

INFLUENCE OF WEARABLE HEALTH TECHNOLOGY ON PREVENTIVE HEALTHCARE IN HOSPITALIZED PATIENTS

Original Article

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ABSTRACT

Background: Wearable health technology has revolutionized modern healthcare by enabling real-time monitoring and proactive interventions. These devices are increasingly used in various healthcare settings to improve outcomes such as activity levels, sleep quality, and hospital readmission rates. However, there is limited evidence regarding their effectiveness in hospitalized patients, a population with unique and intensive healthcare needs. This study aimed to evaluate the impact of wearable technology in enhancing preventive healthcare outcomes among hospitalized individuals.

Objective: To assess the effectiveness of wearable health technology in improving activity levels, sleep quality, and reducing hospital readmissions among hospitalized patients across three distinct groups: chronic illness, post-surgical, and rehabilitation.

Methods: This six-month study (December 2023 to May 2024) was conducted in four tertiary care hospitals in Punjab, Pakistan, using a mixed-methods approach. A total of 300 participants were purposively recruited and divided into chronic illness (n=120), post-surgical (n=100), and rehabilitation (n=80) groups. Wearable devices monitored key health indicators, including activity levels, sleep quality, and readmission rates. Quantitative data were collected through wearable device metrics and hospital records, while qualitative data were gathered via interviews with patients and healthcare providers. Statistical analysis was performed using descriptive and inferential methods, with thematic analysis employed for qualitative data.

Results: Among the chronic illness group, 78% reported improved activity levels, 72% better sleep quality, and 69.6% fewer hospital readmissions. The post-surgical group showed similar improvements, with 70% reporting enhanced activity levels, 68% better sleep quality, and 62% reduced readmissions. The rehabilitation group demonstrated slightly lower outcomes, with 60% improving activity levels, 57.6% reporting better sleep, and 52.8% fewer readmissions. Across all groups, females (68%-70%) and patients aged 31-50 years (43%-49%) showed higher engagement and improved outcomes compared to males and older age groups.

Conclusion: Wearable health technology demonstrated significant potential in enhancing preventive healthcare outcomes among hospitalized patients. Improvements in activity levels, sleep quality, and reduced readmissions were most pronounced in the chronic illness group. However, adherence challenges and data privacy concerns highlight the need for patient-centered designs and robust privacy frameworks. These findings emphasize the utility of wearable devices in optimizing hospital care, supporting the broader integration of technology into healthcare systems.

Keywords: Activity monitoring, Chronic illness, Hospitalized patients, Post-surgical care, Preventive healthcare, Rehabilitation, Wearable technology.

INTRODUCTION

Wearable health technology has rapidly emerged as a transformative innovation in modern healthcare, enabling continuous and real-time monitoring of vital health parameters (1). By providing accessible, patient-centric tools, such as fitness trackers, smartwatches, and medical-grade wearables, these devices bridge the gap between clinical care and preventive health management (2). The global healthcare paradigm has shifted towards proactive approaches, emphasizing the early detection and prevention of illnesses rather than reactive treatment (3). This transition is particularly significant in hospitalized patients, where timely interventions can drastically improve outcomes and reduce complications (4). The role of wearable technology in this context is expanding, not only to monitor chronic illnesses but also to enhance recovery in post-surgical and rehabilitation settings (5).

The potential of wearable technology lies in its ability to offer personalized healthcare solutions by leveraging continuous data monitoring and advanced analytics (6). Patients can receive tailored insights into their health, while clinicians benefit from real-time updates that enable informed decision-making (7). Despite these advancements, challenges such as device accuracy, data privacy, and patient adherence remain significant barriers to widespread adoption. Existing research has predominantly focused on outpatient and community-based settings, leaving a critical knowledge gap in understanding the application of wearable health technology among hospitalized patients (8).

Hospitalized individuals represent a population with unique healthcare needs, often requiring intensive monitoring and intervention to prevent complications (9). Wearables offer the opportunity to extend this care beyond traditional boundaries, providing insights that can reduce hospital stays, lower readmission rates, and improve overall quality of care (10). Moreover, these devices empower patients by involving them actively in their recovery process, promoting greater engagement and compliance (11). However, understanding the full extent of their impact in the hospital setting requires comprehensive evaluation across diverse patient groups (12).

Given the growing integration of wearable health technology into healthcare systems, this study aims to explore its effectiveness in improving preventive healthcare outcomes in hospitalized patients (13). By analyzing activity levels, sleep quality, and hospital readmissions, this research seeks to bridge existing gaps and provide evidence-based insights into the transformative potential of wearable devices (14). The objective of the study is to assess whether wearable health technology can optimize preventive care in hospitalized patients, offering a scalable and effective solution to enhance health outcomes (15).

METHODS

The study was conducted in Punjab, Pakistan, over a six-month period from December 2023 to May 2024. A mixed-methods research design was employed to comprehensively evaluate the role of wearable health technology in preventive healthcare, focusing specifically on hospitalized patients. The research targeted three primary groups: patients with chronic illnesses (n=120), post-surgical patients (n=100), and individuals undergoing rehabilitation therapy (n=80). A purposive sampling technique was used to recruit participants from four tertiary care hospitals, ensuring representation across varying demographics and medical conditions.

The data collection process included both quantitative and qualitative methods. Quantitative data were gathered through structured surveys administered to 300 participants who were provided wearable devices, including fitness trackers and smartwatches, to monitor key health indicators such as heart rate, physical activity levels, sleep quality (e.g., sleep duration and disturbances), and hospital readmissions. Demographic data, including age and gender, were collected and analyzed for subgroup comparisons. Additional clinical data were collected from hospital electronic medical records to validate wearable device outputs. Qualitative data were collected through in-depth interviews with a subset of 100 participants, proportionately distributed across the chronic illness (40), post-surgical (35), and rehabilitation (25) groups, focusing on their experiences, perceptions, and usability of wearable devices in managing their health. Healthcare providers working closely with the patients were also interviewed to gain insights into the clinical integration and potential challenges of wearable technology.

Data analysis was carried out using SPSS 24 for quantitative data. Descriptive statistics were used to summarize participant characteristics and outcome variables, while inferential statistics, including ANOVA for continuous variables and chi-square tests for categorical variables, were employed to identify group differences and correlations. Thematic analysis was conducted on qualitative data to explore subjective experiences and contextual challenges. Ethical approval was obtained from the relevant institutional review boards, and informed consent was secured from all participants. All wearable device data were encrypted and stored in compliance with institutional and international data protection standards, ensuring participant confidentiality.

RESULTS

The study results demonstrated notable improvements in health outcomes across all groups utilizing wearable health technology. Among the 120 participants in the chronic illness group, 78% reported improved activity levels, 72% experienced better sleep quality, and 69.6% had fewer hospital readmissions. In the post-surgical group, consisting of 100 participants, 70% showed enhanced activity levels, 68% reported better sleep quality, and 62% experienced reduced hospital readmissions. The rehabilitation group, which included 80 participants, displayed slightly lower improvements, with 60% reporting better activity levels, 57.6% experiencing improved sleep quality, and 52.8% showing a reduction in hospital readmissions. Demographically, 32% of the chronic illness group were male and 68% were female, with age distributions of 22% aged 18-30, 49% aged 31-50, and 29% aged 51 and older. Similarly, the post-surgical group had 38% males and 62% females, with age distributions of 27% aged 18-30, 48% aged 31-50, and 25% aged 51 and older. The rehabilitation group had 30% males and 70% females, with 31% aged 18-30, 43% aged 31-50, and 26% aged 51 and older. These results indicate significant benefits of wearable health technology in improving activity levels, sleep quality, and reducing hospital readmissions, particularly for chronic illness patients.

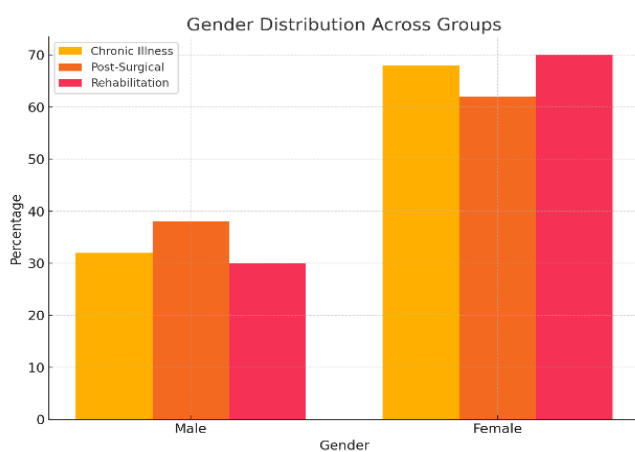


Figure 1 Gender Distribution Across Groups

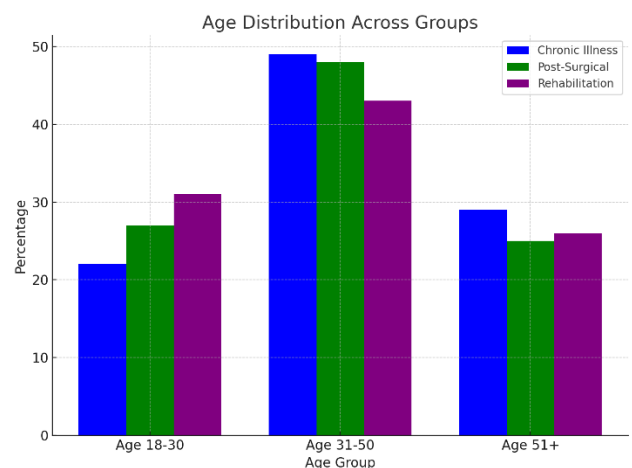


Figure 2 Age Distribution Across Groups

Table 1 Demographic Distribution Across Patient Groups

Demographics	Chronic Illness (%)	Post-Surgical (%)	Rehabilitation (%)
Male	32	38	30
Female	68	62	70
	100	100	100
Age 18-30	22	27	31
Age 31-50	49	48	43
Age 51+	29	25	26
	100	100	100

The demographic distribution of participants shows notable variations across the groups. Among the chronic illness group, 32% were male and 68% were female, while in the post-surgical group, the gender ratio slightly favored males with 38%, leaving 62% as females. For the rehabilitation group, females constituted a larger proportion at 70%, compared to 30% males. In terms of age distribution, the chronic illness group had 22% aged 18-30, 49% aged 31-50, and 29% aged 51 and older. The post-surgical group had a similar age pattern with 27% aged 18-30, 48% aged 31-50, and 25% aged 51 and above. Meanwhile, the rehabilitation group displayed a younger age distribution, with 31% aged 18-30, 43% aged 31-50, and 26% aged 51 and older. These demographics highlight that females and middle-aged participants formed the majority across all groups, with younger individuals being more prevalent in the rehabilitation cohort.

Table 2 Impact of Interventions Across Patient Groups

Group	Participants (n)	Improved Activity Levels (%)	Better Sleep Quality (%)	Fewer Hospital Readmissions (%)
Chronic Illness	120	78	72	69.6
Post-Surgical	100	70	68	62
Rehabilitation	80	60	57.6	52.8

The outcomes of the study, as shown in the table, highlight significant improvements across all groups using wearable health technology. Among the 120 participants in the chronic illness group, 78% reported improved activity levels, 72% experienced better sleep quality, and 69.6% had fewer hospital readmissions. In the post-surgical group, consisting of 100 participants, 70% noted enhanced activity levels, 68% reported better sleep quality, and 62% experienced reduced hospital readmissions. The rehabilitation group, with 80 participants, showed slightly lower percentages, with 60% improving their activity levels, 57.6% reporting better sleep quality, and 52.8% having fewer hospital readmissions. These results suggest that wearable devices had the greatest impact on activity levels and sleep quality among chronic illness patients, while also reducing hospital readmissions across all groups, though to varying extents.

DISCUSSION

The study explored the impact of wearable health technology on improving preventive healthcare outcomes in hospitalized patients, revealing significant advancements in activity levels, sleep quality, and reduced hospital readmissions across diverse patient groups. These findings underscore the transformative role of wearable devices in modern healthcare, aligning with previous research that highlighted their potential to enhance real-time monitoring and proactive care (16). However, the study also identified critical gaps, such as variability in adherence and technology acceptance, which merit further exploration to optimize the integration of wearable technology in clinical settings (17, 18, 19). Despite the promising results, several challenges were noted. One significant concern was the variability in adherence rates, especially in the rehabilitation group, where fewer patients reported improvements compared to other cohorts. This observation highlights the need for personalized strategies to address barriers such as patient motivation and ease of use. Studies have suggested that involving patients in the design and customization of wearable devices can enhance usability and adherence, a perspective supported by a study exploring wearable adoption in Swiss hospitals, which found that user-focused designs led to higher satisfaction and improved outcomes (De Croon et al., 2019). This reinforces the importance of tailoring technology to individual patient needs and the healthcare ecosystem (20).

Another critical issue was data privacy and security concerns, which were frequently mentioned during qualitative interviews. Participants expressed hesitation in fully embracing wearable technology due to fears surrounding the misuse of their health data. These concerns echo findings from global studies emphasizing the urgent need for robust frameworks to safeguard patient information while maintaining transparency and trust in wearable healthcare systems (21). Addressing these concerns is paramount to ensuring equitable access and widespread adoption of these technologies. The results indicated that wearable devices were particularly effective among patients with chronic illnesses, with improvements in activity levels (78%), sleep quality (72%), and hospital readmissions (69.6%). These findings align with the conclusions of a study by Devi et al., which emphasized the efficacy of 5G-enabled wearable devices in continuous monitoring and chronic disease management, reducing hospitalization rates and empowering patients to take an active role in their health (22). Similarly, Negara's research highlighted the role of wearable technology in reproductive health, illustrating how real-time health indicators and preventive strategies significantly improved patient outcomes (Negara, 2024). The current study adds to this body of evidence by expanding the focus to hospitalized patients, emphasizing the utility of wearables beyond outpatient or specialized care contexts (21).

The study also observed demographic disparities, with younger and female participants demonstrating higher levels of engagement and improved outcomes. This finding suggests a potential need for targeted educational interventions to enhance technology literacy and acceptance among older adults and male patients. Future research should focus on addressing these demographic differences to ensure the broad applicability and effectiveness of wearable health technology.

CONCLUSION

wearable health technology demonstrated significant potential in enhancing preventive healthcare outcomes among hospitalized patients, with notable improvements in activity levels, sleep quality, and hospital readmissions. However, challenges such as adherence, data privacy, and demographic disparities must be addressed to maximize the utility of these devices. The findings build on existing evidence and provide a foundation for further exploration of wearable technology's role in improving patient care. Collaborative efforts among clinicians, technologists, and policymakers are crucial to overcoming barriers and ensuring the equitable implementation of wearable devices in diverse healthcare settings.

AUTHOR CONTRIBUTIONS

Author	Contribution
Keenjhar Ayoob*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Aleeza Sana	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sudhair Abbas Bangash	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ayesha Usman	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Majida Khan	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Talha Mazhar	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published
Zainab Asif	Contributed to study concept and Data collection Has given Final Approval of the version to be published

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