

BMJ Open Evaluating the effectiveness of community health worker interventions on glycaemic control in type 2 diabetes mellitus: a systematic review and meta-analysis

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ABSTRACT

Objective Community health worker (CHW) interventions in control of HbA1c levels in diabetes have shown varied effects in randomised controlled trials. In the systematic review reported here, we aimed to evaluate the independent effectiveness of CHW interventions on the control of HbA1c levels in adults with type 2 diabetes.

Design Systematic review and meta-analysis.

Participants 1684 participants from 7 studies were included.

Interventions Randomised controlled trials of adults with type 2 diabetes receiving CHW interventions of at least 12 months' duration compared with usual care were eligible. Databases searched were Ovid MEDLINE, the Cochrane Central Register, CINAHL and Web of Science from 2000 to March 2025. Quality was assessed using the Cochrane RoB2 tool.

Primary outcome measure Through meta-analysis, we calculated the mean weighted difference (MWD) of change in HbA1c level from baseline between groups using RevMan.

Results Seven of 86 retrieved studies were eligible. Six studies were suitable for meta-analysis and included 1280 participants. An inverse variance weighted meta-analysis showed a significant improvement in pooled HbA1c level with an MWD of 0.50% (0.28%, 0.71%) in the CHW group ($p<0.0001$). Outcome heterogeneity was low ($I^2=21\%$), and the overall level of certainty was high.

Conclusions CHW interventions in type 2 diabetes showed statistically significant and clinically important reductions in HbA1c levels in people from minority ethnic groups on low income.

Community health workers (CHW) have contributed to global healthcare systems for over 50 years.¹ CHWs are trusted, non-clinical members of the community who possess shared experiences with their peers and are trained to navigate and advocate for patients within complex health settings.^{1 2} Initially, CHWs were recognised as village health workers, facilitating basic child and maternal health promotion interventions in low-income and

STRENGTHS AND LIMITATIONS OF THIS STUDY

- ⇒ Given the unknown duration between the delivery of a community health worker intervention and its impact on HbA1c, the follow-up of intervention outcomes was required to be at least 12 months for review inclusion.
- ⇒ At the stages of screening abstracts and full text articles, two authors (JE and HH) independently assessed studies against the eligibility criteria, with any disagreements resolved by the involvement of a third author.
- ⇒ Caution should be exercised in drawing direct comparisons between previous study results due to varying statistical effect measures.

middle-income countries.³ CHW roles have evolved, extending their scope to complex chronic disease management interventions across a variety of healthcare settings.⁴⁻⁶

Diabetes has become of increasing concern globally,⁷ with the estimated global prevalence currently at 537 million people and likely to rise to 643 million by 2030.⁸ The WHO¹ states CHWs have significant potential for the extension of healthcare provision to underserved communities. Peretz *et al* in the *New England Journal of Medicine*² outline the value of investing in CHWs to address systemic health inequalities within marginalised communities, who continue to have the worst health outcomes.

Patil *et al*⁹ conducted a systematic review examining the effects of peer support interventions on HbA1c outcomes, which found a minor improvement in HbA1c levels. HbA1c is a biomarker used to measure average blood glucose concentrations over the past 2-3 months. While statistically significant, findings were limited due to the high number of studies with short-term follow-up and did not reach the minimal clinically important

difference (MCID) of 0.5% HbA1c.¹⁰ The evaluation of HbA1c outcomes due to non-pharmacological interventions in type 2 diabetes is likely to require a minimum of 6 months from the start of an intervention to provide evidence of sustained improvement in HbA1c.¹¹ Palmas *et al*¹² reports CHW interventions combined with pre-existing multiprofessional approaches resulted in a modest reduction in HbA1c levels. However, the findings of the review did not assess the independent effectiveness of a CHW intervention. Several randomised controlled trials of independent CHW interventions have since been published.^{13–16}

The effect of the COVID-19 pandemic on overall population health has been profound, particularly among marginalised populations,^{17–18} with increased pressure on primary care services.¹⁹ If CHWs are demonstrated to be effective in the treatment of diabetes, they might offer significant economic advantage on the care of these patients globally. In this systematic review, the effectiveness of CHW interventions providing care of at least 12 months integrated with the usual care of diabetes was assessed.

METHODS

Randomised controlled trials published between January 2000 and March 2025 that reported on CHW interventions with at least 12 months of follow-up, compared with usual care or enhanced usual care, were included in the systematic review. The principal outcome variable was the change in HbA1c level from baseline to follow-up.

Study selection and search strategy

CHWs were defined as any non-healthcare-professional member of the community who had received some degree of training to provide an intervention for patients with type 2 diabetes mellitus. We included RCTs that compared CHW interventions with otherwise usual care or usual enhanced care in study participants aged 16 or over with type 2 diabetes mellitus that measured HbA1c level as a primary or secondary outcome. Given the unknown duration between the delivery of a CHW intervention and its impact on HbA1c, the follow-up of intervention outcomes was required to be at least 12 months. Any CHW-delivered interventions aimed at improving health behaviours, glycaemic levels or social support were eligible. Studies providing blended healthcare professional (HCP)/CHW-delivered interventions were excluded. Studies were excluded where participants were diagnosed with other forms of diabetes. Study participants were 16 years or older. At the stages of screening abstracts and of full text articles, two authors (JE and HH) independently assessed studies against the eligibility criteria, with any disagreements resolved by the involvement of a third author.²⁰

The databases searched were Ovid MEDLINE, the Cochrane Central Register of Controlled Trials, CINAHL and the Web of Science Core Collection.^{21–24} MeSH terms

were searched in addition to key terms where practicable.²⁵ Studies were not restricted to English language, with the use of Google Translate to facilitate screening of non-English articles. A full search strategy is reported in online supplemental supp A.

Risk of Bias, data synthesis and analysis and sensitivity analysis

Data extraction was undertaken manually by one author (JE) and compiled into a table of overall study characteristics. Quality of included studies was assessed using Cochrane's Risk of Bias tool.²⁶ Data extraction and risk of bias were verified sequentially by a second author (PTW). Any discordance was resolved with the involvement of a third author (HH). Meta-analysis was performed using Cochrane's RevMan Meta-analysis software.²⁷ We calculated the mean weighted difference (MWD) in changes from baseline HbA1c level to follow-up level between the CHW intervention and control groups to adjust for varying baseline HbA1c levels using a random effects model.²⁷ Meta-analysis was repeated using a fixed effects model to assess the impact of the level of heterogeneity. A sensitivity analysis was carried out removing each study from the meta-analysis in turn, and in particular looking at the impact of studies with a moderate or high risk of bias. 95% CIs were calculated, and a $p < 0.05$ was considered statistically significant. Heterogeneity among studies was calculated using the I^2 statistic. I^2 values were interpreted for the degree of heterogeneity against guide values.²⁸ Subgroup meta-analyses by ethnicity were also undertaken. Certainty of evidence was assessed using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) domain.²⁹

Patient and public involvement

None.

RESULTS

The titles and abstracts of 1145 records were screened, of which 1045 records were excluded. 100 full text papers were assessed for eligibility, of which seven papers were included in the review. Six studies were included in the meta-analysis. In all seven trials, the intervention was targeted at ethnic population groups with higher-than-average prevalence of diabetes and low income. The outcome of the review was reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist and is shown in detail in figure 1.³⁰ Of the seven trials, six were conducted in the USA and one in Australia.

A summary of study characteristics is shown in table 1, including the mode of patient recruitment, ethnicity of the study populations and duration of the studies.

Study outcomes

The characteristics of the CHW interventions varied across the studies. All studies^{13–16 31–33} outlined the use

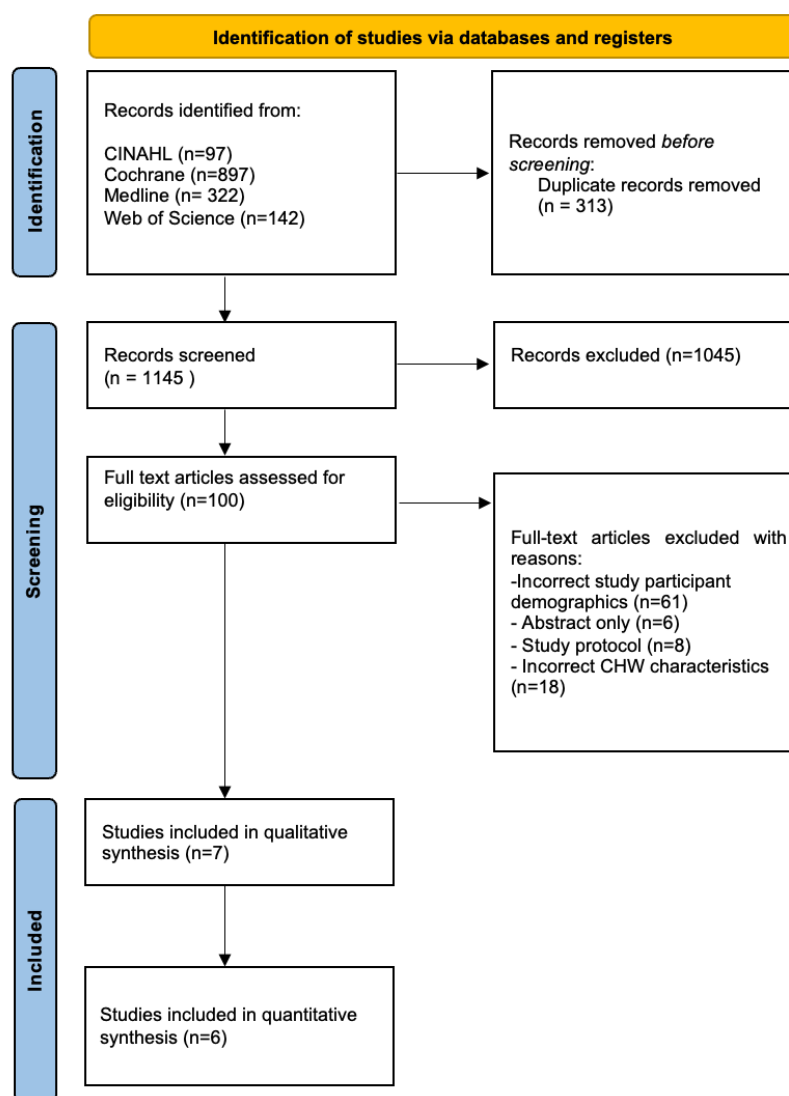


Figure 1 The PRISMA flow diagram represents the identification, screening and inclusion stages of the systematic review. 1145 records were screened at title and abstract stage; 100 full-text articles were assessed for eligibility, with ultimately 7 articles included in the systematic review. Six articles were also included in the meta-analysis. CHW, community health worker; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

of supportive self-management interventions, including health coaching and facilitated goal setting. Five studies used an individual intervention approach,^{13–15 32 33} whereas two studies^{16 31} used a blended individual and group behaviour change approach. Six of the seven studies^{13–16 31 32} provided additional, non-clinical CHW interventions. Three studies^{15 16 31} provided patient empowerment approaches, two studies^{32 33} addressed wider psychosocial factors contributing to diabetes self-management, one study¹⁴ delivered a self-management intervention and one study¹³ involved lifestyle support. Additionally, Prezio *et al*³³ adopted more clinically orientated CHW interventions, analogous to those of HCPs. The characteristics of the control groups in included trials were relatively similar. In five studies,^{14–16 31 32} the

control groups experienced usual care, in addition to mailed educational material covering varying lifestyle factor contexts. Prezio *et al*³³ provided the control group with usual care augmented by blood glucose testing strips and instructions on how to use them. The control group in the study by McDermott *et al*¹³ was given only usual care; control group patients were invited to participate in the CHW intervention 18 months following the trial endpoint.

The structural organisation of CHW training schemes varied significantly among included studies. Six studies^{13–16 31 32} incorporated health coaching and holistic sessions into CHW training programmes. In addition, two of the studies^{15 31} detailed comprehensive training in self-management behaviours and lifestyle advice within CHW

Table 1 Summary of characteristics of included studies

Study, year	Country	Number of participants	Mode of patient recruitment	Population	Nature of intervention	Control	Outcomes	Overall RoB
Carrasquillo <i>et al</i> ¹⁶	Florida, USA	300	Electronic records identification and contact.	Latinos with a type 2 diabetes diagnosis, and most recent HbA1c ≥ 8.0%.	Blended home visit, telephone and group activities to facilitate patient empowerment.	Usual care	At 1-year follow-up HbA1c level was 0.51% lower in the CHW group compared with control.	Medium
Lutes <i>et al</i> ¹⁵	East Carolina, USA	200	Self-referral or primary care provider referral.	Middle aged, rural, African-American women with moderate obesity and recent HbA1c > 7% in the preceding 12 months.	CHWs were also African American and delivered 16-week individual-approach EMPOWER treatment sessions.	Mail-based education materials.	No significant difference in HbA1c reduction at 12 months between CHW intervention and control group (1.84% vs 1.61%).	Low
McDermott <i>et al</i> ¹³	Queensland, Australia	213	Recruited by clinic.	Poorly controlled adults with type 2 diabetes, defined as recent HbA1c ≥ 8.5%, in addition to the presence of other significant comorbidities.	Intervention involved 1-1 general lifestyle support, with ad hoc home visits if requested.	Usual care.	At 18 months, there was a significant reduction in HbA1c level in the CHW intervention group vs control (-1.0% vs -0.2%) when compared with baseline levels.	Low
Nelson <i>et al</i> ¹⁴	Seattle, USA	287	Electronic record identification.	Low-income Latino patients with HbA1c level of ≥ 8.0% in preceding 12 months.	Four 1-1 home visits focussing on self-management strategies.	Usual care.	At 12 months, the change in HbA1c level of CHW intervention group vs control was not significant (-0.51% vs -0.33%) (p=0.54).	Low
Palmas <i>et al</i> ³¹	New York, USA	360	Electronic Health Record identification.	Adult Hispanics aged 35-70 years, with an HbA1c level of > 8% in the preceding 12 months.	CHW intervention comprising group visits, 1-1 visits, telephone. Behavioural change methods included patient empowerment and goal setting.	English- Spanish bilingual health and diabetes education resources, as well as mental health.	After 12 months, HbA1c reduction in the CHW intervention group was greater than that of the control (-0.35% vs -0.05%).	Medium
Prezio <i>et al</i> ³³	Texas, USA	180	Electronic Health record identification.	Uninsured Mexican Americans with diabetes.	The three educational modules were delivered during individual 1-hour sessions over the first 8 weeks. Modules covered clinical blood glucose monitoring, culturally appropriate meal-planning, as well as smoking cessation advice and exercise recommendations.	Diabetes education material, as well as blood glucose monitoring strips.	At 12 months, change in HbA1c level showed significant CHW intervention effect compared with control (-1.6% vs -0.9%).	Low

Continued

Table 1 Continued

Study, year	Country	Number of participants	Mode of patient recruitment	Population	Nature of intervention	Control	Outcomes	Overall RoB
Rothschild <i>et al</i> ³²	Chicago, USA	144	Recruited through health insurer.	Mexican Americans, defined as at least 1 parent or 2 grandparents having been born in Mexico, with a diagnosis of type 2 diabetes, taking oral diabetes agents.	2-year CHW intervention, 36 1–1 visits over 2 years. CHWs taught 5 general self-management skills: brainstorming and problem solving, using a journal or written record, modifying the home environment to support behaviour change, seeking social support from family or friends and managing stress.	The same self-management material via written pamphlet.	Intervention participants showed significantly lower haemoglobin A1c levels than control participants at both year 1 $\Delta=-0.55$; $p=0.021$ and year 2 $\Delta=-0.69$; $p=0.005$.	Low

HbA1c is a biomarker used to measure average blood glucose concentrations over the past 2–3 months. CHW, community health worker.

training programmes. The study by Prezio *et al*³³ outlined the integration of clinical skills into the CHW training programme. The duration of CHW training programmes among studies varied. Five studies^{14 16 32 33} provided the hourly duration of CHW training programmes, ranging from 27 to 100 hours. In the study by McDermott *et al*,¹³ CHWs underwent an intensive 3 weeks of training, but training hours were not defined. Palmas *et al*³¹ did not outline the duration of CHW training in their study.

Participants having poorly controlled diabetes were common among the studies, with five studies^{13–16 31} requiring a minimum HbA1c level of between 7.0% and 8.5% for participant eligibility. Rothschild *et al*³² had no HbA1c requirement. Instead, participants were required to be on at least one oral hypoglycaemic agent to be eligible. Prezio *et al*³³ omitted any minimum HbA1c requirement. The study aimed to evaluate CHW interventions in real-life circumstances, inclusive of populations with varying levels of glycaemic control.

Risk of bias

The outcome of the RoB2 risk of bias assessment is shown in figure 2. All studies provided adequate randomisation techniques, in addition to conforming to intended study interventions, thus presenting low-level risks of bias in both respective domains. The dropout rate varied among studies. Two of the included studies had dropout rates of greater than 15%. Despite both studies using multiple imputation analyses, an increased risk of attrition bias cannot be eliminated.³⁴ In all studies, the measurement and reporting of outcomes were clearly defined and representative of whole-study outcomes, thus the risk of reporting bias was low. While high dropout rates resulted in an overall medium risk of bias for two studies,^{16 31} the overarching picture shows a low risk of bias.

Certainty of evidence

The GRADE approach²⁹ was used to assess overall certainty of evidence (table 2). Overall, there was high certainty of evidence in five studies.^{13–15 32 33} Two studies^{16 31} had a moderate final level of certainty due to identified concerns of risk of bias.

META-ANALYSIS OF STUDIES

Six of the seven studies^{13–15 31–33} were included in meta-analysis. The trial by Carrasquillo *et al*¹⁶ reported a mean HbA1c difference of -0.51% (95% CI -0.94% , -0.08%) in favour of the CHW intervention group at 12-month follow-up compared with usual care. However, due to missing HbA1c mean and SD outcome data at 12 months' follow-up for the CHW and control groups in the trial, we were unable to include the study in the meta-analysis.

Using Revman,²⁷ the inverse variance-weighted average model showed the overall pooled effect of CHW interventions on HbA1c level had an MWD of -0.5% (95% CI -0.71% , -0.28%) (figure 3). The I^2 value was 22%, indicating low heterogeneity. Due to the small number of

Study	Bias arising from the randomisation process	Bias due to deviations from intended intervention	Bias due to missing outcome data	Bias in measurement of the outcome	Bias in selection of the reported result	Overall risk of bias
Carrasquillo et al, 2017						
Lutes et al, 2017						
McDermott et al, 2015						
Nelson et al, 2017						
Palmas et al, 2014						
Prezio et al, 2013						
Rothschild et al, 2014						

Figure 2 Cochrane RoB2 tool was used for assessing the risk of bias of included studies against five modalities, alongside a weighted overall risk of bias determination. Five studies had low overall risk of bias, and two studies had moderate overall risk of bias.

included studies, publication bias could not be ruled out by Egger's test or by funnel plot.³⁵ A sensitivity analysis of studies with low risk of bias showed an MWD of -0.56% in HbA1c and an I^2 value of 19% .

Subgroup analyses by ethnicity

The pooled effect of CHW interventions was collated by ethnicity (figure 4). The Hispanic/Latino subgroup^{14 16 30–32} HbA1c MWD was -0.50% (95% CI -0.80% , -0.19%) ($p=0.001$). However, the I^2 value was 45% , showing the studies to be moderately heterogeneous. The HbA1c MWD in the African American¹⁵ and Indigenous Australian¹³ subgroups was -0.34% (95% CI -0.82% , -0.14%) and -0.7% (95% CI -1.25% , -0.15%), respectively. While statistically significant and exceeding the MCID in the indigenous Australian subgroup, both subgroups^{13 15} had only one study, limiting the interpretation that can be made from the outcomes.

DISCUSSION

In this study, CHW interventions were effective in improving glycaemic control in people affected by type 2 diabetes mellitus, with a statistically significant and clinically important reduction in HbA1c level of 0.5% after meta-analysis of six studies. The intervention was targeted at populations with higher prevalence of diabetes and low income with worse access to healthcare. The intervention was designed to improve self-management. A change of at least 0.5% in HbA1c level is considered to be the MCID following an intervention to improve the outcome of diabetes mellitus.^{10 36} This review is the first to show the independent effectiveness in diabetes of CHW interventions of at least 12 months.

A subgroup analysis of the effect of the CHW interventions in people of Hispanic/Latino ethnicity showed a similar result. The I^2 value of 45% suggests studies in this ethnic group are of moderate heterogeneity,²⁸ suggesting that variable characteristics among the studies may have contributed to the calculation of MWD. The trials among people of Hispanic/Latino ethnicity were all conducted

Table 2 Certainty of evidence using GRADE domains

	Risk of bias	Inconsistency	Imprecision	Indirectness	Publication bias	Final level of certainty
Carrasquillo et al ¹⁶	Some concern	No concern	No concern	No concern	No concern	Moderate
Lutes ¹⁵	No concern	No concern	No concern	No concern	No concern	High
McDermott ¹³	No concern	No concern	No concern	No concern	No concern	High
Nelson ¹⁴	No concern	No concern	No concern	No concern	No concern	High
Palmas ³¹	Some concern	No concern	No concern	No concern	No concern	Moderate
Prezio ³³	No concern	No concern	No concern	No concern	No concern	High
Rothschild ³²	No concern	No concern	No concern	No concern	No concern	High

GRADE, Grading of Recommendations Assessment, Development and Evaluation.

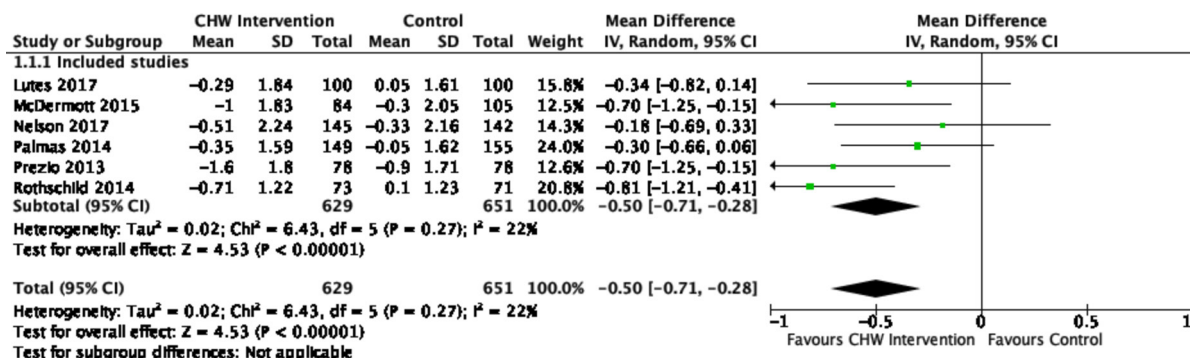


Figure 3 Forest plot for two-arm meta-analysis of all included studies reporting change in HbA1c at >12 months. The overall pooled effect of CHW interventions on HbA1c level resulted in a mean weighted difference of -0.5%, with 95% CIs (-0.71%, -0.28%) visualised by the black diamond. HbA1c is a biomarker used to measure average blood glucose concentrations over the past 2-3 months. The I^2 value of 22% reflects the low level of study heterogeneity. CHW, community health worker.

in the USA.^{14 16 31 32} There is nothing to suggest that the findings would not be replicated in people from other or mixed ethnic groups. Most trials included in this study recruited participants from either low-income or health-uninsured population demographics. Given that six of the seven included studies were conducted in the USA and given their varying context of healthcare system by insurance status, it is plausible to suggest that CHWs could be used to augment stratified levels of conventional care. However, further research is needed in a wider range of ethnic groups and in other health systems to determine the representativeness and broader applicability of the findings.

In addition to targeting populations with higher prevalence and worse outcomes of diabetes, most of the trials in this review targeted patients with poor glycaemic control. People with milder diabetes may not experience the degree of improvement seen in this study. Previous studies have shown that CHWs can hold an integral role within health systems of low-income and middle-income

countries, with contributions in a range of settings.³⁷ The research reported here is an example of reverse innovation in that the innovation of the CHW was originally developed in low-income and middle-income countries and has now been tested in high-income countries.³⁸ All the studies included are from high-income countries, and this review identified significant findings in favour of CHW interventions. It is plausible that adopting this innovation by the implementation of CHW interventions would be beneficial in other populations and ethnic groups in high-income countries. Perveen *et al*³⁷ outline that CHW interventions in low-income and middle-income countries operated substantially in a clinical capacity, as an alternative to resource-scarce HCPs. This review suggests that optimal care of diabetes in high-income countries should also include CHW interventions working in tandem with HCPs. Furthermore, given the regularity of attendance and prolonged impact of CHW interventions in diabetes control, it would be useful to assess whether their role could be of benefit in a

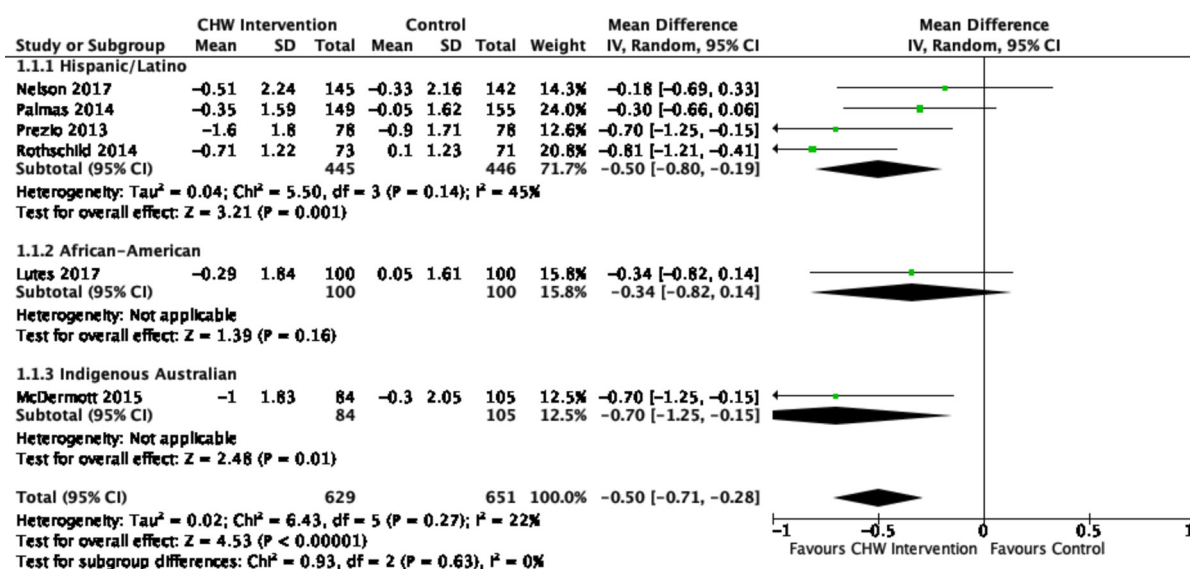


Figure 4 Forest plot for two-arm subanalyses by ethnicity of included studies reporting change in HbA1c at >12 months—stratified into (1) Hispanic/Latino subgroup, (2) African-American subgroup and (3) Indigenous Australian subgroup. CHW, community health worker.

wider context of communicable and non-communicable chronic disease management.

Strengths and limitations

In previous systematic reviews, the effect of CHW interventions in type 2 diabetes included studies that provided short-term follow-up data. Due to fluctuating HbA1c levels over the short term, particularly in patients with unstable glycaemic control,³⁶ CHW interventions could not be evaluated definitively using the HbA1c biomarker over periods of less than 12 months. This is the first systematic review to analyse independent CHW interventions in trials of diabetes mellitus with a follow-up period of at least 12 months. It is important to note that previous systematic reviews have used standardised mean difference (SMD) effect measures in their results.^{9 12} Since all trials in our study reported HbA1c as the sole outcome measure, we calculated the MWD in HbA1c. Furthermore, the calculation of the SMD is affected by varying SDs, and while this is intended to reflect differences in outcome measurement scales, the Cochrane Handbook for Systematic Reviews of Interventions³⁹ outlines a lack of differentiation between this and the effects of expected variability in study populations. Hence, caution should be exercised in drawing direct comparisons between this review and results of previous studies.

The review methodology was thorough; we followed the PRISMA protocol, and the screening stages were completed independently by two authors against the inclusion and exclusion criteria. Included studies in the review underwent assessment for risk of bias using Cochrane's RoB 2 tool.²⁶

While the overall certainty of evidence is high, it is important to consider the limitations of assessing for unknown publication bias due to the small number of included studies. This has been mitigated by a comprehensive and independent search strategy with the aim of minimising publication bias.²⁹ We can be confident that CHWs did cause a significant reduction in HbA1c in the participants in the included studies.

Each of the trials included focused the intervention on participants from specific ethnic or low-income groups. This may limit the generalisability of our findings to the wider population including ethnic groups not participating in the trial. Cheng *et al*⁴⁰ conducted a study estimating the prevalence of type 2 diabetes by race in the USA and found that the prevalence was 75.7% higher in Hispanic adults (24.6%) when compared with non-Hispanic adults (14.0%) ($p < 0.05$). Given that six of the seven included studies^{14–16 31–33} were conducted in the USA, four of which^{14 16 31 32} included only Hispanic adults, it is probable outcomes from this review will not be representative of the wider population. Further research trialling CHW interventions in diabetes among other ethnic groups would be valuable. All included studies were conducted in high-income countries, which may reduce the generalisability of our findings globally. However, the intervention was less costly than would have been the case

if the additional staff were trained professionals. This may encourage low-income and middle-income countries to consider boosting their services for diabetes mellitus using CHWs. Given the varying structures of health systems globally, including healthcare access, resource availability and insurance modality, the feasibility of our findings may not be uniformly practicable.

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Contributors JE contributed to conceptualisation, data curation, formal analysis, investigation, methodology, project administration, resources, software, data validation, data visualisation and writing. PTW contributed to conceptualisation, data curation, funding acquisition, investigation, methodology, project administration, resources, supervision, data validation, data visualisation and writing. HH contributed to data curation, formal analysis, investigation, project administration, software and writing. JE is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

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