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An expanded chronic care management approach to multiple chronic conditions in Hispanics using community health workers as community extenders in the Rio Grande Valley of Texas

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ABSTRACT

Introduction: The synergistic negative effects of type 2 diabetes (T2DM) and hypertension increases all-cause mortality and the medical complexity of management, which disproportionately impact Hispanics who face barriers to healthcare access. The Salud y Vida intervention was delivered to Hispanic adults living along the Texas-Mexico Border with comorbid poorly controlled T2DM and hypertension. The Salud y Vida multicomponent intervention incorporated community health workers (CHWs) into an expanded chronic care management model to deliver home-based follow-up visits and provided community-based diabetes self-management education.

Methods: We conducted multivariable longitudinal analysis to examine the longitudinal intervention effect on reducing systolic and diastolic blood pressure among 3806 participants enrolled between 2013 and 2019. Participants were compared according to their program participation as either higher ($\geq$ 10 combined educational classes and CHW visits) or lower engagement (<10 encounters). Data was collected between 2013 and 2020.

Results: Baseline mean systolic and diastolic blood pressure were 138 and 81 mmHg respectively. There were overall improvements in systolic (−6.49; 95% CI = [−7.13, −5.85]; $p < 0.001$) and diastolic blood pressure (−3.97; 95% CI = [−4.37, −3.56]; $p < 0.001$). The higher engagement group had greater systolic blood pressure reduction at 3 months (adjusted mean difference = −1.8 mmHg; 95% CI = [−3.2, −0.3]; $p = 0.016$) and at 15 month follow-up (adjusted mean difference = −2.3 mmHg; 95% CI = [−4.2, −0.39]; $p = 0.0225$) compared to the lower engagement group.

Conclusion: This intervention, tested and delivered in a real-world setting, provides an example of how CHW integration into an expanded chronic care model can improve blood pressure outcomes for individuals with comorbidities.

1. Introduction

Roughly one in three U.S. adults have been diagnosed with multiple chronic conditions (MCCs), such as co-occurring type 2 diabetes and hypertension. Two in three individuals with diabetes have hypertension and/or receive treatment for hypertension (American Diabetes Association, 2024). The synergistic effects of diabetes and hypertension increase the incidence of cardiovascular disease and mortality (Passarella et al., 2018; Strain and Paldánius, 2018). Among Hispanic adults with type 2 diabetes (T2DM), less than half meet HbA1c or blood pressure

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targets (Casagrande et al., 2017). Along the US-Mexico border, less than a quarter meet blood pressure control recommendations (Vijayaraghavan et al., 2010).

Individuals with MCCs often experience fragmented care and need assistance navigating various health settings. Barriers, including financial and healthcare access, are intensified for this MCC group, leading to delays in or avoidance of medical care (de Heer et al., 2013). The medical complexity and economic costs of treating individuals with MCCs have prompted investigations into effective strategies for providing care to individuals with MCCs (Grembowski et al., 2014).

The American Diabetes Association's (ADA) 2023 guidelines for diabetes care recommend using community health workers (CHWs) to support the management of diabetes and cardiovascular risk factors in underserved communities (ElSayed et al., 2023). Researchers have noted the need for extending the care continuum to the home setting and incorporating the community to support individuals with MCCs (Savitz and Bayliss, 2021). Collaboration between the medical community and CHWs can enhance the patient-centered approach of health care in a cost-effective manner and improve health outcomes (Ingram et al., 1971; Moffett et al., 2018). The roles of CHWs in previously published studies include health education, care navigation, addressing barriers, and providing follow-up to health care services (Mistry et al., 2021).

Studies have begun to examine the integration of CHWs into the healthcare delivery system; however, to date, most CHW-based healthcare delivery interventions have focused on a single health condition, such as asthma, diabetes, or cancer (Jack et al., 2017; Jonas et al., 2022; Blecker et al., 2022; Campos et al., 2018; Roland et al., 2017; Scott et al., 2018). Few CHW interventions are focused on addressing MCCs (Kangovi et al., 2018). It has been well established that 20% of individuals with MCCs comprise 60% of healthcare costs (Boersma et al., 2020; LeRoy et al., 2014). There is a research gap of CHW-based interventions that address concomitant conditions, necessary for external validity in a population with multiple comorbidities.

We tested an intervention where CHWs served as community extenders under an expanded chronic care management model (Epping-Jordan et al., 2004). The Salud y Vida program was implemented in the Rio Grande Valley of Texas, a region known for its high prevalence of diabetes (28.2%), high poverty rates, and low-health insurance coverage (Vatcheva et al., 2020; U.C. Census Bureau, n.d.; Buettgens et al., 2018). The program enrolled individuals with poorly controlled diabetes (HbA1c $\geq$8%) and overtime, added services to address comorbidities with hypertension. Previous research documented a significant mean HbA1c reduction (from 10.2% to 8.93% at 3 months; $p < 0.001$) and results were sustained through 12 months) (Reininger et al., 2022). The purpose of this study is to examine the Salud y Vida program's effect on reducing systolic and diastolic blood pressure over time between groups with higher and lower engagement.

2. Methods

The study was reviewed and approved under exempt status by The University of Texas Health Science Center at Houston Institution Review Board.

The Salud y Vida program has been described elsewhere (Reininger et al., 2022; Zolezzi et al., 2022). In brief, community outreach screenings and clinical laboratory reports at participating clinics were used to identify individuals with a diagnosis of T2DM and poor glycemic control (HbA1c $\geq$8%). Trained personnel obtained written consent and release of health information at enrollment. The HbA1c was used for eligibility screening and recorded as a baseline result. Blood pressure measurements, and other anthropometric measurements were obtained during the enrollment visit and recorded as baseline readings. Demographic information and additional medical history, including medication use, were collected through self-report. Depression was assessed through Patient Health Questionnaires (PHQ-2 and PHQ-9).

Following enrollment, participants were assigned a CHW who conducted home visits within 14-days of enrollment and at quarterly intervals for a period of 12 to 24-months depending on meeting HbA1c targets. The first home visit focused on a brief motivational interview to guide participants with determining a behavior change goal related to their diabetes or hypertension and identifying barriers. Thereafter, home visits assessed behavior changes and participants' overall progress, informed by new HbA1c and blood pressure screenings. CHWs used validated instruments to assess depression, medication adherence, physical activity, and healthy eating status. Referrals to other community resources, such as access to free transportation, were made if CHWs identified barriers to participation.

Diabetes self-management education (DSME) was provided as part of the program. Participants were encouraged to attend the series of six classes. The classes covered all of the ADA-recommended topics and were provided in group settings in convenient community locations (Kolb, 2021). DSME was led by bilingual diabetes educators and CHWs. In June 2018, an additional class focused on blood pressure as added to the series. Participants were encouraged to complete the series within the first 3-months following enrollment.

2.1. Study sample

The study enrolled 6621 individuals between 2013 and 2020. A total of 3806 had a baseline blood pressure screening that met the American Heart Association ranges for elevated blood pressure(120–129 mmHg), Hypertension Stage 1 (130–139 mmHg) or greater (>130 mmHg), and had at least two visits conducted by the Salud y Vida program (Whelton et al., 2018). Consistent with other studies, records with baseline pulse pressure (pulse pressure = systolic blood pressure - diastolic blood pressure) were excluded (Safar et al., 2003; Vaccarino et al., 2001; Warren et al., 2019; Zhao et al., 2014). A total of 3806 participants met these criteria and were included in the analysis.

2.2. Measures

HbA1c point of care testing was conducted using A1CNow + POC assay (Bayer Healthcare LLC) and Abbott Afinion HbA1c Dx. Blood pressure screenings were conducted using WelchAllyn ProBP 2400 and the Omron HBP1300 model. Baseline HbA1c, baseline and follow-up BP screenings were used for the analyses.

Two measures were used to assess depression symptoms and severity at the time of enrollment. The Patient Health Questionnaire-2 (PHQ-2), a 2-item, 4-point Likert scale (0, “not at all” to 3, “nearly every day”), was used to assess the frequency of depressed mood and anhedonia over the past two weeks prior to the full 9-item PHQ-9 (Kroenke et al., 2003). Participants were also asked if they had been previously diagnosed with depression.

Two methods were used to measure medication adherence. Initially, the Morisky Medication Adherence Scale (MMAS-8) was used. The MMAS-8 questionnaire helped to assess adherence (De las Cuevas C, Peñate W, 2015). In order to obtain more information on barriers specific to this study population, the Adherence Starts with Knowledge-20 (ASK-20) was used (Hahn et al., 2008). A Total Barrier Count (TBC) score yields the number of barriers identified on a scale of 0–20 (maximum barriers =20). Permission was obtained to use these validated instruments.

Active medications were recorded during the enrollment visit by looking at the medication bottles or if medication bottles were not available, information was obtained from the participant through self-report.

Participant engagement categories of higher and lower were determined by a few criteria. We identified the core elements of the intervention including DSME classes and CHW home visits and the dose for which we hypothesized an improvement in (Voils et al., 2014) Blood pressure outcomes would occur. This dose was determined based on duration, frequency, and amount. Duration is months of exposure to the

intervention, with 62% of the sample having a duration of 12 months and the rest with a longer duration up to 24 months. Frequency of the core intervention elements for higher engagement included completion of 6 DSME courses (mean = 10.62) and 4 CHW home visits (mean = 4.94) for at least 10 encounters. The amount of intervention delivered was 120 min for each of the DSME classes and approximately 90 min (ranging from 45 to 120 min) for CHW home visits, not including time for service documentation and case notes. The higher engagement category therefore had a dose of 20 h or more intervention, whereas the lower engagement category had less. The categories of higher vs lower engagement also provided a comparative analytic sample by ensuring that the proportion of the sample in each engagement category would allow for meaningful comparisons.

2.3. Covariates

Potential confounding variables used in this analysis included demographic characteristics (age, gender, Spanish as a primary language, employment status, marital status, insurance status, education level, income level), depression as measured by self-report with the PHQ-2, the self-reported use of antihypertensive and diabetes medications, medical support in the form of whether the participant was enrolled in a medical home at baseline, and medication adherence were examined and properly addressed during the development of the final longitudinal multivariable models described below.

2.4. Statistical analysis

We examined overall mean changes in blood pressure levels over time and assessed the Salud y Vida program effect by comparing the longitudinal blood pressure levels between higher and lower engagement groups. We conducted univariable and multivariable longitudinal linear regression models using the generalized estimating equation (GEE) method that accounts for potential correlations of repeated measures within a subject over time. We evaluated Salud y Vida program effects on changes in blood pressure levels over time by testing interactions between the two engagement groups and follow-up month (follow-up visit, month) so that we can obtain estimates of Salud y Vida program effect on blood pressure levels at each follow-up month separately. Potential confounding variables, including demographic characteristics, were examined and addressed during the development of the final longitudinal multivariable models. We also checked if we missed any additional confounding factors that might cause residual confounding. SAS 9.4 (SAS Institute Inc., Cary NC) was used to perform all statistical analyses, and significance was set at the 0.05 level.

3. Results

Demographic and baseline characteristics are presented using means and standard deviation (SD) for continuous variables and counts and percentages for categorical variables in Table 1. We found differences in the participants in the higher and lower engagement groups by age, language of choice, marital status, employment, and education above 8th grade.

More participants in the low-engagement group had depression (22.96% vs. 19.27%).

3.1. Overall Longitudinal BP Trend

Mean systolic blood pressure (SBP) and diastolic blood pressure (DBP) levels over time were estimated and compared based on longitudinal linear regression models using the GEE method (Supplemental Figs. 1-a, 1-b). There was a significant decrease in SBP (mean change = −6.49; 95% CI = [−7.13, −5.85]; $p < 0.001$) and DBP levels (mean change = −3.97; 95% CI = [−4.37, −3.56]; $p < 0.001$) from baseline to 3-month follow-up visit, and the levels remained stable after month 3 up

Table 1
Baseline and engagement characteristics for Salud y Vida participants (n = 3806) (Rio Grand Valley, Texas, US, 2013–2020).

Variable	All n = 3806	Lower engagement n = 2270 (59.64%)	Higher engagement n = 1536 (40.36%)	p-value*
Age (years), mean (SD) [min, median, max]	52.89 (9.91) [18, 54, 86]	52.18 (10.12) [18, 53, 86]	53.94 (9.51) [20, 55, 84]	**<0.0001**
Female, n(%)	2603 (68.39)	1548 (68.19)	1055 (68.68)	0.7492
Preferred Spanish, n(%) (missing: n = 9, 0.24%)	2708 (71.32)	1554 (68.55)	1154 (75.42)	**<0.0001**
Employed, n(%) (missing: n = 415, 10.90%)	1242 (36.63)	791 (39.22)	451 (32.82)	**<0.0001**
Married, n(%) (missing: n = 197, 5.18%)	2150 (59.57)	1260 (58.39)	890 (61.34)	0.0767
Insurance, n(%) (missing: n = 411, 10.80%)	712 (20.97)	413 (20.79)	299 (21.24)	0.7506
Education > 8th grade, n(%) (missing: n = 401, 10.54%)	1686 (49.52)	1039 (51.01)	647 (47.30)	**0.0337**
Participant monthly income ≥ $1000, n (%) (missing: n = 1828, 48.03%)	467 (23.61)	266 (23.27)	201 (24.07)	0.6791
Have medical home, n (%) (missing: n = 285, 7.49%)	2969 (84.32)	1842 (87.34)	1127 (79.82)	**<0.0001**
Blood pressure medication at baseline, n(%)	900 (23.65)	542 (23.88)	358 (23.31)	0.6851
SBP at baseline (mmHg), mean (SD)	138.07 (15.93)	137.95 (15.89)	138.25 (15.99)	0.5772
DBP at baseline (mmHg), mean (SD)	81.14 (10.10)	81.29 (10.30)	80.91 (9.79)	0.2474
HbA1c at baseline (%), mean (SD)	10.03 (1.68)	10.07 (1.72)	9.98 (1.62)	0.1147
Depression at baseline, n(%) (missing: n = 167, 4.39%) [a]	781 (21.46)	497 (22.96)	284 (19.27)	**0.0078**
Diabetes medication at baseline, n(%) [b]	1249 (32.82)	750 (33.04)	499 (32.49)	0.7216
Hypertension at baseline by AHA cutoff (hypertension stage 1 or above), n (%)	3137 (82.42)	1883 (82.95)	1254 (81.64)	0.2972
Medication adherence (Morisky), n(%) (n = 1616 available, 42.46%)				0.5088
Low adherence	543 (33.60)	321 (34.63)	222 (32.22)	
Medium adherence	686 (42.45)	383 (41.32)	303 (43.98)	
High adherence	387 (23.95)	223 (24.06)	164 (23.80)	
ASK20 score (1−20), mean(SD) [min, median, max] (n = 464 available, 12.19%)	2.26 (2.34) [0,2,11]	2.38 (2.32) [0, 2, 11]	2.03 (2.36) [0,1,10]	0.1388
Follow-up duration, mean (SD) [min, max]	12.28 (5.47) [2, 41]	11.6 (5.71) [2, 41]	13.28 (4.94) [2, 39]	<0.0001
Total CHW visits, mean (SD) [min, max]	4.31 (2.05) [0, 16]	3.87 (2.09) [0, 16]	4.94 (1.79) [0, 16]	<0.0001
Total DSME classes, mean (SD) [min, max]	6.54 (6.59) [0, 118]	3.77 (4.12) [0, 36]	10.62 (7.39) [0, 118]	<0.0001

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Table 1 (*continued*)

Variable	All n = 3806	Lower engagement *n* = 2270 (59.64%)	Higher engagement *n* = 1536 (40.36%)	p-value*
Completion rate of DSME classes per month, mean (SD) [min, max]	0.97 (0.80) [0, 7.17]	0.49 (0.50) [0, 2.56]	1.68 (0.62) [0, 7.17]	<0.0001

Note: this table shows column percentages.
* *t*-test for continuous variables, Chi-square test for categorical variables.
[a] based on PHQ2 or self-reported depression data.
[b] based on self-reported diabetes medication usage.

to month 24.

3.2. Salud y Vida Program Effect on Blood Pressure Levels Over Time

Results from both univariable (unadjusted) and multivariable (adjusted) longitudinal analysis showed the higher engagement group to have a lower level of SBP over the entire follow-up period than those in the lower engagement group. Further, this Salud y Vida program effect was significant up to the 15-month follow-up (Table 2). The adjusted mean SBP levels over time by engagement group were calculated based on a multivariable model (adjusted model) and were plotted in Fig. 1.

The interaction effects we found in SBP levels were not observed in DBP levels (Supplemental Table 1). Both univariable and multivariable models showed DBP levels in the higher engagement group were slightly lower in general compared to those in the lower engagement group, but not significant. We found that there was a decrease in DBP levels between baseline and 3 month follow-up visit for both the higher (adjusted mean change = −4.4, $p < 0.0001$) and lower engagement group (adjusted mean change = −3.7, $p < 0.0001$), and both groups maintained their DBP levels after month 3 (Fig. 2).

We conducted a sensitivity analysis to determine if missing values in medication adherence impact the results. Though 57% were missing, medication adherence data were further adjusted in the models (Supplemental Fig. 2-a, Supplemental Fig. 2-b) for both SBP and DBP levels, which resulted in similar findings to those from models without adherence data.

We also conducted subgroup analyses for the participants who completed the programs by month 12 ($n = 2353$, short follow-up group) and those who remained after month 12 ($n = 1453$, long follow-up group). Compared to the short follow-up group, the longer follow-up group had more women (71% vs. 67%) and fewer individuals with insurance (19% vs. 22%). We found higher rates of depression at baseline (24.1% vs. 19.8%) and fewer participants who self-reported blood pressure medications (21.5% vs. 25%) and diabetes medications (31.3% vs. 33.8%) in the longer follow-up group. Though 57% were missing medication adherence data, fewer individuals reported high medication adherence (21.9% vs. 25.3%) in the long follow-up group compared to the short follow-up group. Among the short follow-up group, a decrease from baseline to month 3 was found in both SBP and DBP levels based on univariable and multivariable models ($p < 0.0001$). The higher engagement group with short follow-up (38.21%) had lower SBP and DBP levels over time, compared to the lower engagement group (61.79%), and this finding was either marginally or highly significant across the time points (Supplemental Figs. 3-a, 3-b). These findings of group differences were not observed among the long follow-up group (Supplemental Figs. 4-a, 4-b).

4. Discussion

Among our sample of 3806 Hispanic individuals with poorly controlled HbA1c and hypertension, we found SBP and DBP were reduced and maintained over time for those who had higher

Table 2
Salud y Vida program effect on SBP levels over time for participants in the Rio Grande Valley ($n = 3806$) (Rio Grande Valley, Texas, US, 2013–2020).

Variable	Unadjusted model		Adjusted* model	
	Mean difference (95% CI)	*p*-value	Mean difference (95% CI)	*p*-value
Interaction effect between time and group**		0.0504		0.1687
Higher vs. lower engagement † *at each month*				
At month 0	0.29 (−0.75, 1.33)	0.5818	0.40 (−0.86, 1.66)	0.5330
At month 3	−1.50 (−2.70, −0.31)	0.0138	−1.76 (−3.19, −0.33)	0.0160
At month 6	−1.14 (−2.36, 0.09)	0.0685	−1.03 (−2.50, 0.43)	0.1662
At month 9	−0.77 (−1.99, 0.45)	0.2177	−1.19 (−2.65, 0.27)	0.1102
At month 12	−1.07 (−2.30, 0.16)	0.0890	−1.65 (−3.09, −0.21)	0.0245
At month 15	−2.74 (−4.37, −1.12)	0.0009	−2.27 (−4.22, −0.32)	0.0225
At month 18	−0.72 (−3.77, 2.33)	0.6426	−0.65 (−3.90, 2.59)	0.6929
At month 21	−2.14 (−5.53, 1.26)	0.2171	−2.36 (−5.91, 1.19)	0.1927
At month 24	−1.78 (−5.47, 1.91)	0.3439	−1.63 (−5.50, 2.25)	0.4105
Changes over time *by engagement group*				
Month 3 vs. month 0				
Higher engagement	−7.52 (−8.50, −6.55)	<0.0001	−7.73 (−8.88, −6.58)	<0.0001
Lower engagement	−5.73 (−6.58, −4.88)	<0.0001	−5.57 (−6.62, −4.52)	<0.0001
Month 6 vs. month 3				
Higher engagement	0.86 (−0.07, 1.78)	0.0693	1.60 (0.53, 2.68)	0.0034
Lower engagement	0.49 (−0.42, 1.40)	0.2937	0.88 (−0.22, 1.97)	0.1169
Month 9 vs. month 6				
Higher engagement	−0.24 (−1.15, 0.67)	0.6079	−0.85 (−1.92, 0.23)	0.1229
Lower engagement	−0.61 (−1.54, 0.33)	0.2047	−0.69 (−1.83, 0.45)	0.2332
Month 12 vs. month 9				
Higher engagement	−0.74 (−1.66, 0.17)	0.1121	−1.28 (−2.33, −0.23)	0.0174
Lower engagement	−0.44 (−1.38, 0.49)	0.3546	−0.82 (−1.90, 0.27)	0.1392
Month 15 vs. month 12				
Higher engagement	−1.01 (−2.23, 0.21)	0.1055	0.12 (−1.33, 1.57)	0.8664
Lower engagement	0.67 (−0.60, 1.93)	0.3019	0.74 (−0.75, 2.24)	0.3300
Month 18 vs. month 15				
Higher engagement	1.60 (−0.86, 4.06)	0.2018	1.42 (−1.22, 4.07)	0.2917
Lower engagement	−0.42 (−2.54, 1.70)	0.6974	−0.19 (−2.54, 2.16)	0.8725
Month 21 vs. month 18				
Higher engagement	−1.66 (−4.84, 1.51)	0.3046	−1.88 (−5.25, 1.48)	0.2721
Lower engagement	−0.25 (−2.78, 2.29)	0.8481	−0.18 (−2.94, 2.58)	0.8998
Month 24 vs. month 21				

(*continued on next page*)

Table 2 (*continued*)

Variable	Unadjusted model		Adjusted* model	
	Mean difference (95% CI)	*p*-value	Mean difference (95% CI)	*p*-value
Higher engagement	−0.22 (−3.82, 3.38)	0.9051	−0.01 (−3.81, 3.79)	0.9961
Lower engagement	−0.57 (−3.39, 2.24)	0.6897	−0.74 (−3.58, 2.10)	0.6074
Age (year)	–	–	0.26 (0.21, 0.31)	<0.0001
Sex female vs. male	–	–	−2.83 (−3.94, −1.73)	<0.0001
Language Spanish vs. other	–	–	−2.35 (−3.58, −1.12)	0.0002
Employment Employed vs. other	–	–	−1.11 (−2.15, −0.07)	0.0362
Marital status Married vs. other	–	–	0.21 (−0.78, 1.21)	0.6735
Insurance yes vs. no	–	–	−0.73 (−1.90, 0.45)	0.2267
Education 8th grade or higher vs. other	–	–	−0.25 (−1.36, 0.87)	0.6651
Medical home at baseline yes vs. no	–	–	0.71 (−0.55, 1.97)	0.2699
Blood pressure meds at baseline yes vs. no	–	–	3.34 (1.90, 4.78)	<0.0001
Diabetes meds at baseline yes vs. no	–	–	−3.19 (−4.49, −1.90)	<0.0001
Depression at baseline *** yes vs. no	–	–	1.01 (−0.26, 2.27)	0.1181

CI = confidence interval.

* Multivariable longitudinal linear regression model after adjusting for age, sex, preferred language, employment, marital status, insurance, education, and baseline data including medial home, BP meds, diabetes meds, depression.

† Higher engagement, if total # encounters >10 & # DSME sessions ≥6 & # DSME/month (rate) ≥0.79; otherwise lower engagement.

** Based on interactive models where interactions between study group and follow-up visit (month) were included and tested; *p*-value of overall interaction effect was $p < 0.0001$ for both unadjusted and adjusted models.

*** Based on PHQ2 or self-reported depression data.

engagement. Both the higher and lower engagement groups showed statistically significant reductions ($p < 0.0001$) in mean blood pressure results by 3 months (higher engagement: SBP -7.73, DBP -4.36 mmHg; lower engagement: SBP -5.57, DBP -3.68 mmHg). At 15 months, the higher engagement group had better mean blood pressure improvement (SBP -8.1, DBP -4.9 mmHg). Our hypothesis was that the higher engagement group would have a more pronounced impact than the lower engagement group. Our hypothesis was supported, even though both groups showed a statistically significant decrease and sustained it overtime. Other studies reporting blood pressure outcomes for CHW interventions have shown mixed results. Beasley et al. found reductions in SBP and DBP of 6.2 and 4 mmHg respectively at 6 months (Beasley et al., 2021). Longer-term follow-up results were not reported. Perez-Escamilla et al. reported increases in SBP at 12 and 18 months in the intervention group compared to the control group, although the results were not statistically significant (Pérez-Escamilla et al., 2015).

This study is novel as it examines an expanded chronic care management intervention driven by CHWs in a population with poorly controlled MCCs. This intervention led to greater blood pressure reduction in the higher engagement compared to the lower engagement group, after adjusting for demographic, socioeconomic variables, and baseline health status variables (depression, medical home status, self-reported medications for blood pressure and diabetes).

More participants in the lower engagement group self-reported having a medical home at baseline compared to the higher engagement group ($p < 0.0001$). Although not statistically significant, the lower engagement group also had high rates of self-reported diabetes and antihypertensive medications at baseline compared to the higher engagement group. A contributing factor is that some participants may not have had a clinical diagnosis of hypertension at the time of enrollment, therefore, were not prescribed antihypertensive medications. Other factors can contribute to not reporting medications, such as barriers to access (cost), or non-compliance. Only 36.6% of participants were employed (despite mean age of 52.9) and only 20.97% had insurance. These factors present barriers to access and may influence participants' ability to prioritize self-management goals.

We assessed medical home status at various time points to determine its influence over time. Most participants (82.3%) reported having a medical home across all visits, 14.6% had fluctuations in medical home status, and 3.1% had no medical home. Medical home status did not significantly change our findings.

Our findings show that utilizing the expanded chronic care model can have a positive impact on individuals with MCCs. There exist many challenges with providing additional self-management support within primary care. For one, provider panel sizes and time requirements to serve patients with chronic conditions exceed available time (Ostbye et al., 2005). Others have noted that health systems are poorly designed to offer self-management support (Piette and Kerr, 2006). Our findings demonstrate that the expanded chronic care model with community-based support is patient-centered and helps address barriers to self-management resulting in improved blood pressure health outcomes.

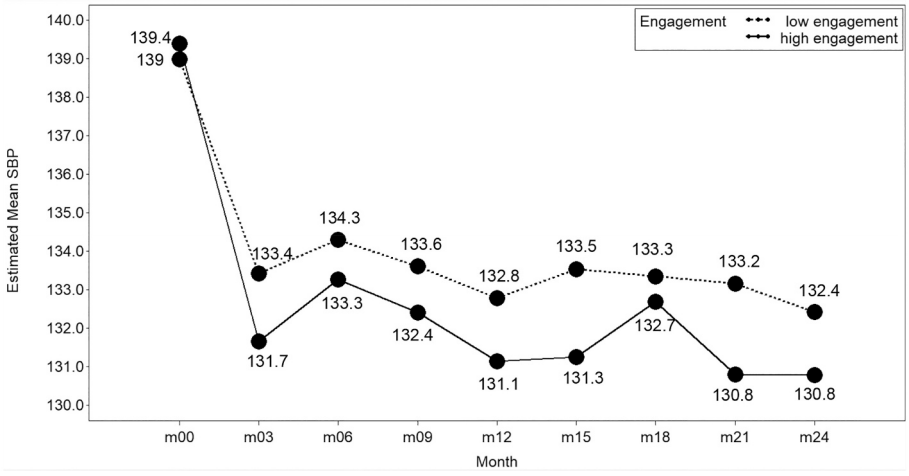

Fig. 1. Adjusted mean SBP levels over follow-up months by engagement group for Salud y Vida participants (Rio Grande Valley, Texas, US, 2013–2020).

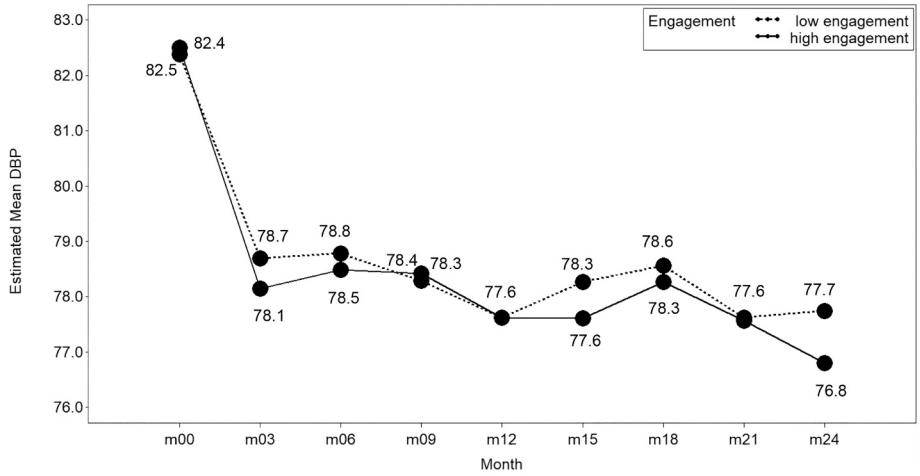

Fig. 2. Adjusted mean DBP levels over follow-up months by engagement group for Salud y Vida participants (Rio Grande Valley, Texas, US, 2013–2020).

4.1. Limitations

A limitation of our study is that the level of improvement seen in our mean blood pressure reduction across all hypertension categories did not meet the generally accepted clinically significant standard for SBP reduction of >10 mmHg and DBP reduction of >5 mmHg (Ettehad et al., 2016). These cut points were established from a meta-analysis of pharmaceutical interventions that showed achieving these reductions resulted in a 20% decrease in future, major cardiovascular events among participants. Clinicians and researchers have looked to science to guide clinical management of blood pressure and the 2017 changes in blood pressure categories have created debate and additional research (Whelton et al., 2022). Generally, recent research has shown that proportional reductions in blood pressure is associated with proportional benefits (Canoy et al., 2022). In fact, a recent study found that a 5 mmHg reduction of SBP reduced the risk of future cardiovascular events by 10% across blood pressure categories (Rahimi et al., 2021). We recommend future research examine blood pressure reductions by blood pressure category in MCC population samples to assess potential trajectory differences associated with intervention exposure overtime.

Another limitation is that self-reported medication status was only collected at enrollment and not overtime. While the program had access to electronic health records with medications prescribed, these records were not a good source of information on which medications had actually been picked up by participants. Therefore, self-reported medication status at enrollment was a better source of medication status. Validated instruments measured medication adherence at follow-up visits. CHWs used the results to navigate participants to their clinic providers for prescriptions and to social worker services when medication funding assistance was needed. We have little information about how medication status changed over time. Future iterations of the program should measure completed healthcare referrals, and medication status specifically. Also, we examined sociodemographic variables at baseline, though variables such as insurance status, employment status, and medical home can change over time. Thus, our results do not account for changes in these time-varying conditions.

5. Conclusion

Our study of the Salud y Vida intervention examined a large sample size longitudinally in a real-world study of effectiveness addressing multiple chronic conditions concurrently. Overall, we demonstrated that for the local population of Hispanic adults with uncontrolled T2DM and where individuals have MCCs and face socioeconomic and systemic barriers to traditional healthcare access, the integration of CHWs into the local healthcare continuum led to sustained improvement in blood pressure for a population with multiple comorbidities concurrently. Future analysis should consider longitudinal measurements by elevated blood pressure category, medication usage during the intervention period, and the measurement of potentially confounding medical condition status such as depression to account for how changes in these variables can also influence health outcomes.

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CRediT authorship contribution statement

Juliana Z. Lopez: Writing – original draft, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **MinJae Lee:** Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Soo K. Park:** Formal analysis, Data curation. **Maria E. Zolezzi:** Writing – review & editing, Supervision, Methodology, Data curation, Conceptualization. **Lisa A. Mitchell-Bennett:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Conceptualization. **Paul G. Yeh:** Writing – original draft. **LuBeth Perez:** Writing – review & editing. **Natalia I. Heredia:** Writing – review & editing. **David D. McPherson:** Writing – review & editing. **Joseph B. McCormick:** Writing – review & editing, Funding acquisition. **Belinda M. Reininger:** Writing – original draft, Methodology, Investigation, Funding acquisition, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ypmed.2024.107975.

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