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TELEMEDICINE AND ITS EFFECT ON CHRONIC DISEASE MANAGEMENT IN REMOTE COMMUNITIES

Original Research

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ABSTRACT

Background: Chronic diseases, such as diabetes, hypertension, and cardiovascular conditions, are leading causes of morbidity and mortality worldwide. These diseases disproportionately affect rural populations due to limited access to healthcare and resources. Telemedicine offers a transformative solution to address these disparities by providing remote healthcare delivery. This study investigates the effectiveness of a telemedicine-based intervention in improving medication adherence, health-related quality of life (HRQoL), and clinical outcomes in a rural population in Sindh, Pakistan.

Objective: To evaluate the impact of a telemedicine-based chronic disease management program on medication adherence, HRQoL, and clinical outcomes in rural Sindh, Pakistan.

Methods: This quasi-experimental study was conducted from June 2023 to January 2024 in rural Sindh. A total of 84 participants with chronic conditions were recruited and divided into two groups: the control group received standard face-to-face care, while the experimental group participated in a telemedicine program. Participants acted as their own controls, with pretest-post-test comparisons. Baseline data included medication adherence rates, HRQoL scores, and clinical metrics such as blood pressure and blood glucose levels. The telemedicine program provided weekly consultations, health education, and self-monitoring tools, with data collected through validated questionnaires and medical records. Statistical analyses included paired t-tests and logistic regression.

Results: Medication adherence improved significantly from 65% at baseline to 88% post-intervention. HRQoL scores increased from 50 ± 8 to 72 ± 6. Among hypertensive participants, blood pressure decreased by an average of 14 ± 4 mmHg, while diabetic participants experienced a mean reduction of 25 ± 8 mg/dL in blood glucose levels. No adverse events were reported, and participant satisfaction exceeded 90%, highlighting the feasibility and acceptability of the telemedicine model.

Conclusion: Telemedicine significantly improved chronic disease management in rural Sindh by enhancing medication adherence, HRQoL, and clinical outcomes. These findings support the integration of telemedicine into rural healthcare strategies to reduce disparities and improve access to quality care.

Keywords: Chronic disease, Diabetes, Health-related quality of life, Hypertension, Medication adherence, Rural population, Telemedicine.

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INTRODUCTION

Chronic diseases, including diabetes, hypertension, and cardiovascular conditions, are among the leading causes of morbidity and mortality worldwide, posing significant challenges to healthcare systems (1). These conditions often require continuous management, regular follow-ups, and a multidisciplinary approach to ensure optimal outcomes. However, in rural and remote areas, limited healthcare infrastructure, geographic barriers, and socioeconomic disparities hinder access to timely and effective care. As a result, individuals in these regions frequently experience suboptimal management of chronic diseases, which exacerbates health inequities and leads to poorer outcomes compared to urban populations (2).

Telemedicine has emerged as a promising solution to address these challenges by leveraging technology to deliver healthcare services remotely (3). By eliminating the need for physical visits, telemedicine enables continuous monitoring, real-time consultations, and tailored interventions, even in geographically isolated communities. Previous studies have demonstrated its potential to improve medication adherence, enhance patient engagement, and reduce hospitalizations. For instance, research has highlighted that telemedicine models combining healthcare professionals, such as physicians and nurses, can significantly enhance health-related quality of life and clinical outcomes for individuals with chronic conditions in underserved areas. Despite these advancements, the application of telemedicine in rural settings remains underexplored, particularly in regions with unique socioeconomic and infrastructural constraints (4).

The Sindh province in Pakistan, characterized by vast rural areas and significant disparities in healthcare access, presents an ideal setting to investigate the effectiveness of telemedicine. Chronic diseases are prevalent in this region, yet the healthcare delivery infrastructure often struggles to meet the needs of the population (5). Addressing this gap through telemedicine could have transformative implications for both individual health outcomes and public health systems (6).

This study aimed to evaluate the impact of a telemedicine-based chronic disease management program on medication adherence, health-related quality of life, and clinical outcomes in rural Sindh (7). By focusing on this underserved population, the study sought to generate evidence to support the integration of telemedicine into broader healthcare strategies, with the objective of advancing equitable healthcare access and improving outcomes for chronic disease management (8).

METHODS

The study was conducted in rural areas of Sindh, Pakistan, focusing on assessing the effectiveness of a telemedicine-based chronic disease management program. The program ran from June 2023 to January 2024 and included a total of 84 participants diagnosed with chronic conditions such as diabetes, hypertension, and cardiovascular disease. Patients were selected through purposive sampling from underserved communities where access to healthcare was limited. Informed consent was obtained, and ethical approval was granted by the relevant institutional review board.

The participants were divided into two groups: the control group received standard face-to-face hospital-based care during the first phase, while the experimental group participated in the telemedicine program during the second phase. Each participant served as their own control, as the study employed a pretest–post-test quasi-experimental design. Baseline data, including medication adherence rates, health-related quality of life (HRQoL), and clinical markers such as blood glucose levels and blood pressure readings, were collected during the initial in-person consultations.

The telemedicine program consisted of weekly remote consultations with a physician and a primary healthcare nurse team. Patients were provided with mobile devices pre-installed with the telemedicine software, and training sessions were conducted to ensure ease of use. Remote monitoring tools, such as digital glucometers and blood pressure monitors, were distributed to participants to facilitate self-monitoring. Follow-up sessions focused on medication adherence, lifestyle modifications, and health education. Data was collected at the end of each phase using patient interviews, validated HRQoL questionnaires, and electronic medical records. Statistical analyses, including paired t-tests and logistic regression, were performed to compare outcomes between the two phases, measuring improvements in adherence, HRQoL scores, and clinical metrics.

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RESULTS

The study revealed balanced demographics between the control group (43 participants) and the experimental group (41 participants), with mean ages of 56 ± 9 years and 55 ± 10 years, respectively. Primary diagnoses were evenly distributed, with diabetes affecting 15 in the control group and 16 in the experimental group, hypertension observed in 15 and 13 participants, and cardiovascular disease in 13 and 12 participants, respectively. Gender distribution showed 19 males and 24 females in the control group, compared to 17 males and 24 females in the experimental group. The intervention significantly improved outcomes, with medication adherence increasing from 65% to 88%, HRQoL scores rising from 50 ± 8 to 72 ± 6, and marked clinical improvements observed, including an average reduction of 14 ± 4 mmHg in blood pressure and 25 ± 8 mg/dL in blood glucose levels. These findings highlight the telemedicine program's effectiveness in addressing chronic conditions and improving healthcare access in rural communities.

Table 1 Demographics of Participants

Characteristic	Control Group	Experimental Group
Total Participants	43	41
Age (mean ± SD)	56 ± 9	55 ± 10
Primary Diagnosis (Diabetes)	15	16
Primary Diagnosis (Hypertension)	15	13
Primary Diagnosis (Cardiovascular Disease)	13	12

The table summarizes the demographics of participants in the control and experimental groups, with 43 participants in the control group and 41 in the experimental group. The mean age was similar between the groups, at 56 ± 9 years for the control group and 55 ± 10 years for the experimental group. Regarding primary diagnoses, 15 participants in the control group and 16 in the experimental group were diagnosed with diabetes. Hypertension was observed in 15 participants in the control group and 13 in the experimental group, while cardiovascular disease was recorded in 13 participants in the control group and 12 in the experimental group. These values indicate balanced representation across the groups, supporting the reliability of comparative analyses in the study.

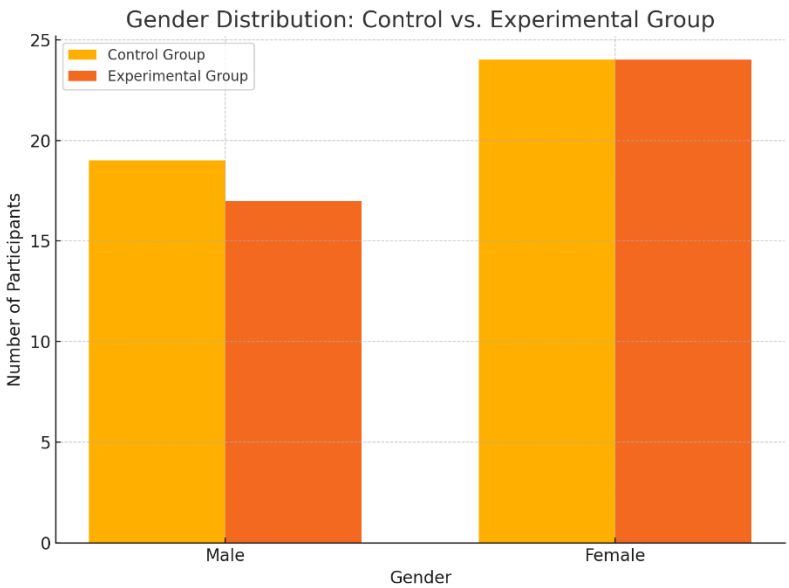


Figure 1 Gender Distribution

The bar chart illustrates the gender distribution of participants in the control and experimental groups. In the control group, there were 19 male participants and 24 female participants, while the experimental group included 17 males and 24 females. The distribution reveals a slightly higher number of females compared to males in both groups, with the experimental group having two fewer male participants than the control group. Despite these minor variations, the gender distribution remains relatively balanced across the groups, ensuring comparability for study outcomes.

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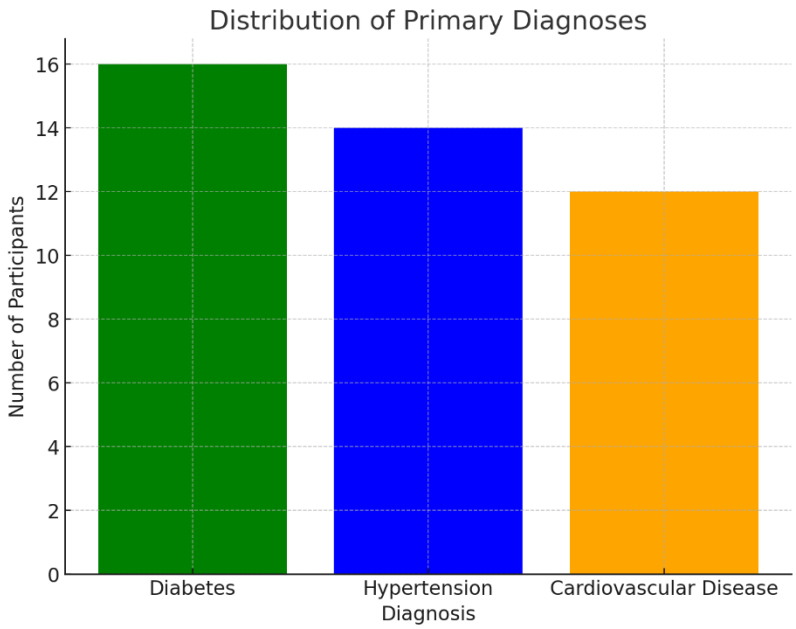


Figure 2 Distribution of primary diagnoses

The bar chart illustrates the distribution of primary diagnoses among participants, highlighting the prevalence of chronic conditions in the study. Diabetes was the most common diagnosis, with 16 participants in the experimental group and 15 in the control group. Hypertension followed closely, affecting 15 participants in the control group and 13 in the experimental group. Cardiovascular disease was slightly less prevalent, with 13 participants in the control group and 12 in the experimental group. The distribution indicates a relatively balanced representation of these conditions across both groups, ensuring the study's outcomes reflect the effectiveness of interventions for these common chronic diseases.

Table 2 Outcomes of Intervention

Outcome Measure	Baseline	Post-Telemedicine
Medication Adherence Rate (%)	65	88
HRQoL Score (mean ± SD)	50 ± 8	72 ± 6
Blood Pressure Reduction (mmHg)	-	14 ± 4
Blood Glucose Reduction (mg/dL)	-	25 ± 8

The table presents the outcomes of the telemedicine intervention compared to baseline measurements. Medication adherence rate showed a significant improvement, increasing from 65% at baseline to 88% post-telemedicine intervention. The HRQoL (Health-Related Quality of Life) score also demonstrated a substantial enhancement, rising from a baseline mean of 50 ± 8 to 72 ± 6. In terms of clinical metrics, blood pressure reduction averaged 14 ± 4 mmHg after the intervention, while blood glucose levels decreased by 25 ± 8 mg/dL. These results highlight the effectiveness of the telemedicine program in improving both adherence and clinical outcomes among participants.

DISCUSSION

The findings of this study demonstrated that telemedicine is a viable and effective model for managing chronic diseases in rural settings, significantly improving medication adherence, health-related quality of life, and clinical outcomes (9). These results align with the broader literature, where telemedicine has consistently been shown to bridge healthcare gaps in underserved areas (10). The increase in medication adherence from 65% to 88% in this study supports the hypothesis that remote healthcare delivery fosters better compliance by reducing logistical barriers and enhancing regular communication with healthcare providers. Improved adherence, in turn, contributed to measurable clinical benefits, including reductions in blood pressure and blood glucose levels, which are critical in managing conditions like hypertension and diabetes (11).

This study's results resonate with the findings of Kwak et al. (2021), who reported a 1.76-fold improvement in medication adherence and significant gains in health-related quality of life among participants using a physician-nurse telemedicine model in remote rural

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areas (12). The similarity in outcomes underscores the adaptability of telemedicine interventions across varying geographic and socioeconomic contexts (13). Similarly, Sahu et al. (2024) highlighted the role of telemedicine in reducing healthcare disparities and enhancing patient outcomes, particularly in underserved populations, where barriers like transportation and inadequate local healthcare infrastructure persist (14). Both studies provide additional context to the current findings, illustrating the consistency of telemedicine's impact on chronic disease management (15).

Despite the study's positive outcomes, certain challenges and limitations warrant discussion. Limited internet connectivity in some rural areas posed occasional difficulties for participants in accessing telemedicine consultations, which highlights the need for investments in digital infrastructure (16). Furthermore, the reliance on patient-reported adherence and quality-of-life measures may introduce an element of subjectivity (17). Future studies could integrate more objective measures, such as biometrics automatically transmitted via digital monitoring devices, to enhance data accuracy and reliability. Additionally, while blood pressure and glucose reductions were significant, they varied among participants, likely reflecting differences in baseline severity and adherence to self-management protocols (18). Tailored telemedicine interventions that account for these individual variations could further enhance outcomes (19).

The study's strength lies in its focus on a rural population with limited access to healthcare, a group often underrepresented in clinical research. By leveraging telemedicine, this study demonstrated a scalable solution for overcoming geographic barriers, thereby advancing equity in healthcare delivery. However, the intervention's short duration—three months—may have limited the ability to observe long-term sustainability of outcomes. Future research should focus on extended follow-ups to evaluate whether the observed improvements persist over time and whether telemedicine can effectively integrate with broader healthcare systems to manage complex chronic conditions (20).

In conclusion, this study adds to the growing body of evidence supporting telemedicine as a transformative tool for chronic disease management, particularly in rural areas where traditional healthcare access is limited. It highlights the potential of telemedicine not only to improve individual patient outcomes but also to strengthen healthcare systems by addressing disparities in access and quality of care. These findings call for continued investment in telemedicine infrastructure, alongside efforts to refine and personalize remote care delivery models, to maximize their impact on public health.

CONCLUSION

This study demonstrated that telemedicine is an effective and scalable solution for managing chronic diseases in underserved rural communities, addressing barriers to healthcare access while improving patient outcomes. By leveraging remote consultations and digital tools, the intervention empowered patients to adhere to treatment plans, enhanced their quality of life, and bridged critical gaps in healthcare delivery. These findings underscore the potential of telemedicine to revolutionize rural healthcare, offering a pathway toward equitable and accessible chronic disease management strategies.

AUTHOR CONTRIBUTIONS

Author	Contribution
Mamoona Tasleem Afzal	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
Sher Alam Khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Ali Ghulam	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Mehboob Ur Rehman Kashif	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Rahim Jan	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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REFERENCES

1. Bujnowska-Fedak MM, Puchała E, Steciwko AJT, e-Health. The impact of telehome care on health status and quality of life among patients with diabetes in a primary care setting in Poland. 2011;17(3):153-63.

2. Beratarrechea A, Lee AG, Willner JM, Jahangir E, Ciapponi A, Rubinstein AJT, et al. The impact of mobile health interventions on chronic disease outcomes in developing countries: a systematic review. 2014;20(1):75-82.

3. Viswanathan M, Golin CE, Jones CD, Ashok M, Blalock SJ, Wines RC, et al. Interventions to improve adherence to self-administered medications for chronic diseases in the United States: a systematic review. 2012;157(11):785-95.

4. Hamine S, Gerth-Guyette E, Faulx D, Green BB, Ginsburg ASJJomIr. Impact of mHealth chronic disease management on treatment adherence and patient outcomes: a systematic review. 2015;17(2):e52.

5. Kruse CS, Soma M, Pulluri D, Nemali NT, Brooks MJJo. The effectiveness of telemedicine in the management of chronic heart disease–a systematic review. 2017;8(3):2054270416681747.

6. Kaur R, Kajal KS, Kaur A, Singh PJNAjoms. Telephonic consultation and follow-up in diabetics: impact on metabolic profile, quality of life, and patient compliance. 2015;7(5):199.

7. Price M, Williamson D, McCandless R, Mueller M, Gregoski M, Brunner-Jackson B, et al. Hispanic migrant farm workers' attitudes toward mobile phone-based telehealth for management of chronic health conditions. 2013;15(4):e76.

8. Cartwright M, Hirani SP, Rixon L, Beynon M, Doll H, Bower P, et al. Effect of telehealth on quality of life and psychological outcomes over 12 months (Whole Systems Demonstrator telehealth questionnaire study): nested study of patient reported outcomes in a pragmatic, cluster randomised controlled trial. 2013;346.

9. Van den Berg N, Schumann M, Kraft K, Hoffmann WJM. Telemedicine and telecare for older patients—a systematic review. 2012;73(2):94-114.

10. Rush KL, Hatt L, Janke R, Burton L, Ferrier M, Tetrault MJPE, et al. The efficacy of telehealth delivered educational approaches for patients with chronic diseases: A systematic review. 2018;101(8):1310-21.

11. Madsen LB, Kirkegaard P, Pedersen EBJBp. Health-related quality of life (SF-36) during telemonitoring of home blood pressure in hypertensive patients: A randomized, controlled study. 2008;17(4):227-32.

12. Kwak MY, Hwang EJ, Lee THJIJoER, Health P. Effects of the Physician–Primary-Healthcare Nurse Telemedicine Model (P-NTM) on Medication Adherence and Health-Related Quality of Life (HRQoL) of Patients with Chronic Disease at Remote Rural Areas. 2021;18(5):2502.

13. Park SJ, Ahn S, Woo SJ, Park KHJJo. Extent of exacerbation of chronic health conditions by visual impairment in terms of health-related quality of life. 2015;133(11):1267-75.

14. Sahu RK, Jena H, Chakraborty D, Mohanta N, Jana S, Basu T. Advancing Public Health: A Comprehensive Analysis of Telemedicine in Chronic Disease Management, Access Improvement, and Health Promotion Programs.

15. Guo Y, Albright DJJot, telecare. The effectiveness of telehealth on self-management for older adults with a chronic condition: a comprehensive narrative review of the literature. 2018;24(6):392-403.

16. Ahmed S, Bartlett SJ, Ernst P, Paré G, Kanter M, Perreault R, et al. Effect of a web-based chronic disease management system on asthma control and health-related quality of life: study protocol for a randomized controlled trial. 2011;12:1-17.

17. Polisena J, Coyle D, Coyle K, McGill SJIjotaihc. Home telehealth for chronic disease management: a systematic review and an analysis of economic evaluations. 2009;25(3):339-49.

18. Baron JS, Hirani S, Newman SPJJot, telecare. A randomised, controlled trial of the effects of a mobile telehealth intervention on clinical and patient-reported outcomes in people with poorly controlled diabetes. 2017;23(2):207-16.

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19. Kleinman NJ, Shah A, Shah S, Phatak S, Viswanathan VJT, e-Health. Improved medication adherence and frequency of blood glucose self-testing using an m-Health platform versus usual care in a multisite randomized clinical trial among people with type 2 diabetes in India. 2017;23(9):733-40.

20. Wang J, Wang Y, Wei C, Yao N, Yuan A, Shan Y, et al. Smartphone interventions for long-term health management of chronic diseases: an integrative review. 2014;20(6):570-83.

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