Examining the Use of Wearable Health Devices for Tracking Physical Activity in Elderly Populations

Aneek Kayani [1], Iqra Sajid[2], Hanan Azfar[3], Umm-e-Habiba[4], Ibraheem Zafar[5], Ramsha Masood[5]

Pakistan Institute of Medical Sciences[1], Sky Care General Hospital, Rawalpindi[2], Bhatti Hospital[3], DHQ Hospital, Chakwal[4], Mohi-ud-Din Institute of Rehabilitation Sciences[5]

Corresponding Email: aneek.kayani@yahoo.com

Abstract

Background: In this modern world, the increased use of wearable technologies is evident owing to significant advances. This study explores how wearable technologies help monitor and enhance physical activity levels among older adults, thus providing valuable insights into their health.

Methods: A longitudinal study recruited older adults from community homes to investigate the impact of wearable technologies among them to evaluate physical activity levels. A self-design questionnaire was used for data evaluation at 3 points, i.e., at baseline, three months, and six months, to observe the change in physical activity trends.

Results: The responses on the usage of wearable technologies and their impact on physical activity levels showed that n=103 males and n=98 females were unaware of the use of wearable gadgets and had no idea about the availability of such gadgets in the labour market. Moreover, chi-square analyses revealed that the likelihood of using wearable gadgets to quantify PA was non-significant, with $p<0.05$ among the elderly population.

Conclusion: The findings of this longitudinal study highlight the potential advantages of wearable health devices in promoting physical activity among older populations. The results show that these gadgets may be motivational aids, resulting in notable increases in step counts, resting heart rates, and users' opinions of wearable technology.

Keywords

Blood Pressure, Elderly, Heart Rate, Physical Activity.

Cite as: Kayani A, Sajid I, Azfar H, Habiba U, Zafar I, Masood R. Examining the Use of Wearable Health Devices for Tracking Physical Activity in Elderly Populations. Allied Med Res J. 2024;2(1):36-45. Available from: https://ojs.amrj.net/index.php/1/article/view/45/42.

Check for updates

DOI: https://doi.org/10.59564/amrj/02.01/006

Received: 12th September 2023, **Revised:** 30th October 2023, **Accepted:** 18th December 2023

Introduction

Wearable healthcare device use has increased substantially in recent years, owing to significant developments in wireless sensors and digital technology[1]. Fitness trackers such as Fitbit, Apple Watch, and Samsung Galaxy Fit, as well as more sophisticated gadgets capable of monitoring blood pressure, glucose levels, and oxygen levels, have become essential tools for individuals seeking to examine, monitor, and improve their physiological well-being[2-3]. While wearables' appeal crosses age categories, this article focuses on the revolutionary effect these devices have had in encouraging active living behaviours among the elderly[3]. With their noninvasive, autonomous design and built-in sensors, these gadgets enable elderly individuals to measure and optimize their physical activity, sleep patterns, and vital signs[4- 5]. Wearable healthcare devices hold tremendous promise for the elderly population because they provide a convenient way to monitor health in real-time, provide personalized feedback to support behaviour changes, enable remote patient monitoring for faster interventions, and cater to chronic conditions and cardiovascular risks[6-7]. These gadgets are well suited to empowering seniors to take proactive actions towards improved health, eliminating the need for frequent medical visits, and eventually improving their quality of life, all while potentially lowering healthcare expenses[8]. As the aged population grows, wearable technology promises a disruptive approach to enhancing healthcare delivery and encouraging active lives among the elderly[9-10].

While wearable healthcare technologies have apparent advantages, broad adoption, particularly among the elderly, confronts significant difficulties[11]. Key considerations include data security and privacy because of the collection and transfer of sensitive health information. Furthermore, the design, accuracy, and dependability of wearable's are considerable challenges. The possible accuracy gap in data obtained from people with different skin tones is especially concerning[12]. Furthermore, adopting new wearable devices, particularly among the elderly, remains challenging. Despite growth projections, reports indicate a slowdown in device usage and a proclivity for users to abandon these devices within months of purchase, emphasizing the critical need to address these challenges to ensure the effective integration of wearable health devices into the healthcare regimens of the elderly population[13]. Existing public health guidelines for persons aged 65 and older who are generally healthy and emphasize participation in moderate to vigorous physical activities. However, these suggestions may provide difficulties for many older people for reasons such as decreased physical fitness, mobility limits, or medical issues. What complicates matters further is that the health advantages of low-intensity activities, which frequently account for a significant amount of daily physical activity for older persons (such as walking), have yet to be as thoroughly characterized as those of more intense activities[14]. For various reasons, quantifying the health benefits of mild-intensity exercise in older persons is critical.

First and foremost, it recognizes that not all seniors can participate in high-intensity workouts, and many may find moderate or strenuous activities physically demanding or even contraindicated due to their health situation[15]. Furthermore, mild-intensity activities are frequently more long-term sustainable for seniors since they may be smoothly integrated into their daily routines, boosting the chance of persistent involvement[16]. This consistency in physical activity is critical for reaping long-term health advantages, which is especially important for the elderly, as it directly leads to greater mobility, lower risk of chronic diseases, and general well-being. Recognizing the importance of these light activities in the lives of older persons, the current research aims to investigate the application of wearable health devices for measuring physical activity in senior populations. This study will benefit healthcare professionals by providing the latest evidence about the usage of wearable technology in older adults and how it impacts their health and quality of life by monitoring and enhancing their daily activities.

Methodology

Study Design and Setting

This study adopted a longitudinal design to investigate the impact of wearable health devices on physical activity levels among older adults. Two hundred fifty older adults were recruited from an old-age community home using a non-probability convenience sampling technique. Data from participants was collected at three different points, i.e., baseline, three months, and six months, to observe the changeable trends in physical activity.

Sample Selection Criteria

Male and female older adults aged 65 years or older who were willing to participate were included. In contrast, those who had refused to participate or had difficulty performing daily living activities were excluded.

Data Collection Procedure

The data was collected from a self-designed questionnaire, which included questions about demographic information and the usage of wearable technologies/gadgets to enhance physical activity levels. Furthermore, baseline measures of heart rate (HR), blood pressure (BP), and step counts were compared to those obtained at three- and six-month intervals. At the start of the trial, all enrolled individuals received wearable health devices. These gadgets had functions for tracking and monitoring physical activity, such as step counts and heart rate readings.

Timeline for Data Collection

- ***Baseline Data Collection:*** At the start of the trial, demographic information, as well as baseline measures of HR, BP, and step counts, were collected.

- ***Three-Month Follow-up:*** A three-month follow-up evaluation was undertaken, which included the completion of the questionnaire as well as the collection of HR, BP, and step-count data.

- ***Six-Month Follow-up:*** At six months, the final data collection took place, including questionnaire responses and HR, BP, and step count measures.

Ethical Considerations

The study was according to the guidelines of Belmont report for having human subjects as participants. All subjects included in the study were given complete autonomy to discontinue research without providing any reason. Moreover all information's that were gathered were kept confidential and was not used anywhere else other than the purpose of this research. Informed consents were taken prior to induction of participants in the study.

Data Analysis Strategies

- Statistical analysis was performed using SPSS version 24.

- Descriptive statistics in terms of frequencies and percentages was run for demographics and adapted foot questionnaire.

- Descriptive statistics were used to summarize demographic data and questionnaire responses.

- Analyses of Variance were used to compare changes in HR, BP, and step counts across the three data points. Questionnaire responses were analyzed to discover patterns and trends in senior participants' use of wearable devices to increase physical activity.

Results

The analyses of the findings revealed that of the total number of n=250 participants, n=135 were male and n=115 were female; the average age of male participants was 68.52±2.5yeras whereas females were 71.21± 3.2 years. The demographic Characteristics of participants are illustrated in Table-1 as follows:

Table-1 Demographic description of participants

Variables	(n) %	Mean±S.D
Male	135 (54%)	68.52±2.5
Females	115 (46%)	71.21±3.2

Further, the responses related to the use of wearable gadgets to monitor physical activity (PA) were asked, and it was found that n=103 males and n=98 females were unaware of the use of wearable gadgets and had no idea regarding the availability of such gadgets in the market. Moreover, chi-square analyses revealed that the likelihood of using wearable gadgets to quantify PA was non-significant, with $p<0.05$ among the elderly population (Table-2). Additionally, baseline information like heart rate, number of steps per day, and blood pressure were gathered one week after the first visit to monitor all data through a gadget. The detailed description is illustrated in Table-2.

Table-2 Baseline information and readings taken on first visit and after one week

Variables		Male	Females	X^2	p-value
Awareness regarding use of wearable gadgets for quantification of PA					
Wearable gadgets previously used	Yes	32	17	0.34	0.05
	No	103	98	4.25	<0.05
Gadget can be used for measuring PA	Yes	25	13	0.25	>0.05
	No	110	102	5.68	<0.05
Do you think gadget can be beneficial for your health	Yes	58	48	1.58	=0.03
	No	77	67	3.25	<0.05
Baseline Measurement of HR, BP and number of step counts/day (Measurement taken after week 1)					
Variables		**Mean±S.D**			
Heart Rate		85±3.56			
Blood Pressure (mmofhg)	**Systole**	148.25±4.52			
	Diastole	98.58±4.58			
Number of steps/day		1325.25±11.56			

After taking the baseline information, a follow-up was performed after three months and then after six months, and the findings revealed that wearable gadgets had shown significant improvement in the given outcome measures. The step count number had significantly raised $p<0.05$ from 1325.5±11.56 to 3568.84±15.58 after week three and increased to 4028.47±18.57 at week six. The measurement of BP also showed a significant betterment $p<0.05$, along with a significant $p<0.05$ reduction in resting heart rate. Moreover, participants' responses regarding the use of wearable gadgets also changed significantly $p<0.05$, and more participants were supported and became aware of the use of wearable gadgets. On inquiring about the change in perspective for the use of wearable gadgets and improvement in physical activity, the participants responded that the continuous measurement of the outcomes and availability of data regularly had deeply motivated them to improve PA (Table-3).

Table-3 Assessment performed after 3 weeks and after 6 weeks comparing with baseline

Awareness regarding use of wearable gadgets for quantification of PA						
Weeks	**Variables**		**Male**	**Females**	**X^2**	**p-value**
Baseline	Wearable gadgets previously used	Yes	32	17	0.34	0.05
		No	103	98	4.25	<0.05
	Gadget can be used for measuring PA	Yes	25	13	0.25	>0.05
		No	110	102	5.68	<0.05
	Do you think gadget can be beneficial for your health	Yes	58	48	1.58	=0.03
		No	77	67	3.25	<0.05
Week 3	Wearable gadgets previously used	Yes	45	56	1.56	<0.05
		No	90	59	2.35	<0.05
	Gadget can be used for measuring PA	Yes	59	65	3.35	<0.05
		No	76	50	1.89	<0.05
	Do you think gadget can be beneficial for your health	Yes	73	58	4.58	<0.05
		No	62	57	5.8	<0.05
Week 6	Wearable gadgets previously used	Yes	58	75	5.56	<0.05
		No	77	40	3.22	<0.05
	Gadget can be used for measuring PA	Yes	82	90	6.9	<0.05
		No	55	25	4.1	<0.05
	Do you think gadget can be beneficial for your health	Yes	90	103	7.8	<0.05
		No	45	12	2.1	<0.05
Measurement of HR, BP and number of step counts/day between group analysis						
Variables	**Baseline Mean±S.D**	**Month 3 Mean±S.D**	**Month 6 Mean±S.D**	**Df**	**Level of Significance**	**CI**

HR		85±3.56	82.3±2.58	78.25±3.33	5	<0.05	95%
BP	**SBP**	148.25±4.52	132.32±3.26	128.56±2.45			
	DBP	98.58±4.58	93.42±5.55	90.48±1.89			
Step Counts		1325.25±11.56	3568.84±15.58	4028.47±18.57			

Discussion

The study's significant findings emphasize the potential advantages of wearable technology in enhancing Physical Activity (PA) among the elderly population. The 250 participants had a pretty evenly distributed gender distribution, according to the first demographic study. Notably, a sizable number of both sexes (103 men and 98 women) were at first ignorant of the use of wearable technology for PA monitoring. The use of these devices did, however, result in significant improvements in key outcome measures, including a remarkable increase in daily step counts, a decrease in resting heart rate, and favourable changes in participants' attitudes towards and awareness of the use of wearable gadgets, according to later analyses. These results imply that constant monitoring and data accessibility via wearable technology might be a motivational element for raising PA levels in the senior population, which is a potential path to improving good ageing and general wellbeing. According to a research of 4,551 respondents in the United States, just approximately 30% of individuals utilize wearable healthcare devices, making acceptance and use of these devices still very low[17]. Nearly half of consumers use wearables daily, and the majority are prepared to provide healthcare professionals access to their health information. Higher wearable device usage was linked to demographic traits such as being female, White, younger (18–50 years old), having higher education levels, and having a household income above $75,000. Additionally, wearable adoption was higher among people who reported better health, being overweight, enjoying exercise, and having more faith in technology[16-17]. These results highlight the necessity of focused initiatives by healthcare practitioners, device producers, and legislators to close the adoption gap and encourage wider usage of wearable healthcare devices among various American demographic categories[16]. According to a survey of people aged 50 and beyond, 20.5% of older persons measure their physical activity using mobile devices like smartphones, smart watches, or tablets[18]. According to the research, men, younger people, those who are very interested in new technology, and people who exercise frequently are likelier to use these mobile tracking gadgets than other demographic groups[18-19]. Participants also mentioned that personal motives, as opposed to social ones, were more important motivators for using a device, such as keeping track of their physical activity and encouraging themselves to maintain good health. This study highlights the significance of more research into the usability and motivational features of mobile health tracking technology among older persons, offering a possible method for fostering health and wellbeing in this population[17]. An investigation of the use and attitudes of Wearable Devices (WDs) among the older population includes a systematic review and a survey. The comprehensive review, which included 31 pertinent research, found that WDs typically had good effects even though men comprised most study subjects. The poll, which received answers from 233 people, found that just a small percentage of seniors were now using WDs. However, more than 60% indicated an interest in utilizing them in the future, particularly to enhance physical and mental activity[18]. It is noteworthy that a sizable proportion of responders were women. The study emphasizes the necessity of educating seniors about the possible advantages of WDs for the early diagnosis and prevention of health issues. In order to better serve their needs and preferences, it also emphasizes the significance of involving geriatric people, guaranteeing gender equality, and considering both healthy and sick individuals in future studies and testing of WDs[18-20]. The study's longitudinal approach, which enabled the evaluation of changes in physical activity and health indicators over time, contributed to its strengths by enabling a more thorough understanding of the effects of wearable health devices on older populations. Additionally, a varied sample of seniors was guaranteed by choosing volunteers from local nursing facilities. The study's dependability was increased by using wearable technology to track physical activity and health data, which offered impartial measurements. This study has certain limitations, i.e., using a self-designed questionnaire may lead to responsive bias. Further, persistent behaviour change was not observed, as the long-term benefits of the study were not evaluated. The findings of this study may only apply to the older adult population as it lacks generalizability due to the modest sample size and specific population. Thus, future studies must investigate the study's relevance to the broader sample, settings and population.

Conclusion

The findings of this study showed that gadgets are used as motivational aids, resulting in notable increases in step counts, resting heart rates, and users' opinions of wearable technology.
However, for wearable technologies, there is still a need for continuous monitoring and data accessibility to compute the precise results of physical activity levels in the long term to encourage older adults to improve their quality of life.

Acknowledgments
We dedicate this research to study participants for sharing valuable insights and our family and peers for their support.

Conflict of Interest
None.

Grant Support and Funding Disclosure
None.

References

1. Liu JY, Kor PP, Chan CP, Kwan RY, Cheung DS. The effectiveness of a wearable activity tracker (WAT)-based intervention to improve physical activity levels in sedentary older

adults: A systematic review and meta-analysis. Archives of Gerontology and Geriatrics. 2020 Nov 1;91:104211.
2. Vogel J, Auinger A, Riedl R, Kindermann H, Helfert M, Ocenasek H. Digitally enhanced recovery: Investigating the use of digital self-tracking for monitoring leisure time physical activity of cardiovascular disease (CVD) patients undergoing cardiac rehabilitation. PloS one. 2017 Oct 11;12(10):e0186261.
3. Ferguson T, Olds T, Curtis R, Blake H, Crozier AJ, Dankiw K, Dumuid D, Kasai D, O'Connor E, Virgara R, Maher C. Effectiveness of wearable activity trackers to increase physical activity and improve health: a systematic review of systematic reviews and meta-analyses. The Lancet Digital Health. 2022 Aug 1;4(8):e615-26.
4. Beg MS, Gupta A, Stewart T, Rethorst CD. Promise of wearable physical activity monitors in oncology practice. Journal of oncology practice. 2017 Feb;13(2):82-9.
5. Franssen W, Franssen GH, Spaas J, Solmi F, Eijnde BO. Can consumer wearable activity tracker-based interventions improve physical activity and cardiometabolic health in patients with chronic diseases? A systematic review and meta-analysis of randomised controlled trials. International Journal of Behavioral Nutrition and Physical Activity. 2020 Dec;17(1):1-20.
6. Wu M, Luo J. Wearable technology applications in healthcare: a literature review. Online J. Nurs. Inform. 2019 Nov;23(3).
7. Mercer K, Li M, Giangregorio L, Burns C, Grindrod K. Behavior change techniques present in wearable activity trackers: a critical analysis. JMIR mHealth and uHealth. 2016 Apr 27;4(2):e4461.
8. Schrack JA, Cooper R, Koster A, Shiroma EJ, Murabito JM, Rejeski WJ, Ferrucci L, Harris TB. Assessing daily physical activity in older adults: unraveling the complexity of monitors, measures, and methods. Journals of Gerontology Series A: Biomedical Sciences and Medical Sciences. 2016 Aug 1;71(8):1039-48.
9. Evenson KR, Goto MM, Furberg RD. Systematic review of the validity and reliability of consumer-wearable activity trackers. International Journal of Behavioral Nutrition and Physical Activity. 2015 Dec;12(1):1-22.
10. Kirk MA, Amiri M, Pirbaglou M, Ritvo P. Wearable technology and physical activity behavior change in adults with chronic cardiometabolic disease: a systematic review and meta-analysis. American Journal of Health Promotion. 2019 Jun;33(5):778-91.
11. Steinert A, Haesner M, Steinhagen-Thiessen E. Activity-tracking devices for older adults: comparison and preferences. Universal Access in the Information Society. 2018 Jun;17:411-9.
12. Cooper C, Gross A, Brinkman C, Pope R, Allen K, Hastings S, Bogen BE, Goode AP. The impact of wearable motion sensing technology on physical activity in older adults. Experimental gerontology. 2018 Oct 2;112:9-19.
13. Rasche P, Wille M, Theis S, Schäefer K, Schlick CM, Mertens A. Activity tracker and elderly. In2015 IEEE International Conference on Computer and Information Technology; Ubiquitous Computing and Communications; Dependable, Autonomic and Secure Computing; Pervasive Intelligence and Computing 2015 Oct 26 (pp. 1411-1416). IEEE.

14. Macridis S, Johnston N, Johnson S, Vallance JK. Consumer physical activity tracking device ownership and use among a population-based sample of adults. PloS one. 2018 Jan 2;13(1):e0189298.
15. Panicker RM, Chandrasekaran B. "Wearables on vogue": a scoping review on wearables on physical activity and sedentary behavior during COVID-19 pandemic. Sport sciences for health. 2022 Sep;18(3):641-57.
16. Chandrasekaran R, Katthula V, Moustakas E. Patterns of use and key predictors for the use of wearable health care devices by US adults: insights from a national survey. Journal of medical Internet research. 2020 Oct 16;22(10):e22443.
17. Seifert A, Schlomann A, Rietz C, Schelling HR. The use of mobile devices for physical activity tracking in older adults' everyday life. Digital health. 2017 Nov;3:2055207617740088.
18. Kekade S, Hseieh CH, Islam MM, Atique S, Khalfan AM, Li YC, Abdul SS. The usefulness and actual use of wearable devices among the elderly population. Computer methods and programs in biomedicine. 2018 Jan 1;153:137-59.
19. Abouzahra M, Ghasemaghaei M. The antecedents and results of seniors' use of activity tracking wearable devices. Health Policy and Technology. 2020 Jun 1;9(2):213-7.
20. Chandrasekaran R, Katthula V, Moustakas E. Too old for technology? Use of wearable healthcare devices by older adults and their willingness to share health data with providers. Health Informatics Journal. 2021 Nov 17;27(4):14604582211058073.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design: Kayani A

Acquisition, Analysis or Interpretation of Data: Sajid I

Manuscript Writing & Approval: Kayani A, Sajid I, Azfar H, Habiba U, Zafar I, Masood R

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.