinct applications that users communicated.

Between 2018 and 2023, a comprehensive review of 30 research examined the efficacy of wearables in enhancing medical results for persons with chronic illnesses. The thorough analysis revealed favorable and neutral findings when discussing the impact of wearables on healthcare results in chronic illness. One important discovery was that there was no evident connection between using a specific wearable device and its acceptance among individuals with chronic diseases for physiological monitoring. Most public health applications that synchronize with wearables, which are included in this analysis, emphasize diseases and provide data related to the illnesses being investigated, such as the locations of pressure areas. The adoption of wearables in healthcare presents several problems. At first, wearables were explicitly created for the public health and fitness sector and did not adhere to the regulatory criteria necessary for medical devices. The wide range of chronic illnesses examined and the many wearables utilized restrict the capacity to establish a robust empirical foundation for endorsing a particular wearable device to address a specific ailment. Additional investigation should prioritize examining the effects of a particular wearable device on a specific chronic illness to provide

substantiated data about its efficacy, particularly considering the many functionalities of most wearable devices. The evaluation is subject to various constraints, including applying wearables that are now old-fashioned. More sophisticated devices have since replaced all smartwatch brands included in these experiments with enhanced technological capabilities for physiological monitoring. While the observed trend is attributed to the pace of technical progress, the findings presented in this research partially represent the potential of wearable technology beyond 2023.

4. Conclusion and future scope

The comprehensive analysis could not identify a definitive use of wearables to enhance public health results for chronic illnesses. Wearables are gaining popularity within the community. As studies and advances in wearable technologies, these gadgets are expected to facilitate significantly healthy lifestyle changes for consumers. Further investigation is necessary to establish a definitive cause-and-effect relationship between wearable devices and public health for individuals with chronic illnesses for physiological monitoring. As the evidence supporting the application of wearables in managing chronic diseases becomes more robust, additional obstacles must be addressed to implement them widely in medicine. These issues include meeting strict legal requirements, ensuring data is secure and confidential, and ensuring the correctness of the program.

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