Effectiveness of Patient-centered Care for Diabetes Self-management to Improve Glycemic Control and Self-care Behaviors in Adults With Type 2 Diabetes: a Systematic Review

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Research

Keywords: Education and counselling, HbA1c, meta-analysis, patient-centred care, type 2 diabetes, self-management

Posted Date: July 8th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-674310/v1

Abstract

Background: Patient-centered care in diabetes self-management might be a significant factor in improving self-care outcomes yet the supporting evidence is inadequate. This review is aimed to assess the effectiveness of patient-centered self-management care interventions on self-care outcomes such as glycemic control (HbA1c) and self-care behaviors in adults with type-2 diabetes compared with usual care.

Methods: CINAHL, PubMed, Cochrane Library, Google Scholar and the HEC Pakistan digital library were searched for English language studies that assessed patient-centered self-management educational and/or behavioral interventions in adults aged 18 years or above with type 2 diabetes from 1991 to 2020. Interventional studies comprising randomized controlled trials (RCT) and quasi experimental studies (QES) with at least three months follow up and reporting on self-care outcomes with glycemic control (HbA1c) as primary outcome and self-care behaviors including diet control, physical activity, medication adherence and foot care as secondary outcomes were included.

Results: Of the 168 identified records, 25 were found eligible comprising 21 RCTs and 4 QESs with total 4,443 participants. The meta-analysis involved 23 studies that provided enough information for a pooled estimate of HbA1c. Compared with the control group, patient-centered self-management interventions significantly lowered HbA1c −0.53 (95% CI −0.73, −0.32). Stratified analysis for HbA1c with respect to various aspects of intervention showed larger effects in interventions employing both educational and behavioral components −0.59 (95% CI −0.86, −0.32), spanned over shorter (<03 months) duration −0.56 (95% CI −0.86, −0.27), administered by nurses −0.80 (95% CI −1.44, −0.16) and delivered in community setting −0.65 (95% CI −1.00, −0.29). Moreover, patient-centered self-management interventions were found effective in improving diet control, physical activity and foot care.

Conclusion: This systematic review provided the evidence supporting the effectiveness of patient-centered self-management care interventions in improving glycemic control and self-care behaviors in adults with type 2 diabetes and identified key features of intervention contributing towards success.

Background

Diabetes mellitus (DM) refers to a group of metabolic conditions characterized by unusual high blood glucose levels with impairment in carbohydrates, protein and fat metabolism due to abnormalities in insulin secretion, insulin response or both(1). World Health Organization (WHO) devides DM into two types: type 1 and type 2(1). Type 1 DM is characterised by immune mediated beta cell destruction that leads to absolute insulin deficiency(2). Type 2 DM implies gradual loss of beta cell activity resulting in relative insulin deficieny(2). Hyperglycaemia is the classical clinical manifestation in both types that is mainly linked with an increased risk of microvascular- and macrovascular complications(3). Microvascular complications such as neuropathy, retinopathy and nephropathy as well as macrovascular complications like stroke, ischaemic heart disease and peripheral vascular disease; are chief contributors of increased morbidity and mortality in this population(4).

According to Interntional Diabetes Federation (IDF) report 2019, “463 million people (aged 20–79 years) worldwide have DM” where type 2 DM accounts for 90%. Furthermore, it is projected that by the year 2045, 700 million people will have DM (5). Based on IDF, the Middle East and North Africa region has a high prevalence of DM, with 55 million people affected(5). Furthermore, it has been reported that the incidence is highest among adults living in low- and middle-income countries, accounting for 79% of all cases (6).

Pakistan is a low middle income country with an estimated 221.7 million population making it the world's sixth most populous country(7). Pakistan ranks fourth among top ten countries with the highest number of DM population aged 20–79 years (5). As per IDF report, Pakistan has 19.4 million people (aged 20–79 years) with DM and it is estimated that by 2045, 37.1 million will have DM moving Pakistan to third place (5). Another study estimates that the current DM prevalence in Pakistan is around 26.9% with type 2 DM accounting for 90% of all cases(8).

The rise in type 2 diabetes in Pakistan is driven by socioeconomic, demographic, environmental and genetic factors with key contributors including growing urbanisation, sedentary lifestyle, unhealthy eating habits and obesity (3). Besides, a poor health care system including inaccessibility to health care centers, inequality in health care services provision, gender disparity and poor socioeconomic conditions with low level education as well as unemployment are aggravating the problem (9).

Type 2 DM due to its growing prevalence has turned into a serious health problem for Pakistan and around the world. If not properly managed, it is posing a substantial risk to morbidity and mortality as a result of devastating health complications(10). On the other hand, it is increasing the financial burden of individuals and their families with significant impact on the health systems and national economies (11). Currently, Pakistan is spending 12% of its total health budget (less than 1% of gross domestic product) on DM care with nearly 70% devoted to the management of DM associated complications (9). Therefore, delaying the progression of DM and avoiding its associated complications is the cornerstone that can lead to improved health and economic outcomes of individuals, families, society and the health care system (12).

According to established guidelines, a healthy lifestyle with improvement in self-care behaviours and medication as needed; can delay type 2 DM progression and thus, avoivd serious complications(13). As a result, type 2 DM, is also known as a self-managed condition because patient themselves perform majority of their care(14). Effective self management requires patient’s full commitment and capability to perform self-care activities such as healthy dietary habits, daily physical activity, smoking cessation, regular blood glucose monitoring and regular intake of medicines (12). Patient needs to make a concerted and self motivated effort towards adoption of a healthy life style as pharmacotherapy alone cannot achieve these goals(15). Therefore, for effective self management of type 2 DM; a patient-centered approach is certainly needed.

Patient-centered care has been acknowledged as a desirable attribute of health care since late 1980s when the concept ‘patient centeredness’ was first introduced(16). Patient centeredness refers to the use of a bio-psycho-social perspective which means focusing on the patient and honoring his/her preferences, needs and values as a holistic being rather than a biomedical perspective which focuses on disease(17). Patient-centered care in type 2 DM self-

management is a purposefully designed holistic care intervention that provides individuals with information and skills they need to effectively self-manage their condition and achieve optimum glycemic control in addition to medication (18). Self-management education is the major component of patient-centered care which according to WHO, provides basis for management of the disease(19). The literature supports that up to 8% of diabetes-assoicated complications can be reduced through proper self-management education(20). Counselling as behavioral intervention is another major component of patient-centred care. The American Association of Diabetes Educators (AADE) suggests to prepare patients for behaviour change by epuipping them with the necessary skills to improve their self-care behaviors. According to AADE, seven parameters of self care behaviors are "healthy diet, regular blood-sugar monitoring, regular physical activity, medication adherence, resilient coping skills, effective problem-solving and risk-reduction behaviors (21). Literature supports that behavioral interventions focusing these self care activities resulted in improved health outcomes in this population(22, 23). A meta analysis published in 2003 has demonstrated the effectiveness of educational and behavioral interventions in improving glycemic control in patients with type 2 DM (24).

Given the increasing prevalence of type 2 DM in Pakistan and the risk of increased morbidity and mortality, a patient-centred care can play a crucial role in effective self management. Therefore, an updated systematic review of patient-centered care employing educational and behavioral interventions, would give a better understanding of whether this care approach is associated with improved self-care outcomes. This review aimed to assess the effectiveness of patient-centered care for diabetes self-management to improve glycemic control and self-care behaviors in adults with type 2 DM compared with usual care.

Methods

2.1 Search Strategy:

The literature search was performed in CINAHL, PubMed, Cochrane Library, Google Scholar and the HEC Pakistan digital library for studies in English language published between January 1, 1990 and September 30, 2020. January 1, 1990 was selected as the search initiation date because the term patient-centered-care/ patient centeredness has been introduced in the literature in late 1980s(16). The Medical Subject Headings (MeSH) terms used were: "Type 2 Diabetes" or "Type II Diabetes," and "Patient-Centered-Care" or "Person-Oriented-Care" or "Holistic Care" or "Self-Care," and "Self-Management" and "Glycemic Control" or "HbA1c". The retrieved titles and abstracts were evaluated for relevance. Articles found relavant were reviewed as full text for consideration of inclusion in this review by completing the eligibility form based on inclusion criteria. In addition to systematic database searches, manual search was performed to find studies in reference lists of relevant articles. This review was planned, carried out and reported in compliance with "preferred reporting items for systematic reviews and meta-analysis (PRISMA) guidelines" (25). Figure. 1 shows the PRISMA flow chart for selection of the studies and reasons for exclusion.

2.2 Inclusion and Exclusion Criteria:

Studies that satisfied the inclusion criteria listed below, were found eligible: (1) type of studies as interventional studies comprising RCTs and QESs; (2) type of participants as adults aged 18 years or above diagnosed with type 2 DM for at least last six months; (3) type of intervention as patient-centred care intervention for diabetes self-management with educational and/or behavioral component provided in any setting, by any method, by any provider, for any contact time and follow up for at least three months; (4) comparision intervention as usual care or standard care; lastly, (5) type of outcomes involving glycemic control (HbA1c) as primary outcome and self-care behaviors including diet control, physical activity, medication adherence and foot care as secondary outcomes.

The following studies were excluded: (1) review, (2) non-intervention study, (3) qualitative study, (4) protocol, (5) involved patients with type 1 DM only, (6) involved adult patients with type 2 DM and with other chronic conditions, (7) involved patients under 18 years of age, (8) targeted exclusively at prevention of type 2 DM. and (9) primarily reporting development or feasibility of intervention.

2.3 Data Extraction

Data from the eligible studies was extracted and entered into Excel sheet. Data entered was double checked for correctness and completeness. Inconsistencies in retrieved data were adressed and disagreements adjudicated by reaching consensus.

2.4 Quality Assessment of Individual Studies:

Methodological quality of Individual studies was assessed using 'Cochrane Collaboration risk of bias (Rob)' assessment tools that yield judgment as low, high or unclear risk. Rob 2 (version 2 of the Cochrane risk of bias tool for randomized trials) was used for RCTs(26). Whereas, ROBINS-I (Risk of bias in non-randomized studies of Interventions) was used for QESs(27). Blinding of the participants and providers was not possible due to the nature of the intervention. Authors of the studies were contacted to request additional information. Out of twenty one RCTs, nine were graded as low risk of bias (28–36); eight as high risk of bias (23, 37–43) and, four as unclear risk of bias (44–47). Out of four QESs; two were of unclear risk of bias (22, 48) and the other two were of high risk of bias (49, 50).

3. Statistical Analysis:

A meta-analysis was performed using REVMAN 5.4.1 to calculate the magnitude of pooled effect size for change in HbA1c, the primary outcome (51). Of 25 included studies, 23 that reported on HbA1c were included in meta-analysis comprising 20 RCTs and 3 QESs. Data entered in REVMAN involved final values of mean and standard deviation of HbA1c for experimental group as well as control group and the number of participants in each group. Standardized mean difference of HbA1c between experimental and control group and 95% confidence intervals were calculated for estimation of effect size. I^2 statistics were used to estimate statistical heterogeneity among studies. Random effect model was applied on more than 50% heterogeneity(52). To further explore sources of heterogeneity, following stratified analyses were performed: (1) stratified analysis based on quality of the studies; (2) stratified analysis based on key aspects of intervention including (a) component of intervention (educational vs. educational and behavioral), (b) duration of intervention (< three month vs. three to six

months vs. > six months), (c) provider of intervention (nurse vs. other professional vs. ≥ 2 disciplines) and (d) setting of intervention (hospital vs. community vs. combined hospital and community).

Results

4.1 Characteristics of Studies:

For this review, 25 studies met the eligibility criteria. The included studies were published between 1998 and 2020 where the majority (60%) of the studies was published between 2015 and 2020. Most of the studies were RCTs accounting for 84% (23, 29–34, 36–39, 41–47, 53–55). Total 4,443 participants were involved with the mean age of 56.1 years (range 18 to 69 years). Study population involved patients with type 2 DM with mean duration of disease 7.5years (range 06 months (42) to 12.9 years (46)). Single study sample size ranged from 22 (56) to 886 (30) where the sample size in each study involved both male and female patients. The characteristics of 25 studies are presented in Table 1.

Table 1
Characteristics of 25 included studies in the review

No.	Author & Year	Country	Study Design	No. of Participants recruited / at follow up	Intervention					
					Theoretical Basis	Mode of delivery	Provider	Setting	Components	Dura
1	Kinmonth et al.	England	RCT	360/250	NR	Face to Face	Nurse Physician	Hospital	Educational Behavioral	NR
2	Glasgow et al. [20]	Colorado, USA	RCT	886/733	NR	Face to Face	Physician	Hospital	Educational Behavioral	> 06 Mor
3	Tayler et al.	Canada	RCT	40/39	Supportive Care Model	Face to Face	Nurses Physician	Community	Educational Behavioral	04 Mor
4	Scain et al.	Brazil	RCT	104/104	NR	Face to Face	Nurse	Hospital	Educational	04 wee
5	Sacco et al. [21]	Florida, USA	RCT	62/48	NR	Telephone	Psychologist	Community	Educational	06 Mor
6	Carter et al.	Washington, USA	RCT	74/47	NR	Online	Nurse	Community	Educational Behavioral	NR
7	Forjuoh et al.	Texas, USA	RCT	376/263	NR	Face to face	Physician	Hospital and Community	Educational Behavioral	06 Wee
8	Yuan et al.	Hong Kong, China	RCT	88/76	NR	Face to face	Nutritionist	Hospital	Educational	08 wee

No.	Author & Year	Country	Study Design	No. of Participants recruited / at follow up	Intervention					
					Theoretical Basis	Mode of delivery	Provider	Setting	Components	Dura
9	Escamilla et al.	Connecticut, USA	RCT	211/148	NR	Face to face	Community Health Worker (CHW)	Community	Educational Behavioral	12 mor
10	Ebrahimi et al.	Iran	RCT	106/103	Empowerment Model	Face to face	Nurse Endocrinologist Nutritionist	Hospital	Educational Behavioral	08 wee
11	Jutterström et al.	Sweden	RCT	195/171	Hernandez theory of integration	Face to face	Nurse	Hospital	Educational Behavioral	06 Mor
12	Windrum. et al. [19]	Hampshire, UK	RCT	203/203	NR	Face to face	Physician	Hospital	Educational	03 Wee
13	Azami et al.	Iran	RCT	142/142	Social Cognitive Theory	Face to face and telephone	Nurse	Hospital	Educational Behavioral	03 Mor
14	Abraham et al.	India	RCT	80/41	NR	Face to face and telephone	Physician	Hospital	Educational Behavioral	06 wee
15	Cheng et al.	China	RCT	242/201	Empowerment Model	Face to face and telephone	Nurse	Hospital	Educational Behavioral	06 wee
16	Zheng et al.	China	RCT	60/60	NR	Face to face	Physician	Hospital	Educational Behavioral	02 Wee

No.	Author & Year	Country	Study Design	No. of Participants recruited / at follow up	Intervention					
					Theoretical Basis	Mode of delivery	Provider	Setting	Components	Dura
17	Ing et al.	Honolulu, USA	RCT	65/38	NR	Face to face	CHW, Pharmacist, Nutritionist Physician Psychologist	Community	Educational Behavioral	03 Mor
18	Varming et al.	Denmark	RCT	154/97	NR	Face to face and telephone	Nurse	Hospital	Educational Behavioral	03 Mor
19	Spencer et al.	Canada	RCT	222/147	NR	Face to face	CHW	Community	Educational Behavioral	06 Mor
20	Omer et al.	Ajman, UAE	RCT	218/164	NR	Telephone (WhatsApp	Pharmacist	Community	Educational	06 Mor
21	Utz et. al.	Virginia, USA	Quasi experimental study	22/21	Social Cognitive Theory	Face to Face	Certified Diabetes Educator (CDE)	Community	Educational Behavioral	08 Wee
22	Gavgani et al.	Iran	Quasi experimental study	32/30	Information Motivation and Behavioral skill Model	Face to face	Physician	Hospital	Educational Behavioral	04 Wee
23	Fardazar et al.	Iran	Quasi experimental study	180/180	attribution theory	Face to face	Physician	Hospital	Educational	Thre (60 sess
24	Guner et al.	Turkey	Quasi experimental study	101/101	NR	Face to face and Telephone	Nurse Physician	Community	Educational	02 wee sess follo by S twic wee six mor

No.	Author & Year	Country	Study Design	No. of Participants recruited / at follow up	Intervention					
					Theoretical Basis	Mode of delivery	Provider	Setting	Components	Dura
25	Hailu et al.	Ethiopia	RCT	220/142	NR	Face to face	Nurse	Hospital	Educational	06 Mor

4.2 Characteristics of Intervention:

Interventions of all studies were compared to usual care. Usual care majorly involved consultation with the physician; having blood sugar, blood pressure and weight checked; and getting schedule for the next appointment. 32% studies (8 out of 25) reported on theoretical model used for design and implementation of self-management intervention (22, 23, 29, 33, 46, 49, 53, 56). Two studies(48, 53) based their intervention on social cognitive theory; two(29, 33) on empowerment model; one each based on supportive care model(46), information motivation and behavioral skill model(22), Hernandez theory of integration(23) and attribution theory(49). The mean duration of interventions was twelve weeks, ranging from two weeks (49, 55) to twelve months (34). A wide range of intensity of intervention was reported ranging from 15–20 minutes over a day (31) to 1530 minutes over twelve months (34). Majority (68%) of the studies administered both educational and behavioral components of intervention. The follow-up duration ranged from three months (22, 38, 39, 46, 49, 55, 57, 58) to eighteen months (41). Five (20%) studies used the multidisciplinary care approach to deliver the intervention (29, 32, 44, 46, 50). The interventions were delivered in hospitals in 15 (60%) studies whereas; community was the setting for nine (36%) studies. One study reported administration of intervention both in hospital as well as community (43).

4.3 Study Outcomes:

4.3.1 Primary Outcome (Glycemic Control HbA1c)

HbA1c was reported as an outcome measure in 23 studies. Majority (70%) of the studies reported statistically significant reduction in HbA1c. Because of the significant heterogeneity (> 50%) among studies, random effect model was applied. At 95% CI with 3496 participants in 20 RCTs and 3 QESs, the magnitude of effect − 0.53 (95% CI − 0.73, − 0.32) was statistically significant (p < 0.00) showing a substantial reduction in HbA1c in the experimental group compared to the control group. Pooled effect size of HbA1c is shown in Figure-2. The likelihood of publication bias among studies was measured with Funnel plot illustrated in Figure-3. The visual inspection of funnel plot shows an asymmetric appearance with a gap in the bottom indicating that there might be some publication bias; most likely for the reason that smaller studies without statistically significant effects remain unpublished.

4.3.1.1 Stratified Analysis for change in HbA1c

a. Stratified analysis based on quality of the studies

Based on the judgement of low, high and unclear risk of bias, a stratified analysis was performed by grouping studies into three categories: (1) low risk, (2) high risk, and (3) unclear risk. Studies with low risk of bias produced largest effect size (-0.67; 95% CI -0.09, -0.24) compared to the studies with high risk (-0.57; 95% CI -0.93, -0.22) and unclear risk (-0.25; 95% CI -0.40, -0.09). Overall heterogeneity was 87% therefore; a random effect model was applied (see Fig. 4a).

b. Stratified analysis based on components of intervention

Earlier Gary TL et al., (2003) in their meta-analysis, concluded that studies with behavioral component of intervention were found more effective in reducing HbA1c compared to studies involved educational component only(24). In this analysis, studies were sub-grouped into two components of intervention; (1) educational and (2) combined educational and behavioral intervention. Pooled effect size indicated that studies with educational and behavioral components yielded larger effect size (-0.59; 95% CI -0.86,-0.32) compared to studies with educational component only (-0.42; 95% CI -0.56,-0.28). Overall heterogeneity ($I^{2)}$ was 90% therefore; random effect model was applied (see Fig. 4b).

b. Stratified analysis based on Duration of Intervention

Existing evidence suggested that longer duration of intervention (> six months) showed significant reduction in HbA1c compared to shorter duration (< six months) (59). In this review considering the span of intervention; studies were sub-grouped into (1) studies with duration of intervention < three months; (2) three to six months; and (3) > six months. Pooled effect size indicated that studies with shorter duration (< three months) produced larger effect size (-0.56; 95% CI -0.86, -0.27) compared to studies with duration of intervention three to six months (-0.45; 95% CI -0.75, -0.15) and studies with longer duration of intervention > six months (-0.10; 95% CI -0.35, -0.16). Overall heterogeneity (I^2) was 83% therefore; random effect model was applied (see Fig. 4c).

c. Stratified analysis based on provider of intervention

Evidence suggests that a multidisciplinary team approach is more effective in improving HbA1c(60). Given this, a stratified analysis was performed by dividing studies into three groups based on the provider of intervention: (1) a nurse; (2) other professional such as a physician, nutritionist, pharmacist or

community health worker; and (3) multidisciplinary team members (≥ 2 disciplines). Pooled effect size indicated that studies involved nurse as a provider of intervention produced larger effect size (-0.80; 95% CI -1.44, -0.16) compared to studies with other professional as provider (-0.50; 95% CI -0.75,- 0.24) and studies involving ≥ 2 disciplines (-0.36; 95% CI -0.63,-0.10). Overall heterogeneity (I^2) was 87% therefore; random effect model was applied (see Fig. 4d).

d. Stratified analysis based on setting of intervention

To see the effect of setting, a stratified analysis was performed by grouping studies into three categories: (1) hospital, (2) community, and (3) combined setting including both hospital and community. Studies with intervention delivered in community setting produced largest effect size (-0.65; 95% CI -0.10, -0.29) compared to hospital (-0.49; 95% CI -0.77, -0.22) and combined setting (-0.14; 95% CI -0.42, -0.14). Overall heterogeneity was 87% therefore; a random effect model was applied (see Fig. 4e).

4.3.2 Secondary Outcomes

a. Diet Control

Eleven studies (22, 31–33, 35, 36, 39, 40, 46, 49, 61) reported on dietary outcomes where the majority (73%; 8 out of 11) of the studies showed statistically significant improvement in diet control in the interventions group.

b. Physical Activity

Ten studies (22, 31, 32, 35, 36, 39, 40, 46, 49, 61) reported on physical activity or exercise outcome where the majority (70%; 7 out of 10) of the studies(22, 31, 35, 39, 49, 54, 58) showed significant improvement in physical activity in the intervention group.

c. Medication Adherence

Three studies (35, 40, 56) reported on this outcome that showed statistically non-significant improvement in medication adherence in the intervention group.

d. Foot care

Ten studies (22, 30–32, 35, 36, 40, 43, 49, 61) reported on foot care outcome. Majority (60%; 6 out of 10) of the studies (30–32, 35, 36, 49) showed statistically significant improvement in foot care in the intervention group.

Discussion

This review aimed at evaluating the effectiveness of patient-centered self-management care interventions on self-care outcomes of adults with type 2 DM compared with usual care. The most important indicator of optimum management of DM is glycemic control (HbA1c). Therefore, the primary outcome of this review was glycemic control (HbA1c) whereas, changes in diet control, physical activity, medication adherence and foot care were the secondary outcomes.

To estimate the overall effect of intervention, a meta-analysis was performed to calculate the magnitude of effect size for change in HbA1c. Pooled effect size indicated a statistically significant difference in HbA1c between experimental and control group − 0.53 (95% CI − 0.73, − 0.32). The findings of this review are similar to the previous meta-analysis by Gray et al., (2003) that reported statistically significate reduction in HbA1c (-0.43; 95% CI -0.71,-0.15) (24). This review confirmed that the patient-centered self-management interventions are accompanied with a significant decrease in HbA1c. Since, HbA1c is one of the important predictors of DM associated complications and a key therapeutic goal towards its effective self-management; findings of this review have some important implications for contemporary practice. Evidence suggests that 21% risk is reduced for any DM associated complication and its related deaths with 1% decline in HbA1c (62). Thus, reduction in HbA1c has clinical significance.

Further, a stratified analysis for change in HbA1c was performed with regards to the quality of the included studies which showed larger effects among studies with high quality judgement (low risk of bias) further supporting the evidence. Stratified analyses were also performed with regards to various key aspects of intervention in order to ascertain key elements that might contribute towards effective self-management of type 2 DM. In this review, interventions involving educational and behavioral components, spanned over shorter (< three months) duration, provided by nurses and delivered in community settings; were found more effective as indicated by larger effect sizes. Some findings of this review are contrary to the previous meta-analysis by Gary et al., (2003) where interventions that involved longer duration (> 3 months) and provided by physicians; were found more effective. It appears that interventions with longer duration may carry an element of fatigue due to long contact times which may produce lesser effect. There is a need to explore further the factors associated with longer duration interventions demonstrating an area of research. Moreover, findings of this review showing larger effects with nurses as providers of intervention emphasize the importance that nurses are uniquely positioned to bring their expertise and knowledge towards effective self-management of type 2 diabetes. This, again demonstrate an area of research to further investigate the clinical effectiveness of nurse-led interventions. The findings are consistent with previous meta-analysis with regards to the setting of intervention confirming that interventions delivered in community settings are more effective(24).

With regards to secondary outcomes, this review indicated that patient centered self-management care interventions are effective in improving patients' diet control, physical activity, and foot care. However, the effect on medication adherence was not found effective which may be due to the reason that only a few studies reported this outcome.

Limitations And Strengths

The limitations of this review consist of: only English language studies were included; selective reporting of the outcomes might have affected the findings; frequent methodological biases which were found in included studies; insufficient description of intervention in the included studies; not reporting of

medications or any drug prescription information since medication intake may act as a confounder between the interventions and outcomes.

However, this review contained numerous strengths which include: rigorous reviewing methods; thorough search to capture all relevant information, explicit and reproducible eligibility criteria, stratified analysis which allowed answering of clinically relevant and important questions.

Conclusion

This review concludes providing evidence supporting that patient centered care for DM self-management is effective in improving glycemic control and self-care behaviors in adults with type 2 DM. Moreover, some gaps were found that are needed to be addressed: (1) Medication adherence was reported by a few studies, (2) a few studies provided a thorough description with regards to intervention including intensity, duration, length of follow-up and theoretical background, (3) Behavioral component was not described in adequate detail with regards to the methods which were applied.

Abbreviations

AADE: American Association of Diabetes Educators

CINAHL: Cumulative Index to Nursing and Allied Health

DM: Diabetes Mellitus

IDF: International Diabetes Federation

QES: Quasi Experimental Study

RCT: Randomized Controlled Trial

WHO: World Health Organization

Declarations

Acknowledgements:

Not applicable

Authors' Contributions:

KA: Study conception and design, Literature retrieval, drafting of the manuscript.

KD: Data analysis & interpretation, critical revision of the manuscript.

RG: Study conception, critical revision and final approval of the manuscript.

EF: Conceptualizing the review process, data analysis and interpretation, critical revision and final approval of the manuscript.

Availability of data and materials:

Data and materials are available from the corresponding author upon request.

Competing Interests:

The authors declare that they have no competing interests.

Consent for publication:

Not applicable

Ethics Approval and consent to participate:

Not applicable

Funding:

None

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Figures

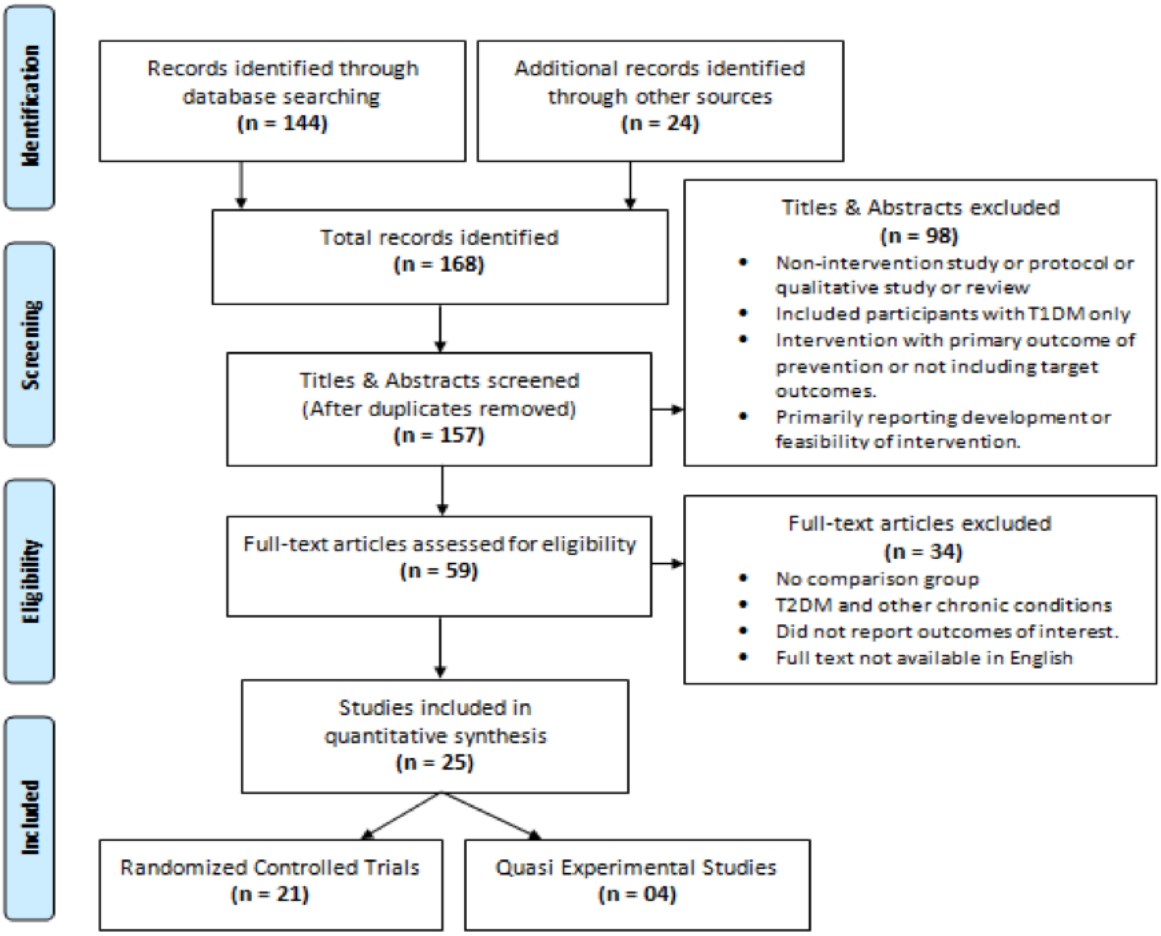


Figure 1

PRISMA flow chart for study selection and reasons for exclusion

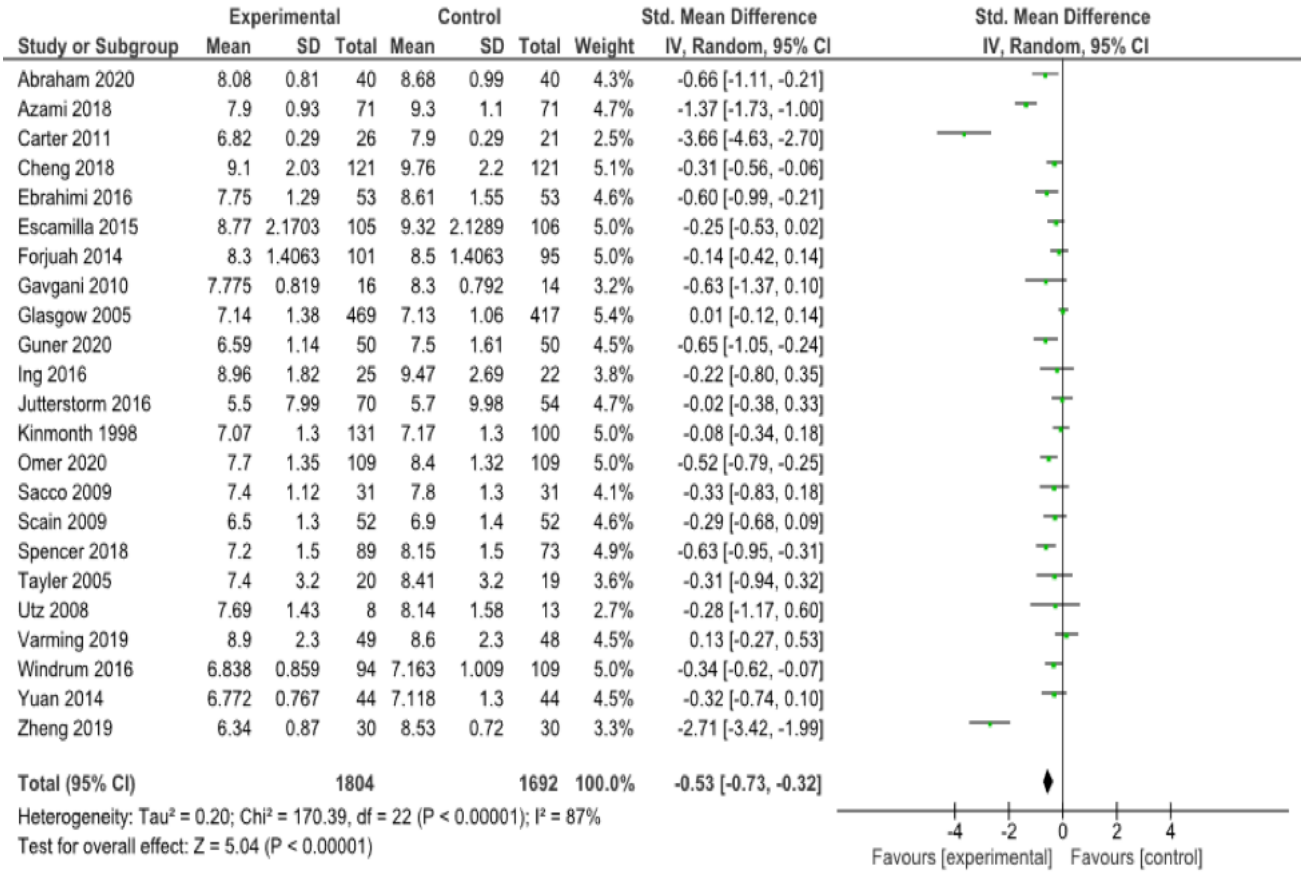


Figure 2

Forest Plot of pooled effect size of HbA1c

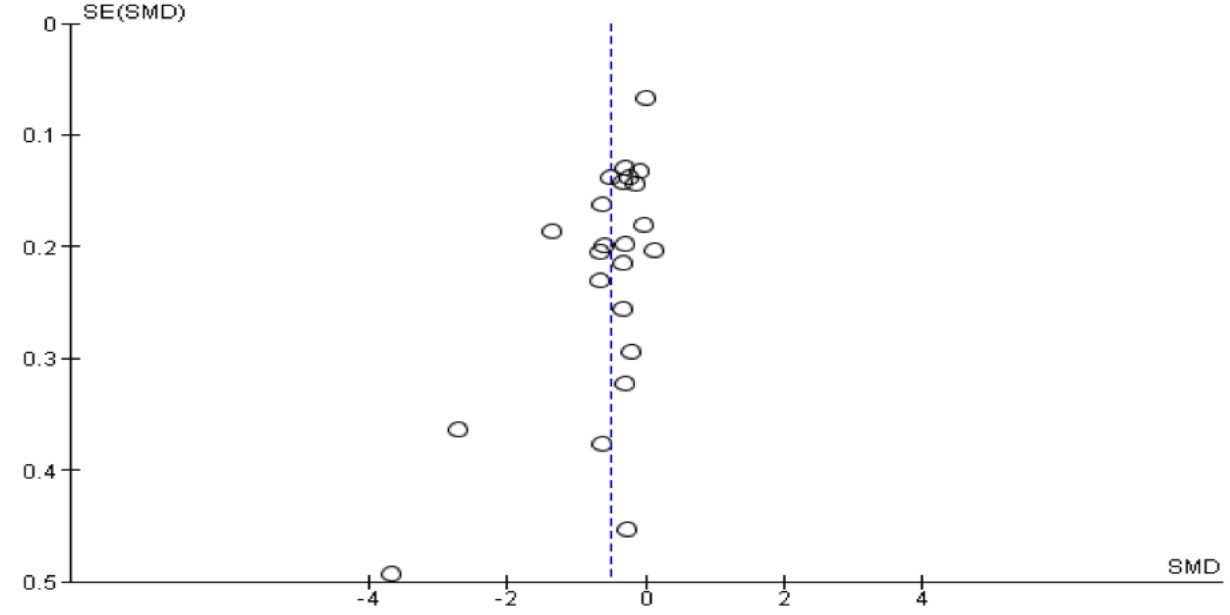
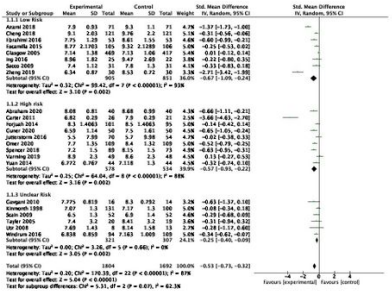
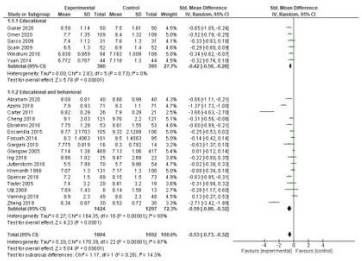


Figure 3

Funnel Plot for publication bias in HbA1c effects



4a



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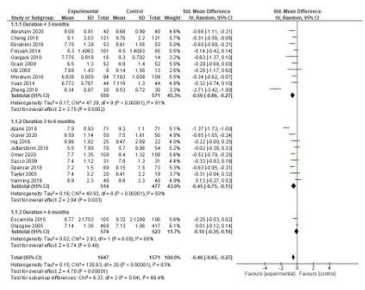

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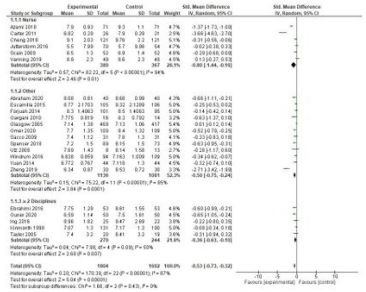

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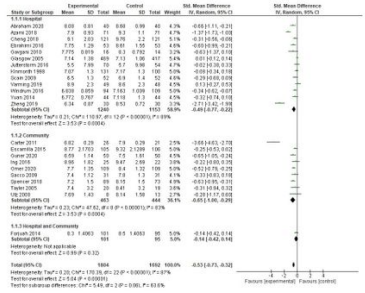

4e

Figure 4

4a Pooled effect size of HbA1c in studies sub-grouped by quality. 4b Pooled effect size of HbA1c in studies sub-grouped by components of intervention. 4c Pooled effect size of HbA1c in studies sub-grouped by duration of intervention. 4d Pooled effect size of HbA1c in studies sub-grouped by Provider of intervention. 4e Pooled effect size of HbA1c in studies sub-grouped by setting of intervention.

Supplementary Files

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- PrismaChecklist.KainatSR.doc