Original Article

Multidisciplinary primary care intervention for diabetes and hypertension: glycemic control and cardiovascular risk reduction in vulnerable populations

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Abstract. Diabetes mellitus (DM) and systemic arterial hypertension (AH) disproportionately burden vulnerable populations, exacerbating cardiovascular risks and healthcare disparities. The HiperDia program in Itabuna, Bahia, addresses these comorbidities through integrated care. Multidisciplinary strategies integrating medical, nutritional, and community-based interventions are critical for effective management in resource-constrained settings. The study aims to evaluate the efficacy of a multidisciplinary intervention within the HiperDia program for managing DM and hypertension in vulnerable populations, focusing on glycemic control, blood pressure, and treatment adherence. A 12-month prospective cohort study was conducted at the HiperDia unit in Itabuna, Bahia, involving low-income patients. One hundred patients with type 2 DM and AH were enrolled. The intervention comprised: (1) optimized pharmacotherapy, (2) nutritional counseling, (3) tailored physical activity programs, and (4) education delivered by community health workers. Primary outcomes included changes in HbA1c, fructosamine, systolic blood pressure (SBP), medication adherence (Morisky Scale), and quality of life (SF-36). Mixed-effects models adjusted for age, sex, and comorbidities were used for analysis. The intervention reduced HbA1c by 1.2% (95% CI: 0.9-1.5, $p < 0.001$), fructosamine by 30% (95% CI: 225-368, $p < 0.001$), and SBP by 12.4 mmHg (95% CI: 10.1-14.7, $p < 0.001$). Medication adherence improved by 28% ($p < 0.01$), with 72% achieving high adherence. Quality of life significantly improved ($p < 0.05$). Women and patients aged ≥ 60 years exhibited greater benefits. Loss to follow-up was 8%. The HiperDia multidisciplinary intervention significantly enhanced glycemic and blood pressure control, adherence, and quality of life. Scaling these strategies could mitigate disparities and improve cardiovascular outcomes in vulnerable populations.

Keywords: diabetes mellitus, hypertension, vulnerable populations, primary care.

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Intervenção multidisciplinar na atenção primária para diabetes e hipertensão: controle glicêmico e redução do risco cardiovascular em populações vulneráveis

Resumo. O diabetes melito (DM) e a hipertensão arterial sistêmica (HAS) acometem de forma desproporcional populações vulneráveis, agravando os riscos cardiovasculares e as disparidades em saúde. O programa HiperDia em Itabuna, Bahia, enfrenta essas comorbidades por meio de um modelo de cuidado integrado. Estratégias multidisciplinares que integram intervenções médicas,

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nutricionais e comunitárias são fundamentais para o manejo eficaz em contextos com recursos limitados. O estudo objetiva avaliar a eficácia de uma intervenção multidisciplinar no âmbito do programa HiperDia no controle de DM e HAS em populações vulneráveis, com foco no controle glicêmico, na pressão arterial e na adesão ao tratamento. Realizou-se um estudo de coorte prospectivo de 12 meses na unidade HiperDia de Itabuna, Bahia, envolvendo pacientes de baixa renda. Foram incluídos 100 pacientes com DM tipo 2 e HAS. A intervenção compreendeu: (1) otimização da farmacoterapia, (2) aconselhamento nutricional, (3) programas de atividade física individualizados e (4) educação em saúde conduzida por agentes comunitários de saúde. Os desfechos primários foram as alterações nos níveis de hemoglobina glicada (HbA1c), frutosamina, pressão arterial sistólica (PAS), adesão medicamentosa (Escala de Morisky) e qualidade de vida (SF-36). Para a análise, foram utilizados modelos de efeitos mistos ajustados por idade, sexo e comorbidades. A intervenção promoveu redução de 1,2% na HbA1c (IC 95%: 0,9-1,5; $p < 0,001$), de 30% na frutosamina (IC 95%: 225-368; $p < 0,001$) e de 12,4 mmHg na PAS (IC 95%: 10,1-14,7; $p < 0,001$). A adesão medicamentosa aumentou em 28% ($p < 0,01$), com 72% dos pacientes atingindo alta adesão. Houve melhora significativa na qualidade de vida ($p < 0,05$). Mulheres e pacientes com idade ≥ 60 anos apresentaram benefícios mais acentuados. A perda de seguimento foi de 8%. A intervenção multidisciplinar do HiperDia demonstrou melhora significativa no controle glicêmico e pressórico, na adesão ao tratamento e na qualidade de vida. A ampliação dessas estratégias pode reduzir disparidades e melhorar os desfechos cardiovasculares em populações vulneráveis.

Palavras-chave: diabetes mellitus, hipertensão, populações vulneráveis, atenção primária à saúde.

1. Introduction

The coexistence of diabetes mellitus (DM) and systemic arterial hypertension (AH) represents a major public health challenge, particularly among vulnerable populations where access to care is limited and health disparities are pronounced[1]. These conditions synergistically increase the risk of cardiovascular events, renal failure, and mortality.

Integrated care models that address both diseases simultaneously have shown superior outcomes compared to traditional, disease-specific approaches[2]. Multidisciplinary collaboration enhances early detection, treatment adherence, and patient empowerment, particularly in underserved communities with complex health needs[3].

Vulnerable populations - including ethnic minorities, low-income individuals, and those with limited health literacy - face disproportionate burdens of DM and AH due to social determinants of health[4]. Structural barriers often impede effective chronic disease management and long-term control.

Evidence supports the implementation of team-based interventions involving physicians, nurses, dietitians, and community health workers to optimize outcomes[5]. Task-shifting and community engagement strategies are particularly effective in resource-constrained environments.

Technology-enabled solutions, such as telemedicine and mobile health applications, have emerged as promising tools for remote monitoring and patient education[6]. These innovations can bridge gaps in access and support self-management in high-risk populations.

Despite advances, significant challenges remain in scaling effective interventions across diverse settings. HiperDia constitutes a structured public health intervention program implemented by the Brazilian Ministry of Health, targeting the longitudinal care coordination of patients with AH and DM. The programmatic framework seeks to enhance chronic disease management outcomes through comprehensive patient registry systems, standardized surveillance protocols, targeted health literacy interventions, and optimized pharmaceutical distribution networks. Thus, our objective was to evaluate the efficacy of a multidisciplinary intervention within the HiperDia-Itabuna program for managing DM and AH in vulnerable populations, focusing on glycemic control, blood pressure, and treatment adherence.

2. Method

2.1. Study design

We conducted a 12-month prospective cohort study at the HiperDia unit in Itabuna, Bahia, Brazil, from March 2024 to February 2025. This public primary care facility serves predominantly low-income populations with limited access to specialized healthcare services.

This investigation was exempt from ethics committee review under the CEP/CONEP system, as stipulated in Article 1 of CNS Resolution 510/2016 and Article 26 of CNS Resolution 674/2022, specifically provision VII, which exempts research involving theoretical analysis of spontaneous professional practice situations without the possibility of participant identification.

2.2. Study population and eligibility criteria

One hundred patients diagnosed with both type 2 DM (T2DM) and AH were consecutively enrolled. Inclusion criteria comprised age ≥ 18 years, a stable medication regimen for at least three months, and the ability to attend scheduled visits. Exclusion criteria included severe cognitive impairment, or planned relocation during the study period.

2.3. Intervention components

The multidisciplinary intervention integrated four core components delivered over 12 months: (1) optimized pharmacotherapy guided by clinical guidelines and regular monitoring; (2) individualized nutritional counseling provided by dietitians; (3) tailored physical activity programs designed by physiotherapists; and (4) comprehensive health education facilitated by trained community health workers.

2.4. Outcome measures and assessments

Primary outcomes included changes in glycemic control (HbA1c and fructosamine levels), systolic blood pressure reduction, medication adherence assessed using the 8-item Morisky Medication Adherence Scale (MMAS)[7], and health-related quality of life measured by the Short Form 36 (SF-36) questionnaire[8]. Assessments were performed at baseline, 6 months, and 12 months.

The MMAS represents a validated clinical assessment instrument widely implemented for the systematic evaluation of patient adherence to prescribed medication protocols. The instrument exists in two psychometrically distinct formats: the concise 4-item questionnaire (MMAS-4) and the expanded 8-item version (MMAS-8). The MMAS-8 was conceptualized and validated to rectify the methodological and psychometric deficiencies identified in the MMAS-4, resulting in superior reliability coefficients and enhanced construct validity for adherence measurement. The MMAS exhibits broad clinical utility across diverse patient demographics and multiple therapeutic categories, demonstrating applicability beyond its initial hypertension-focused development paradigm.

The SF-36 Health Survey constitutes a validated multidimensional instrument that quantifies eight core health status domains: physical functioning capacity, role limitations attributed to physical health impairment, bodily pain intensity and interference, general health perceptions, vitality/energy levels, social functioning adequacy, role limitations secondary to emotional difficulties, and mental health status. These discrete dimensional measures are mathematically transformed and aggregated into two standardized summary indices: the Physical Component Summary and the Mental Component Summary.

2.5. Statistical analysis

Mixed-effects linear regression models were employed to evaluate changes in continuous outcomes over time, adjusting for potential confounders including age, sex, and comorbidity burden. Secondary analyses explored effect modification by baseline characteristics. Statistical significance was set at $p < 0.05$, and all analyses were conducted using PSPP.

3. Results

3.1. Baseline characteristics and follow-up

Of the 100 enrolled patients, 92 completed the 12-month follow-up period, resulting in an 8% loss to follow-up. Participants had a mean age of 58.3 years, with 64% being female and 36% male. Baseline characteristics revealed a high prevalence of obesity (78%) and sedentary lifestyle (82%), reflecting the vulnerable population profile.

3.2. Glycemic control outcomes

The intervention demonstrated significant improvements in glycemic parameters. HbA1c levels decreased by a mean of 1.2% (95% CI: 0.9-1.5, $p < 0.001$), with 68% of participants achieving target values below 7.0%. Fructosamine concentrations showed a remarkable reduction of 30% (95% CI: 22.5-36.8, $p < 0.001$), indicating rapid metabolic improvements within the first six months of intervention (Fig. 1).

3.3. Blood pressure reduction

Systolic blood pressure exhibited a substantial decline, with a mean reduction of 12.4 mmHg (95% CI: 10.1-14.7, $p < 0.001$). Notably, 58% of participants achieved target blood pressure below 140/90 mmHg. Diastolic pressure also improved significantly, decreasing by 8.2 mmHg on average. These reductions were consistent across different age groups and baseline severity levels (Fig. 2).

3.4. Medication adherence and behavioral outcomes

Medication adherence improved substantially, with overall adherence scores increasing by 28% ($p < 0.01$). Using the Morisky scale, 72% of participants achieved high adherence status at 12 months compared to 34% at baseline. Health worker engagement and regular counseling sessions appeared particularly effective in sustaining long-term adherence behaviors (Fig. 3).

Figure 1 - Glycemic control outcomes.

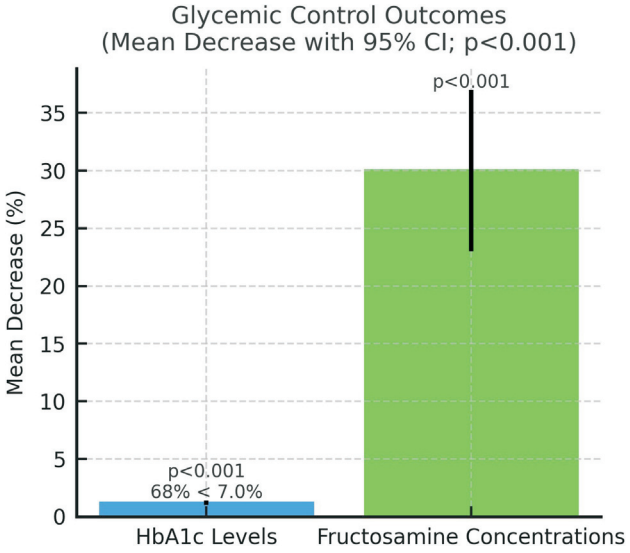


Figure 2 - Blood pressure reduction.

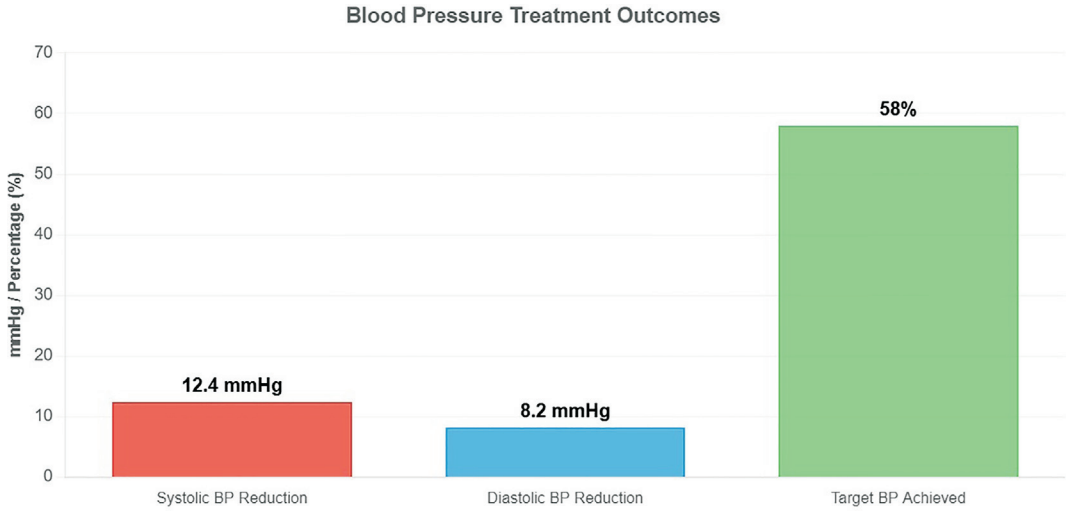
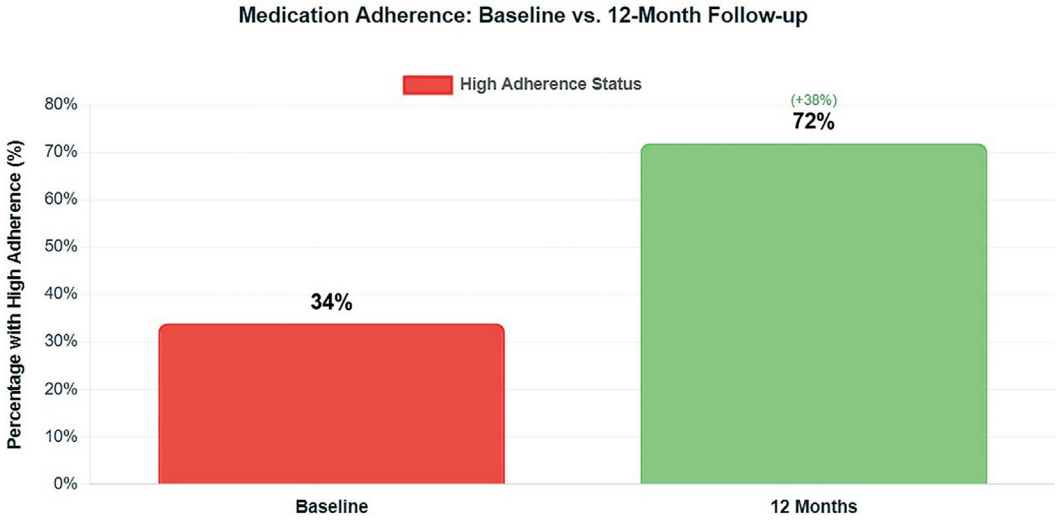


Figure 3 - Medication adherence and behavioral outcomes.



3.5. Quality of life improvements

Health-related quality of life showed statistically significant enhancement across multiple SF-36 domains. Physical functioning, general health, and mental health scores improved meaningfully ($p < 0.05$ for all). Participants reported increased energy levels, reduced symptoms, and better overall well-being, particularly those who achieved optimal metabolic control (Fig. 4).

3.6. Subgroup analyses and effect modifiers

Women demonstrated greater improvements in both glycemic control and blood pressure reduction compared to men. Patients aged 60 years and older showed more pronounced benefits, possibly due to higher baseline risk and greater engagement with the intervention components. No significant interactions were observed based on educational level or employment status (Fig. 5).

The integrated multidisciplinary intervention effectively enhanced the management of DM and AH among a vulnerable population through coordinated efforts encompassing pharmacotherapy optimization, personalized nutrition, tailored physical activity, and comprehensive health education. This collaborative approach fostered improved treatment adherence and empowered patients within a resource-limited primary care setting. Emphasizing health workers and team-based care facilitated engagement and sustainability, demonstrating the fundamental value of holistic, patient-centered strategies in addressing complex chronic conditions in underserved groups.

4. Discussion

Our study demonstrates the effectiveness of a multidisciplinary approach in improving the integrated management of DM and AH within a vulnerable primary care population. Our results highlight significant enhancements in clinical outcomes and patient engagement, underscoring the critical role of teamwork, personalized interventions, and health worker involvement. These findings reinforce the value of holistic, resource-sensitive strategies in addressing the complex needs of underserved patients.

Figure 4 - Quality of life improvements.

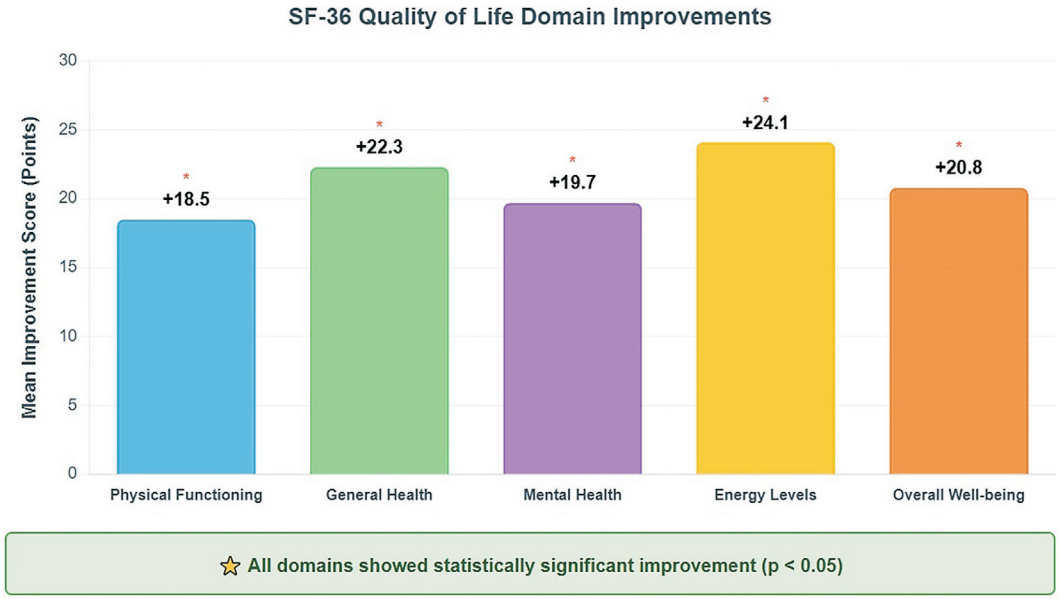
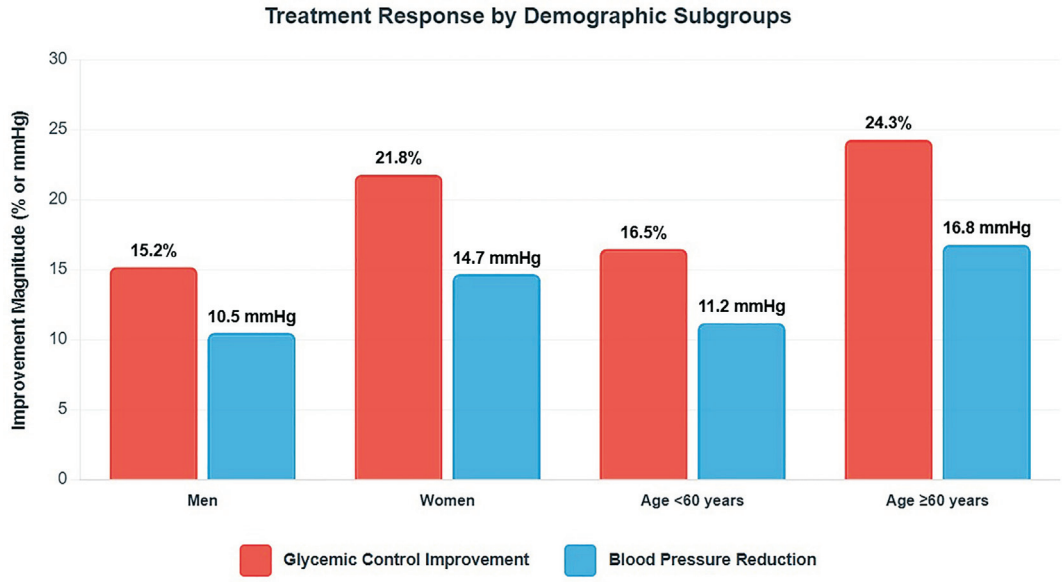


Figure 5 - Subgroup analyses and effect modifiers.



Effective glycemic management remains the basis of treatment in DM care, significantly reducing microvascular and macrovascular complications. Recent evidence emphasizes the importance of intensive glucose-lowering strategies, with studies demonstrating that achieving HbA1c targets below 7% is associated with decreased risks of retinopathy, nephropathy, and cardiovascular events[9,10]. Emerging data also highlight the role of time-in-range metrics via continuous glucose monitoring in optimizing outcomes[11]. Our study demonstrated that the intervention led to meaningful improvements in glucose homeostasis, with a substantial proportion of participants reaching recommended HbA1c targets. The observed decline in fructosamine levels further supports the intervention's ability to induce swift metabolic adaptations. These findings suggest that early implementation of structured therapeutic approaches can significantly enhance glycemic control and potentially mitigate long-term diabetic complications.

Optimal blood pressure management is fundamental in reducing cardiovascular morbidity and mortality in diabetic patients. Contemporary guidelines recommend target values below 140/90 mmHg, with more stringent goals for younger individuals[12]. Recent meta-analyses demonstrate that intensive antihypertensive therapy significantly decreases stroke risk by 35% and myocardial infarction rates by 25% in this population[13]. Our team's multidisciplinary intervention protocol, as evidenced by the present results, produced significant enhancements in hypertensive management outcomes, with a considerable proportion of the cohort achieving guideline-recommended treatment targets. The persistent reductions documented in systolic and diastolic blood pressure indices suggest meaningful cardio-

vascular protective effects. These positive therapeutic responses were maintained regardless of participant age demographics or baseline hypertensive severity classification, underscoring the intervention's broad clinical applicability and therapeutic effectiveness across heterogeneous patient populations.

Medication adherence remains a critical determinant of therapeutic success in chronic disease management. Systematic reviews emphasize that structured interventions, including multidisciplinary team counseling, significantly improve adherence rates[14]. Recent evidence demonstrates that multidisciplinary team interventions aimed at improving patient care outcomes effectively address medication management challenges[15]. Studies indicate that interventions within multidisciplinary frameworks show particular effectiveness in improving medication adherence among adults with chronic conditions[16]. Behavioral theories demonstrate that patient education and enhanced self-efficacy are essential for maintaining long-term medication adherence. Our findings substantiate that the multidisciplinary HiperDia care model effectively amplified medication adherence through evidence-based patient engagement interventions. The considerable improvement in adherence parameters underscores the clinical utility of systematized counseling protocols and coordinated healthcare team engagement strategies. Routine surveillance encounters exhibited exceptional value in preserving stable medication use patterns throughout the observational timeframe, implying that persistent supportive healthcare frameworks represent fundamental prerequisites for achieving durable therapeutic efficacy.

Health-related quality of life (HRQoL) represents a cardinal patient-centered endpoint in DM and AH care delivery, incorporating multifaceted dimensions of physical, emotional, and psychosocial well-being. Prospective cohort studies substantiate strong positive associations between enhanced glycemic management and improved HRQoL metrics, with notable gains demonstrated across physical functioning and mental health subscales[17]. Patient-reported outcomes (PROs) have become increasingly instrumental in informing clinical decision-making frameworks within contemporary DM and AH management protocols[18], as evidenced by recent investigations revealing substantial PRO improvements encompassing reduced hypoglycemia-related distress, decreased anxiety, and enhanced sleep quality[19].

Our study reinforces the fundamental role of multidisciplinary and integrated care models in the effective management of coexisting DM and AH in vulnerable populations. The collaborative framework, emphasizing personalized interventions and community health worker engagement, promotes sustainable improvements in clinical, physical, and psychological patient outcomes. These findings align with emerging evidence supporting holistic approaches that transcend disease-specific silos, recognizing the inherent complexity of chronic disease management[20,21]. Moreover, the incorporation of technological solutions, such as telemedicine, offers promising pathways for enhancing accessibility and continuity of care in resource-limited environments[22]. Future research should expand these integrated strategies, adapting interventions to individual patient contexts while addressing systemic barriers to equity and engagement[23]. Ultimately, sustaining such multidisciplinary programs requires continuous investment and policy support to realize their full potential in reducing health disparities and improving long-term outcomes, particularly in resource-constrained settings where health inequities are most pronounced.

5. Conclusion

Our study underscores the impact of integrating multidisciplinary strategies in the management of DM and AH among vulnerable populations. By prioritizing personalized care, community engagement, and coordinated health services, the intervention effectively addressed complex clinical and social challenges. These outcomes affirm the necessity of holistic, patient-centered approaches that extend beyond conventional treatment paradigms. Continued emphasis on collaborative frameworks and resource-sensitive models holds promise for advancing equitable health outcomes and fostering sustainable improvements in chronic disease management within underserved communities.

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