

## Effectiveness of Community Health Worker-led Diabetes Self-Management Education on Type 2 diabetes patients: A Systematic Review and Meta-Analysis

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### ABSTRACT

**Objective:** Community Health Workers are important in building individual and community capacity through outreach, community education, informal counselling, social support and advocacy programs, which enhance health knowledge and self-sufficiency. Our aim was to examine the effectiveness of a Community Health Worker-led Diabetes Self-Management Education in improving clinical and psychosocial outcomes.

**Methods:** A thorough systematic literature search was undertaken in Medline, Pubmed, Ovid, PsycINFO, EMBASE and JBI databases (searched from December 2018 to 31<sup>st</sup> January 2019). Once selected articles were retrieved, all titles and abstracts were screened, and eligible articles identified for full text inclusion. These retrieved full texts articles were screened for eligibility and selected according to established inclusion criteria. Of the 182 studies retrieved, 20 were included for examination.

**Results:** HbA1c outcomes were statistically significant for short and long terms with effect sizes of -0.21 (95%CI -0.31, -0.10) and -0.26 (95% CI -0.36, -0.15) respectively and favored the CHW group. Values for secondary outcomes measured except diabetes knowledge yielded statistical significance for the CHW group.

**Conclusion:** The CHW-intervention is an effective model that has significant impact on glycemic control, diabetes knowledge, self-care behaviors and emotional distress and well-being.

### INTRODUCTION

Globally, chronic diseases are responsible for about 70% of deaths with an estimated 16 million deaths recorded in 2016 [1]. Diabetes mellitus is an important chronic disease with an overwhelming global concern that poses a challenge to health professionals. [2] defines diabetes mellitus as a group of metabolic disorders characterized by increased blood glucose concentration [3]. People living with diabetes have a higher risk of morbidity and mortality than the general population as the ensuing hyperglycemia results in many debilitating complications that impact on the quality of life [3]. Hence, attempts should be made to identify patient health needs and increase access to care [4]. Nevertheless, WHO identifies significant disparities in access to essential health services particularly in under-served, excluded or vulnerable populations; in addition, there have been relevant shortages of health workers in many regions [1]. As a result, there has been an urgent need and attention for community-based health workers (CHWs) to increase access to essential

quality health services in primary health care and universal health coverage [1].

Previous studies indicated that the work of the CHW was important during health screening and promotion of chronic diseases using simple risk assessment tools [5]. Although successes have been achieved with the incorporation of CHW

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in diabetes self-management over the years, there are few studies where effectiveness has been realized [5-8].

This systematic review and meta-analysis investigated the effectiveness of Community Health Workers on educating and supporting Type 2 Diabetes Mellitus patients in self-management towards the improvement in clinical and psychosocial outcomes.

## METHODS

### Search strategy

A thorough systematic literature search was undertaken in Medline, Pubmed, Ovid, PsycINFO, EMBASE and JBI databases ((searched from December 2018 to 31<sup>st</sup> January 2019). Once selected articles were retrieved, all titles and abstracts were screened, and eligible articles identified for full text inclusion. These retrieved full texts articles were screened for eligibility and selected according to established inclusion criteria: if adults over 18 years, diagnosed with type 2 diabetes. Studies and participants were excluded if below 18 years, unwell to participate and/or T2DM patients who could not partake in an educational session.

### Search results

The search for studies through the databases and grey literature produced 199 articles. Seventy-two studies were identified and removed as duplicates after the titles were scanned. The titles and abstracts of the 127 records retrieved were read and 67 studies were excluded, while 60 papers were further screened. Full-text articles of the 60 papers were assessed for eligibility and 20 of these articles met the inclusion criteria, while 40 studies were added to the excluded studies. Hand searches of reference list of the included studies yielded no results.

### Eligibility criteria (Inclusion and Exclusion)

Patient-Adults over 18 years diagnosed of Type 2 diabetes mellitus. Intervention was a Community Worker Led Diabetes Self-Management Program (DSME). The Comparator- Usual or Standard Care and the Outcomes included clinical (HbA1c, Lifestyle behaviors, Body mass Index (BMI), Weight), psychosocial outcomes (diabetes knowledge, Self-efficacy). The Setting was defined as workplace, home, communities (health) centers, faith-based institutions, primary health centers, clinics. English language restrictions applied.

### Reasons for excluding studies

40 articles were excluded with the following reasons to validate the 20 studies included in the review. Firstly, 13 studies were omitted because they failed to measure the clinical and psychosocial review outcomes stated explicitly. In addition, 9 studies were further excluded based on the adoption of an observational descriptive study design (case study, cohort, mixed methods approach). Another reason for excluding 8 studies was that the authors failed to specify a

CHW intervention (interventions not delivered by CHW). Though three studies employed a quasi-experimental/experimental design, the study was not clinically controlled. In addition, two RCT used a non-intervention design (provided only the rationale and design for the study). Moreover, authors of 3 studies included results of diabetes with other co-morbidities but failed to provide results pertaining to diabetes only. Lastly, the 2 studies published before 2008 were also omitted.

### Critical appraisal

The Critical Appraisal Skills Programme (CASP) Checklist (31.05.13) was used, consisted of eleven critical questions measuring the results of a study to assess the quality of RCTs and CCTs. Studies were scored poor, medium and good quality depending on the score to questions on CASP. Poor studies were included in the review but had to meet the inclusion criteria as per Joanna Briggs Institute (JBI) recommendation [12].

### DATA EXTRACTION

The data was extracted with the guidelines of JBI Data Extraction for Experimental/Observational Studies [13].

### Data synthesis

A narrative summary (NS) was used to present the findings of the review [14]. A meta-analysis was used to indicate the weighted average over results of individual studies and improve the effect size estimates. The inherent heterogeneity across the studies (duration for education, post-intervention measures) prompted the use of the random effect model.

Assessment of statistical heterogeneity was undertaken by  $I^2$  statistics [14]. Hence, the standardized mean difference was used as the measure of primary effects for measures of outcomes. Allocation Concealment of the various studies assessed selection bias in randomized controlled trials.

## RESULTS AND DISCUSSION

### Description of the included studies

Twenty RCTs were included as shown and were conducted in community and primary health centers (**Table 1**). Study quality assessment using the CASP tool showed that included studies were of medium and high quality. Most studies were conducted in settings with interventions towards poorly controlled diabetes patients. Studies chose different designs for their study selection.

### Theme 1: Improvement in HbA1c and secondary outcomes (Lipids, Weight and Blood pressure)

16 identified studies revealed that CHW had effects towards improving glycemic control as early as three months of DSME although the impact on secondary outcome (Lipids, Weight and Blood pressure) was somewhat variable across all the studies. Our findings were consistent

**Table 1.** Representing study participants, intervention and clinical outcomes.

Number	Author	Participants		Study Intervention	Clinical Outcomes
		Setting	Population /sample size		
1	[16]	Maharashtra Rural community	Rural central India 299, I= 153 C=146	CHW face to face, health education interaction, visits, telephone reminders	Improving HbA1c Decreasing Glucose (FBS, PPBS) levels
2	[17]	Chicago, USA Homes	African Americans Hispanics 244, S1= 120 S2= 124	Pharmacist-CHW intervention	Improvement in HbA1c Improving Quality of Life
3	[18]	Detroit Community health centre	Latinos 222, I= 89, C1= 60, C2= 73	6 months CHW (DSME) intervention plus 12 months telephone outreach	Improving glycemic control ( HbA1c Improvement in Lipid profiles Decreasing Diabetes distress/ Depression Enhancing Diabetes Support
4	[19]	Miami, outpatient clinics	Latinos 300, I= 150 C= 150	1-year CHW home visits, telephone calls, and group- level activities.	Improvements in HbA1c levels Increasing Physical/ Sedentary Activity and healthy diet
5	[20]	Dallas, Texas Community facility	African American Women 200, I=100, C=100	CHW - 16 phone- based lifestyle intervention sessions	Improvement in weight Confidence in participating in Self-Care Higher Self- Efficacy levels
6	[21]	Weill Cornell Primary care clinics	Hispanics 180, I= 60 I- 60 C-60	5 months in-person CHW diabetes education, 2 months visits, - months phone calls	1% HbA1c reduction Reduction in Blood Pressure levels
7	[22]	South West Houston Community clinic	Hispanics 62, I= 31, C= 31	Chws leading a team for group visits for 3hr each month for six months.	Improving glycemic control ( HbA1c ) Decreasing Blood pressure levels Weight loss
8	[23]	Ontario Care Home	Adults from Ontario, Canada 94, I=47, C=47	3 Nurses and 9 paraprofessionals delivered standard care plus one-one home coaching for 6-weeks	Effective Insulin management with Self-efficacy Promotion Decreasing burden of depression and hospital anxiety
9	[24]	Baltimore Home	Korean Americans 209, I= 104	RN/CHW didactic Education or	Reduction in HbA1c levels

			C- 54, C- 51	training, telephone counseling (self-Help model- PRECEDE)	Improving Self-Efficacy Improvement in Quality of life
10	[25]	Korean resource centre Community	Korean Americans 250, I-120, C-130	RNs and CHW delivered 2hr structured education for six weeks Individual counseling using motivational interviewing method via telephone Lessons on Self-monitoring of blood glucose	Reduction in HbA1c levels Decreasing levels of Lipid profiles Increase in Self-Efficacy to deal with diabetes Improvement in Diabetes quality of life
11	[26]	Baltimore, Maryland Community Health center	Samoans 268, I-104 C-164	Nurse-care manager, 4 chws One-on-one home CHW visit every 3 months, monthly, group meetings or one-one for low, moderate, and high-risk individuals	Improved HbA1c levels Reduction in BMI Lowering Blood pressure levels
12	[27]	Health Council, Hartford Home	Latinos 211, I- 106 C – 105	CHW delivered 17 individual sessions at home for 12-months	Improving HbA1c levels Reduction in Lipids Improving Weight
13	[28]	Metropolitan Chicago Home	Mexican Americans 144, I= 73 C=74	CHW delivered self-management training 36 home visits for 2 years	Improving glycemic control (Serum HbA1c) Adopting and maintaining Self-management behavior
14	[29]	Northern Manhattan Home	Hispanics 360, I= 181 C = 179	CHW, one-on-one visits, group visits, and telephone follow-up.	Improving Glycemic control (A1c) Improvement in Blood Pressure levels Reduction in Lipid levels
15	[30]	Detroit Health center	Latinos PL- 60 CHW-56	12months of monthly telephone outreach delivered by CHWs using motivational interviewing	Improvement in HbA1c levels Decreasing Blood Pressure levels
16	[31]	Baltimore Community Health center	Samoans 268, I= 104 C= 164	Nurse case manager and CHW visits and group educations	Improving diabetes control (HbA1c) Decreasing Blood Pressure Increasing Patient Activation Measure

17	[32]	Southwest Detroit, Home	African Americans/Hispanics 183, I= 84 C= 99	CHW group education and visits, Family Health advocates telephone call with empowerment models	Improvement in HbA1c levels Improvements in Lipid levels Increasing Diabetes Knowledge Understanding Diabetes Self-Management
18	[33]	Los Angeles Community Clinic	Hispanics/Latinos 189, I- 75 C- 60 + 54	CHW education and monitoring services	Reducing HbA1c levels Improving Self-care behaviors Increasing diabetes knowledge
19	[34]	Florida Medical Center	USA 62, I=31 C- 31	Paraprofessional coaching via telephone intervention; one phone call per week for the first 3 months, and one bi-weekly call for the remaining 3months.	Improvement of HbA1c; BMI levels Impact on Self-Efficacy
20	[35]	Webb County Health Center	Mexican Americans 131, I= 63 C- 68	10-week diabetes self-management taught course led by promotores.	Demonstrating Improved HbA1c levels Increase in Strengthening Health beliefs

**Key:** I- Intervention group (CHW ONLY), CHW- Community health worker, PL- Peer leader, C-control group, S1- Sequence 1 (Pharmacist + CHW group), S2- Sequence 2 (Pharmacist only group)

with [36], who examined the effectiveness of a CHW diabetes self-management for a primary Samoan population and concluded that the program had a positive impact in terms of improved HbA1c. This was reinforced by [37], who evaluated the impact of a diabetes education program delivered by CHW in community settings and concluded sustained glycemic control improvements. Research undertaken by [38] investigated the impact of CHW-led DSME and indicated that HbA1c and systolic BP levels 1-year post-baseline were significantly reduced. Furthermore, a diabetes education program for CHW in improving clinical outcomes for patients concluded the intervention was significant in concluding the intervention improved HbA1c and lipid profiles of patients [39,20], who undertook 12-month phone-based lifestyle sessions, indicated, however, there were no differences amongst HbA1c of groups over length of study. [34] also revealed no significant differences

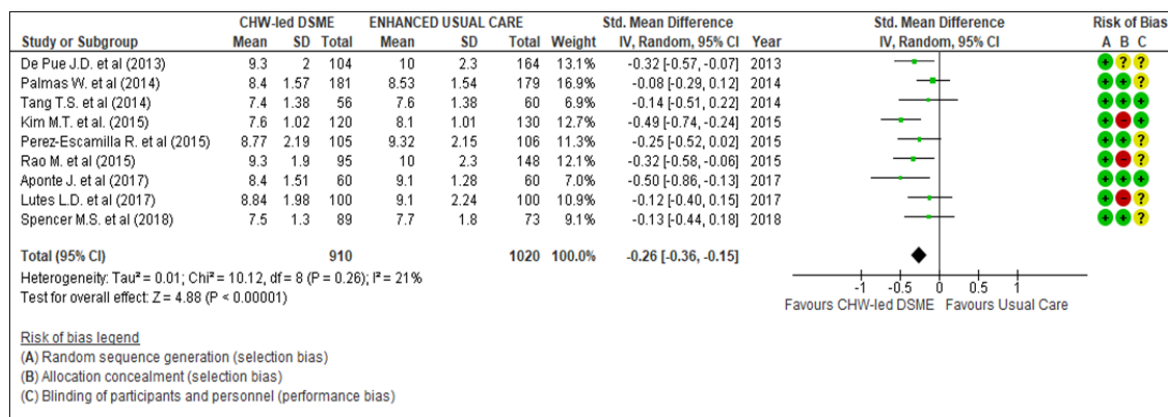
in HbA1c between groups. Similarly, both studies showed significant impacts towards self-management behaviors.

### Meta-analysis

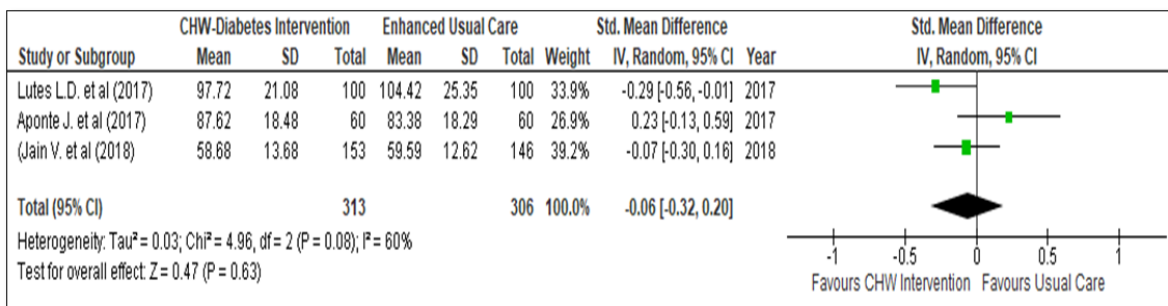
**HbA1c:** Nine studies with 1930 participants reported on CHW intervention for HbA1C at 12-months. The accumulated effect size indicates a statistical significance of CHW -intervention as compared to usual care with effect size of -0.26 (95% CI -0.36, -0.15). Statistical heterogeneity was  $I^2 = 21\%$  (**Figure 1**).

**Weight:** Three studies with 619 participants reported on CHW- intervention for weights at 6-months, with an identified heterogeneity,  $I^2 = 60\%$ . The effect size depicts the importance of the intervention towards weight reduction, - 0.06(-0.32, 0.20) (**Figure 2**).





**Figure 1.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (HbA1c- 12 months), outcome: 1.6 HbA1c at 12- months.



**Figure 2.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (Weight- 6 months), outcome: Weight at 6- months.

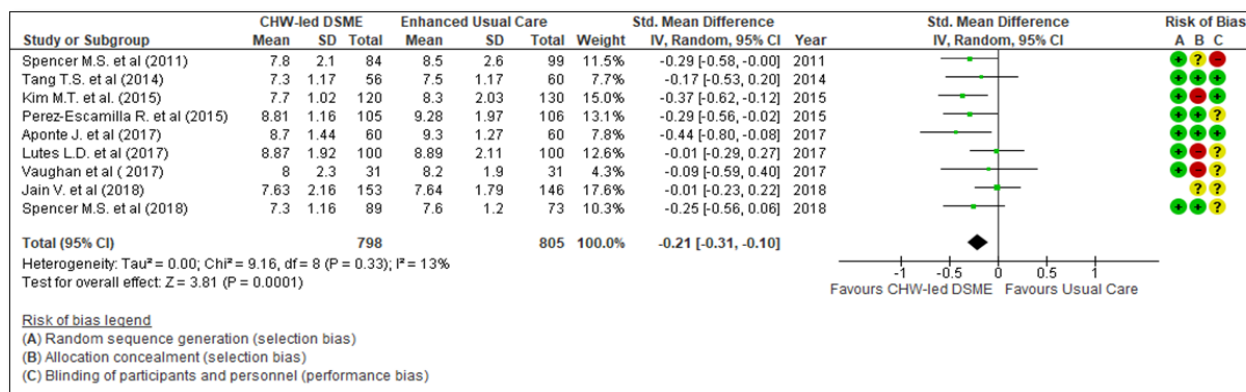
## Theme 2: Improvement in HbA1c and quality of life (qol)

Findings were consistent with results of study, which evaluated the impact of the DEP (Diabetes Equity Project) a clinic-based diabetes self-management and education program led by (CHWs), on patients' clinical outcomes, self-management skills, and quality of life and concluded the intervention yielded improvements in HbA1c (8.3% to 7.4%) and quality of life [40]. Moreover, the findings were also echoed in a recent systematic review and meta-analysis for DSME programs [41], that revealed a non-significant effect on HbA1c and improvements towards QoL in African Americans. The meta-analysis revealed (**Figure 3**) that there was a significant short-term outcome for CHW-diabetes intervention over usual care for reported outcomes of HbA1C. The treatment effect size (0.21 (95%CI -0.31, -0.10)) demonstrated the effectiveness of the CHW-diabetes intervention since the nine papers used in the analysis were graded medium to high quality. Findings of the meta-analysis (**Figure 3**) were consistent with results of study measuring the effectiveness of community-based peer-led diabetes self-management programmes (for improving clinical outcomes and quality of life of adults with diabetes in primary care settings in low and middle-income countries [42].

As compared to [17,25,24] employed the use of bi-lingual CHW, which meant that patients felt more comfortable interacting and could report barriers such as illiteracy or inaccessibility to healthy foods to CHW than with physicians. This reason could explain why HbA1c treatment effects were more pronounce (patients demonstrating lower HbA1c levels) for the two studies as all the studies measured effects in nearly the same number of participants, duration and intervention used. A current literature review advises the deployment of bi-lingual CHW among other strategies to enhance their roles in improving diabetes outcomes amongst ethnic minority populations [43]. This review reinforces that need for additional CHW interventions in assisting with the prevention of the development of T2DM.

## Meta-analysis

**HbA1c:** Nine studies with 1603 participants reported on post CHW-led diabetes intervention on HbA1C (six-months). A combined effect of the results demonstrated a significant benefit of CHW-intervention compared to usual care for T2DM with effect size of -0.21 (95%CI -0.31, -0.10) (**Figure 3**). Statistical heterogeneity was  $I^2 = 13\%$ .



**Figure 3.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (HbA1c), outcome: 1.1 HbA1c at 6-months.

### Theme 3: Improvement towards self-efficacy and self-management behavior

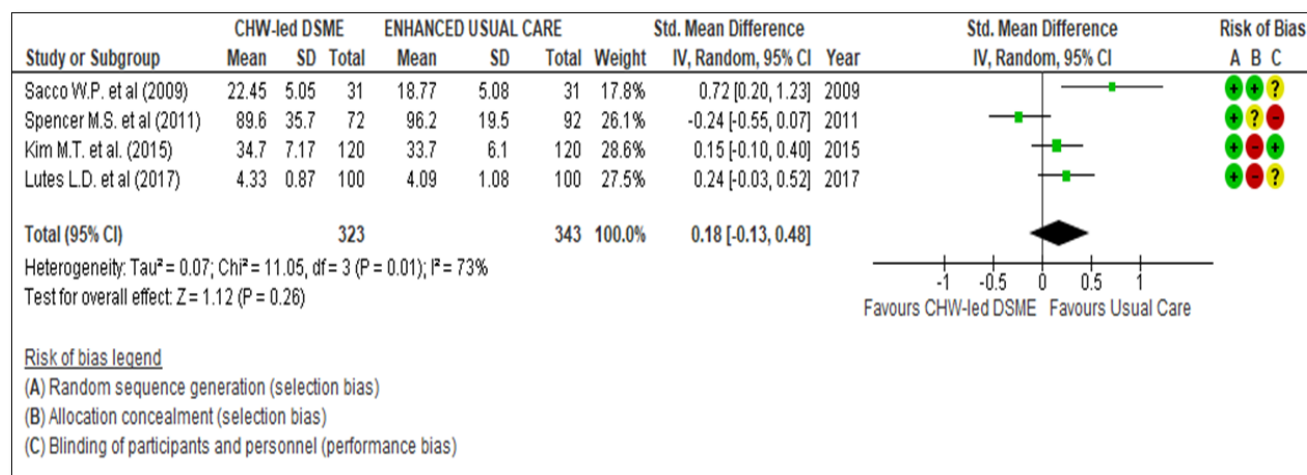
The positive changes found in our study were consistent with [44], who investigated the incorporation of CHW as clinical team members in improving diabetes self-management and concluded the intervention impacted positively on self-management skills. In addition, a 10-week lifestyle intervention concluded the program resulted in significant changes for self-management behaviors [45]. Moreover, the feasibility of CHW DSM program also concluded that the intervention yielded positive impacts for diabetes knowledge, self-efficacy and self-management behaviors [46]. Ten studies recorded statistically significant effects for self-efficacy and self-management behaviors/knowledge; [20] showed only positive results for tremendous weight reduction which could indicate the perception of some self-management knowledge towards food selection although the results provided were not conclusive.

Most studies integrated several theoretical, conceptual frameworks, guidelines and standards in delivering the CHW-diabetes interventions. Studies that employed similar theories/concepts produced similar results signaling the importance of theory integration in diabetes self-management intervention. The choice of different frameworks underpins numerous ways to enhance diabetes self-management programs. However, there may be instances where one framework was more advantageous to use, this could be the reason for some few varied results in the initiation and sustainability of self-management behaviors amongst study results.

### Meta-Analysis

#### Self-Care

Four studies with 666 participants reported on CHW intervention for diabetes self-care at 6-months. The accumulated effect size indicates a non-statistical significance of CHW -intervention as compared to usual care with effect size of 0.18 (95% CI -0.13, 0.48). Statistical heterogeneity was  $I^2 = 73\%$  (Figure 4).

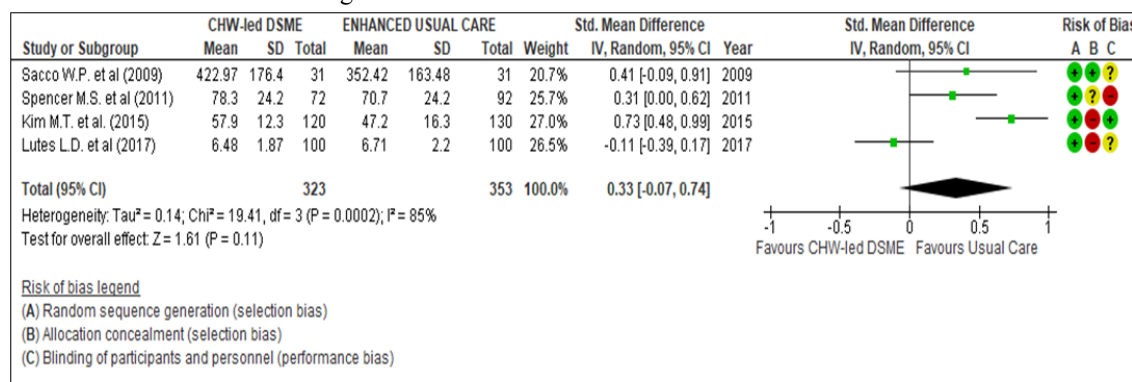


**Figure 4.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (Diabetes Self-Care), outcome: 1.5 Diabetes Self-Care at 6- months.

### Self-efficacy

Four studies with 676 participants reported on CHW intervention for self-efficacy at 6-months. The accumulated effect size indicates a non-statistical significance of CHW -

intervention as compared to usual care with effect size of 0.33 (95% CI -0.07, 0.74). Statistical heterogeneity was  $I^2=85\%$  (**Figure 5**).



**Figure 5.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (Self-efficacy), outcome: 1.2 Self-efficacy at 6-months.

### Theme 4: Impact on depression/diabetes distress symptoms and diabetes support

Our results were consistent with the findings of studies [46], who evaluated the impact of CHW in managing stress in diabetes and concluded that the study significantly reduced diabetes and mental stress and improved patient satisfaction [36] investigated an educational program delivered by CHW. It concluded the intervention significantly improved depression symptoms. In addition, these findings were echoed by Souza et al. [38], who investigated the impact of a CHW-led DSME and concluded the program successfully provided diabetes support and education, medication assistance, access to community help centers, and social support.

CHW employed varied roles such as coaches [34], family health advocates [18] and educators [30,28,17], to assist patients with problem solving skills, translation and referral to resources. This finding was consistent with the results of Captieux et al. [47], who concluded that CHWs play several roles in T2DM self-management, including structured education, ongoing support and health system advocacy.

Hence, preparing and coordinating CHW roles is essential and needs consolidation. It could, therefore, be concluded that the work of the CHW was important in providing support for patients during DSME/S programs to achieve improvement in glycemic control. This finding is consistent with results of several studies [48,49], which concluded supported self-management interventions using a range of approaches improves short-term glycemic control.

### META-ANALYSIS

#### Depression

Three studies with 406 participants reported on CHW intervention for depression symptoms at 6-months. The accumulated effect size indicates a statistical significance favoring the CHW -intervention with effect size of -0.03 (95% CI -0.23, 0.16). Statistical heterogeneity was  $I^2=0\%$ . Our results were consistent with findings of a systematic review with meta-analysis of 25 (RCT and non-RCT) which investigated the psychosocial interventions to reduce diabetes distress (**Figure 6**) [51].

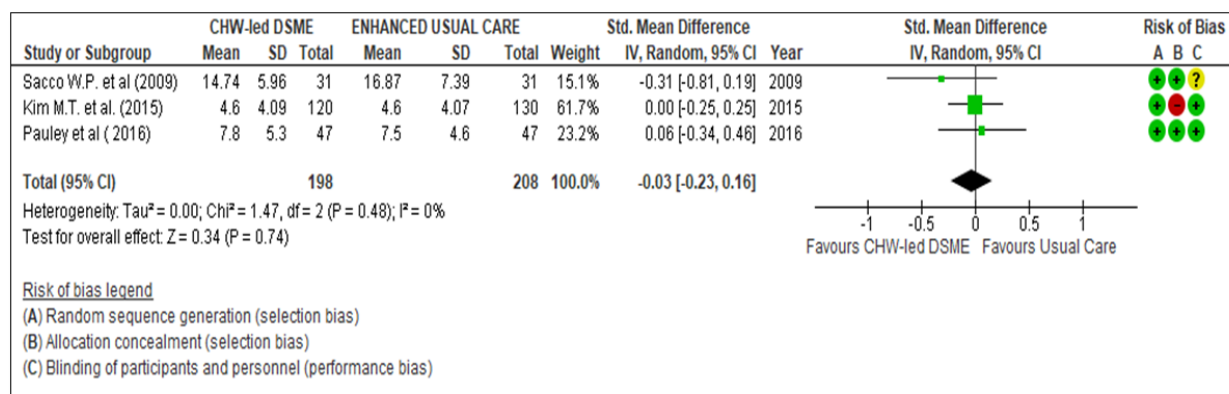
### CONCLUSION

The effectiveness of Community Health Worker-led diabetes self-management education on Type 2 diabetes patients was investigated. The study revealed that Community Health Worker-led DSME promotes an improvement in HbA1c levels at 6 months and a sustained effect at 12 months; increased diabetes knowledge, self-efficacy, and self-management practice and a decrease in depressive symptoms but an improvement in quality of life. It also demonstrated advancement in care co-ordination and support services to patients.

### RECOMMENDATIONS

- The review advocates for a collaborative CHW-professional intervention that provides the opportunity for CHW to receive training and supervision. Nevertheless, future research should measure longer duration of intensive behavioral self-management intervention.





**Figure 6.** Forest plot of comparison: Effectiveness of CHW-LED/ Usual Care DSME (Depression Symptoms), outcome: 1.3 Depression symptoms at 6- months.

- Finally, further research is required to ascertain the facilitators and barriers for the successful implementation of CHW diabetes led interventions.

#### CONTRIBUTOR SHIP STATEMENT

- AA, AM, IS and GA contributed to the design of the review.
- AA created the search strategy and conducted the search.
- AA and GA screened the papers, extracted and analysed the data.
- AA, GA and AM drafted the paper and all authors reviewed the draft and approved the final version.

#### PATIENT AND PUBLIC INVOLVEMENT

It was not appropriate or possible to involve patients or the public in the design, or conduct, or reporting, or dissemination of our research.

#### ETHICS COMMITTEE APPROVAL

This was not required for this article.

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