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Review

Evaluating the Effect of a Diabetes Health Coach in Individuals with Type 2 Diabetes

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ABSTRACT

Objectives: Diabetes health coaching has not been adequately assessed in individuals with type 2 diabetes. The objective of this review was to synthesize the evidence of health coaching for individuals with diabetes to determine the effects of coaching on diabetes control, specifically on glycated hemoglobin (A1C) levels.

Methods: The EMBASE, MEDLINE, CINAHL, PsychINFO and Cochrane Central Register of Controlled Trials databases were searched from inception to January 2015. Reference lists from important publications were also reviewed. At least 2 evaluators independently screened and extracted data from eligible studies.

Results: A total of 8 trials met the selection criteria, which included 724 adult participants; 353 participants were randomized to a diabetes health coaching intervention, and 371 were randomized to usual care. The pooled effect of diabetes health coaching overall was a statistically significant reduction of A1C levels by 0.32 (95% CI, -0.50 to -0.15). Longer diabetes health coaching exposure (>6 months) resulted in a 0.57% reduction in A1C levels (95% CI, -0.76 to -0.38), compared to shorter diabetes health coaching exposure (≤6 months) (-0.23%; 95% CI, -0.37 to -0.09). Across all studies, diabetes health coaching consisted of goal setting, knowledge acquisition, individualized care and frequent follow up.

Conclusions: Diabetes health coaching has an emerging role in healthcare that facilitates self-care, behaviour change and offers frequent follow up and support. This review finds that health coaching for those with diabetes is an effective intervention for improving glycemic control, which may be of greater benefit when offered in addition to existing diabetes care.

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R É S U M É

Objectifs : L'accompagnement en santé de la personne diabétique n'a pas été bien évalué chez les individus souffrant du diabète de type 2. L'objectif de cette revue était de synthétiser les données scientifiques sur l'accompagnement en santé des individus diabétiques pour déterminer les effets de l'accompagnement sur la maîtrise du diabète, particulièrement sur les taux d'hémoglobine glyquée (A1c).

Méthodes : Nous avons consulté les bases de données EMBASE, MEDLINE, CINAHL, PsychINFO et Cochrane Central Register of Controlled Trials de leur création à janvier 2015. Nous avons passé en revue les listes de références de publications importantes. Au moins 2 évaluateurs ont examiné et extrait de manière indépendante les données des études admissibles.

Résultats : Parmi les 724 participants adultes provenant de 8 essais qui répondaient aux critères de sélection, nous avons réparti aléatoirement 353 participants à l'accompagnement en santé de la personne diabétique et 371 participants aux soins habituels. Dans l'ensemble, l'effet groupé de l'accompagnement en santé de la personne diabétique montrait une réduction statistiquement significative des taux d'A1c de 0,32 (IC à 95%, -0,50 à -0,15). Une plus longue durée d'accompagnement en santé de la personne diabétique (>6 mois) entraînait une réduction des taux d'A1C de 0,57% (IC à 95%, -0,76 à -0,38), alors qu'une plus courte durée d'accompagnement en santé de la personne diabétique (≤6 mois) entraînait une réduction

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de 0,23% (IC à 95%, -0,37 à -0,09). Dans toutes les études, l'accompagnement en santé de la personne diabétique consistait à établir des objectifs, à acquérir de connaissances, et à offrir des soins individualisés et un suivi fréquent.

Conclusions : Le nouveau rôle que l'accompagnement en santé de la personne diabétique joue dans les soins de santé facilite l'autonomie en matière de santé et la modification du comportement, et offre un suivi fréquent et du soutien. Cette revue démontre que l'accompagnement en santé des personnes diabétiques est une intervention efficace pour améliorer la régulation de la glycémie et qu'il peut se révéler plus avantageux lorsqu'il est offert en plus des soins actuels du diabète.

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Introduction

Diabetes is increasingly becoming a crucial health issue worldwide. Both developing and developed countries are battling surging prevalence rates, with approximately 2.4 million Canadians currently living with diabetes (1,2). The high prevalence of diabetes and its associated comorbidities result in great financial costs to the healthcare system, in addition to the personal costs for individuals. Diabetes and its complications cost the healthcare system and the economy in Canada more than \$11.7 billion dollars in 2010 alone, and this figure is expected to increase to \$16 billion by 2020 (3).

The goals of treatment for type 2 diabetes are, ultimately, to achieve glycemic targets while minimizing adverse events (e.g. hypoglycemia) and preventing short- and long-term complications (4–8). A major factor in achieving good diabetes control is self-management. Specifically, diabetes self-management education and support have been shown to reduce the impact of diabetes on individuals (9–24). Moreover, research evidence in support of diabetes self-management emphasizes individualized education and support, with consideration of 1) patients' attitudes and capabilities; 2) risks for adverse events (e.g. hypoglycemia); 3) durations of type 2 diabetes; 4) life expectancies; 5) other comorbidities; and 6) patients' resources and support (23,24).

The complex nature of diabetes and heterogeneity in management often requires frequent access to and coordination of care across healthcare providers and healthcare sectors, as well as able and engaged individuals (25–29). Diabetes healthcare providers are often challenged to provide ongoing, long-term diabetes self-management education and support that is geared to individuals, while aligning interventions to match the individuals' readiness to change and their personal goals and priorities (28–31).

Health coaching is defined as health-related education, behaviour change and support by a healthcare professional (32–35); diabetes health coaching by a healthcare professional with expertise in diabetes is emerging as an effective intervention. Health coaching has been shown to improve clinical health outcomes (i.e. glycaemic control), medication/treatment adherence, healthcare utilization (i.e. emergency department visits) and adherence to evidence-based practices (34–37). The goal of this systematic review and meta-analysis was to synthesize the best evidence so as to determine the effects of health coaching on adults with type 2 diabetes in terms of clinical outcomes, particularly glycated hemoglobin (A1C) levels, self-care behaviours and quality of life.

Methods

Search strategy

We searched all relevant biomedical databases, including MEDLINE, EMBASE, CINAHL, PsychINFO and the Cochrane Database of Randomized Controlled Trials. In consultation with a medical librarian, we developed a search strategy based on an analysis of medical subject headings (MeSH) terms and key text words from 1946 to the present. A start date of 1946 was chosen intentionally because it

would include the inception of various databases. Specifically, the search strategy included combining diabetes coaching terms, such as *counselling*, *coaching*, *diabetes mellitus*, *telemedicine*, *consultations*, with methodologic terms; they were searched in English-language, published, peer-reviewed literature using validated search strategies (<http://hiru.mcmaster.ca/hiru/>) of electronic databases (MEDLINE, EMBASE, CINAHL, the Cochrane Central Register of Trials, and PsychINFO). Reference lists from relevant meta-analyses, systematic reviews and clinical guidelines were also examined. The appendix includes the full search strategy across the various databases. The authors followed the requirements of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement for transparency in reporting of this review and meta-analysis.

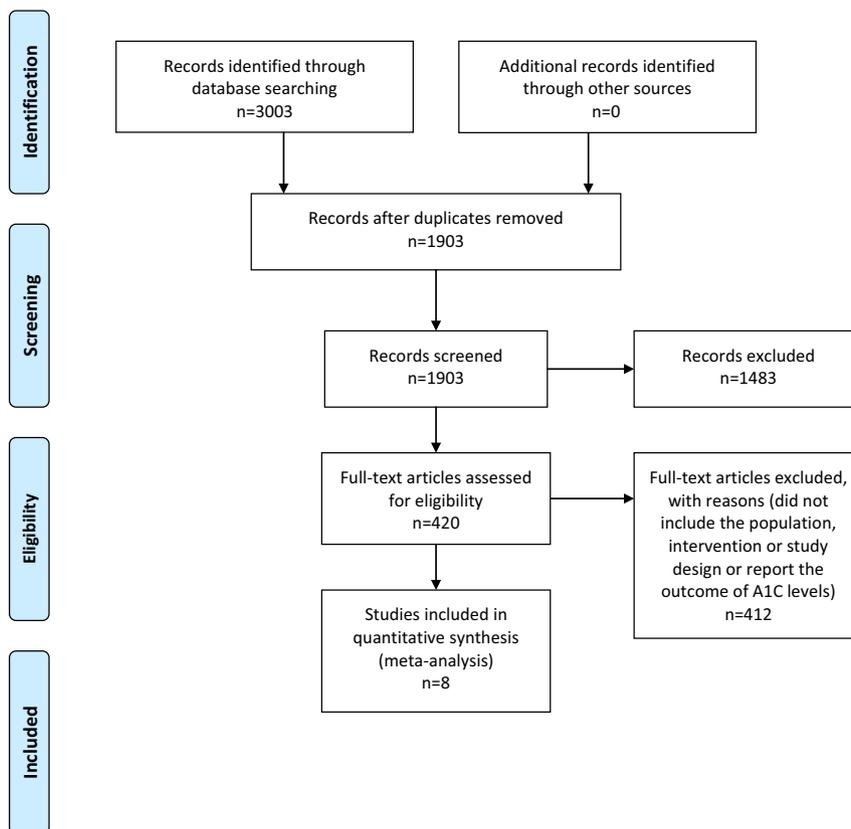
Study screening, data abstraction and quality assessment

All citations retrieved were reviewed against predetermined eligibility criteria. To be included, studies had to be written in English, to have been published in a peer-reviewed journal between January 1946 and January 20, 2015, and to meet the following criteria: 1) be a randomized controlled trial; 2) report data on adults ≥ 18 years of age with type 2 diabetes; 3) report a health-coaching intervention (in addition to usual care or self-management education/support); 4) be conducted by a health professional; and 5) report a mean change in A1C levels. Studies were excluded if 1) they reported data on subjects younger than 18 years of age or who did not have type 2 diabetes; 2) they reported data on pregnant women; 3) health coaching was not the primary intervention; 4) they did not report changes in A1C levels; 5) they were not randomized controlled trials or used a quasi-randomization methodology, including cluster randomization; and 6) there was no statement that informed consent was obtained.

Title and abstracts were reviewed for relevance by the lead investigator and 2 assistants; full text inclusion, quality assessment and data extraction were done by 2 research assistants who resolved disagreements through discussion. Data were abstracted by 2 people using a standard format; in cases of disagreements, consensus was reached after discussion. Items abstracted pertained to study characteristics, patient characteristics and outcome results. Individual study qualities were assessed by using the Cochrane risk of bias tool (38) for limitation in sequence generation, allocation concealment, blinding of participants and personnel, blinding of outcome assessment, incomplete reporting, selective reporting, other risks for bias and overall risks for bias.

Data analysis

To perform the meta-analysis, we utilized immediate post-treatment data (mean, standard deviation) for continuous outcomes of A1C levels. The DerSimonian and Laird random effects models with the inverse variance method were used to generate the summary measures of effect in the form of mean difference (MD); MDs were calculated using change from baseline data, along with its standard deviation (SD) for both the intervention and the control groups. For studies in which the SD was not reported, we calculated the SD from the reported standard error (SE) of the mean



*Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. PLOS Med 6: e1000097. doi:10.1371/journal.pmed.1000097. www.prisma-statement.org.

Figure 1. PRISMA 2009 Flow Diagram*.

or 95% confidence intervals (CIs). For studies with more than 1 intervention arm, we included the data for each intervention arm compared with the control group but split the sample size for the control group into equal halves to avoid unit-of-analysis error and double counting. The Cochrane Q ($\alpha=0.10$) and I^2 statistic were employed to quantify the statistical heterogeneity between studies, where $p < 0.10$ indicated a high level of statistical heterogeneity between studies. To evaluate statistical stability and effect on statistical heterogeneity, sensitivity analyses were also performed for the primary outcome of interest, A1C levels, based on length of intervention (≤ 6 months and > 6 months). All analyses were performed using Review Manager, v. 5.1 software (Cochrane IKMD, The Nordic Cochrane Centre, Copenhagen, Denmark).

Results

Search results

Our search strategy (Figure 1) resulted in 2175 titles and abstracts to be reviewed for relevance, which yielded 526 full-text studies. Of these studies, a total of 8 randomized controlled trials (39–46) were identified that fit our inclusion criteria; the remaining 136 were excluded for not meeting the required inclusion criteria. In the 8 included studies, there was a total of 724 participants at baseline

(study sample sizes range from 18 to 101), with 353 receiving a coaching intervention and 371 receiving usual care (control).

Participants' characteristics

Across all studies, the intervention arm's participants' mean ages ranged from 53.1 to 65.8 years, and the percentage of females ranged from 13% to 100%; the mean duration of diabetes ranged from 2.7 to 13.1 years. The control arm's participants' mean ages ranged from 52.8 to 65.8 years, and the percentage of females ranged from 36% to 100%; the mean duration of diabetes ranged from 2.7 to 13.1 years. Study characteristics are shown in Table 1.

Quality appraisals

The risk of bias for each study was assessed, and it was determined that all 8 studies were considered to be of weak methodologic quality due to unclear or high risk of bias (Table 2).

Intervention characteristics

Several strategies to facilitate diabetes coaching were used in the studies. Telephone-only strategies included multiple sessions, with frequency decided upon by either coaches or participants and flexibility in duration, ranging from 15 to 60 minutes in time per session (41,44,46). A combination of telephone and face-to-face strategies was used in a staged manner, with coaching commencing with frequent face-to-face sessions followed by telephone follow up later

Table 1
Characteristics of included studies

Study	Cinar, Schou (2014) Turkey
Objective	To determine whether a health-coaching approach compared with formal health education resulted in better outcomes among patients with type 2 diabetes in improving glycemic control and oral health by use of clinical and subjective outcome measures
Methods	Design: Prospective intervention study with random allocation Selection: Patients with type 2 diabetes were randomly selected from the outpatient clinics of 2 hospitals in Istanbul, Turkey. Inclusion criteria: 1) Confirmed type 2 diabetes; 2) 30- to 65-year-old patients with at least 4 functional teeth and 3) no psychological treatment or hospitalization Exclusion criteria: 1) Not meeting inclusion criteria; or 2) declining to participate
Participants	Sample: N=197 (but only 186 received intervention) Intervention: n=77; Control: n=109 Follow up n: Intervention: n=75; Control: n=101 Mean age overall (SD): Intervention: not stated; Control: not stated Gender (male %): Intervention: n=40; Control: n=39 Race/ethnicity (white %): Intervention: not stated; Control: not stated Mean BMI (SD): Intervention: n=30.1 (5.3); Control: n=31 (6.1) Baseline A1C % (SD): Intervention: n=7.5 (1.5); Control: n=7.8 (1.6) Follow Up A1C % (SD): Intervention: n=6.9 (1.3); Control: n=7.8 (1.6)
Intervention	Intervention duration: 64 weeks Description of intervention: Patients set up their goals and action plans, focusing on improvement of lifestyle and clinical measures, under the supervision of the coach. Each coaching session, as the foundation for the next coaching session, was used for subsequent monitoring of patients' progress toward the achievement of their target goals. Description of control group: Participants received formal/traditional health education. Length of follow up: 16 months post baseline
Study	Cho et al (2011) South Korea
Objective	The primary objective was to test whether A1C levels improved after 3 months in a controlled trial of a remote coaching system using a PDA and the internet.
Methods	Design: A randomized controlled design by simple random selection. Selection: 6 socioeconomically and demographically similar public healthcare posts associated with Chung-ju city were selected by simple random selection. Patients who were registered with the primary healthcare posts were invited to participate. Inclusion criteria: 1) a diagnosis of type 2 diabetes; 2) patients aged >40 years and 3) patients with a A1C levels of 7.0% to 11.0% who had been followed for more than 6 months by the healthcare post Exclusion criteria: 1) diagnosed or suspected disease of the liver, pancreas, endocrine organs or kidneys; 2) ischemic heart disease or cerebrovascular disease or a history of such disease; 3) creatinine higher than 0.133 mmol/L; 4) treatment with intensive insulin regimens or 5) unable to attend regularly
Participants	Sample: N=71 Intervention: n=36; Control: n=35 Follow up n: Intervention: n=32; Control: n=32 Mean age overall (SD): Intervention: n=65.3 (9.3); Control: n=63.1 (10.3) Gender (male %): Intervention: n=44; Control: n=34 Race/ethnicity (white %): Intervention: not stated; Control: not stated Mean BMI (SD): Intervention: n=25.2 (3.4); Control: n=24.7 (3.1) Baseline A1C % (SD): Intervention: n=8.0 (0.8); Control: n=8.0 (1.0) Follow up A1C % (SD): Intervention: n=7.5 (0.9); Control: n=7.8 (1.1)
Intervention	Intervention duration: 12 weeks Description of intervention: Specialized management mediated by a PHC nurse Description of control group: Usual care Length of follow up: 12 weeks post baseline
Study	Frosch et al (2011) United States
Objective	To see whether participants assigned to the experimental condition would report more engagement in self-care behaviours and would have lower A1C, lipid and blood pressure levels after completing the intervention at 6 months
Methods	Design: A 2-group RCT Selection: Patients with type 2 diabetes mellitus were recruited from 3 academic primary care practices (2 internal and 1 family medicine) and 1 community-based safety-net clinic that provides care for the poor and uninsured in the Los Angeles, California, USA, area between August 2008 and November 2009. Inclusion criteria: 1) at least 40 years of age; 2) history of diabetes for at least 1 year; 3) attending the clinic for routine follow up visits and completing at least 2 visits in the last 12 months; 4) A1C values of 8.0% or greater; 5) owning a DVD player and television at home; 6) primary language English or Spanish; 7) no severe visual impairments and 8) not currently enrolled in a diabetes support or education program or having participated in similar programs in the last 6 months.
Participants	Sample: N=201 Intervention: n=100; Control: n=101 Follow up n: Intervention: n=83; Control: n=87 Mean age overall (SD): Intervention: n=56.7 (8.3); Control: n=54.3 (8.9) Gender (male %): Intervention: n=46; Control: n=57 Race/ethnicity (white %): Intervention: n=21.2; Control: n=18.0 Mean BMI (SD): Intervention: n=33.3 (8.0); Control: n=32.8 (7.4) Baseline A1C % (SD): Intervention: n=9.4 (1.9); Control: n=9.8 (2.1) Follow up A1C % (SD): Intervention: n=8.9 (0.19); Control: n=9.2 (0.19)
Intervention	Intervention duration: 24 weeks Description of intervention: Patients receive a 24-minute DVD program with accompanying booklet and received up to 5 sessions of telephone coaching with a nurse educator. Description of control group: Patients received a 20-page brochure developed by the National Diabetes Education Program of the National Institutes of Health. Length of follow up: 6 months post baseline

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Table 1 (continued)

Study	Orsama et al (2013) Finland
Objective	To evaluate the impact of active assistance technology on A1C levels, body weight and blood pressure in individuals with type 2 diabetes
Methods	Design: RCT Selection: Invitation letters were sent to 337 patients who were screened from the electronic health record system at the Sipoo, Finland, Community Health Centre. Inclusion criteria: 1) known diagnosis of type 2 diabetes; 2) elevated A1C levels (>6.5%) or currently using oral diabetes medication and 3) age range of 30 to 70 years Exclusion criteria: 1) expected poor study compliance (e.g. information technology illiteracy or reluctance to perform self-monitoring); 2) pregnancy; 3) life expectancy of less than 1 year; 4) major elective surgery within the past 6 months or planned for the next 6 months or 5) psychiatric disorders (e.g. depression) or alcohol or narcotics abuse
Participants	Sample: N=56 Intervention: n=27; Control: n=29 Follow up n: Intervention: n=24; Control: n=24 Gender (male %): Intervention: n=54; Control: n=54 Race/ethnicity (white %): Intervention: not stated; Control: not stated Mean BMI (SD): Intervention: n=30.7 (4.5); Control: n=33.5 (8.0) Baseline A1C % (SD): Intervention: n=6.86 (1.56); Control: n=7.09 (1.51) Follow up A1C % (SD): Intervention: not stated; Control: not stated
Intervention	Intervention duration: 10 months Description of intervention: The intervention group participated in a diabetes lifestyle self-management promotion program involving remote patient reporting and automated theory-based health behavior feedback. Description of control group: The control group received standard medical care, including diabetes education, annual check-ups and diabetes guidance and education given by a doctor or nurse during patient-initiated visits to their health center. Length of follow up: 10 months
Study	Ruggiero et al (2010) United States
Objective	To evaluate the impact of the medical assistant coaching intervention on A1C levels compared with a treatment-as-usual group and to evaluate the impact of the intervention on psychosocial mediators as compared to the treatment-as-usual group
Methods	Design: RCT Selection: Low-income minority populations with type 2 diabetes receiving care at a Federally Qualified Health Care clinic Inclusion criteria: 1) Latino or African American ethnicity; 2) age >50 years; 3) last 2 A1C levels >7%; 4) diagnosis of type 2 diabetes for at least 1 year; 5) prescribed diabetes medication
Participants	Sample: N=50 Intervention: n=25; Control: n=25 Follow up n: Intervention: n=24; Control: n=19 Mean age overall (SD): Intervention: n=65.8 (9.35); Control: n=65.8 (9.35) Gender (male %): Intervention: n=34; Control: n=34 Race/ethnicity (white %): Intervention: 0; Control: 0 Mean BMI (SD): Intervention: n=30.1 (5.3); Control: n=32.4 (6.59) Baseline A1C % (SD): Intervention: n=8.9 (1.59); Control: n=8.45 (1.71) Follow up A1C % (SD): Intervention: n=8.73 (1.74); Control: n=8.5 (2.25)
Intervention	Intervention duration: 26 weeks Description of intervention: 2 face-to-face sessions during quarterly clinic visits and 4 monthly telephone calls between visits Description of control group: Participants received formal/traditional health education. Length of follow up: 6 months post baseline
Study	Varney et al (2014) Australia
Objective	To understand the extent to which intervention effects are maintained in the post-intervention period
Methods	Design: RCT Selection: Participants were recruited over 13 months from the Diabetes Clinic of St Vincent's Hospital Melbourne, an Australian public teaching hospital. Inclusion criteria: not stated Exclusion criteria: 1) unable to provide informed consent; 2) non-English speaking; 3) cognitively impaired, receiving palliative care, severely hearing impaired or without telephone access
Participants	Sample: N=94 Intervention: n=47; Control: n=47 Follow up n: Intervention: n=35; Control: n=36 Mean age overall (SD): Intervention: 59 (not stated); Control: 64 (not stated) Gender (male %): Intervention: n=72; Control: n=64 Race/ethnicity (white %): Intervention: n=98; Control: n=79 Mean BMI (SD): Intervention: n=32.1 (not stated); Control: n=30.9 (not stated) Baseline A1C % (SD): Intervention: n=8.2 (not stated); Control: n=8.5 (not stated) Follow up A1C % (SD): Intervention: n=8.2 (not stated); Control: n=8.4 (not stated)
Intervention	Intervention duration: 6 months Description of intervention: In addition to usual diabetes care, the intervention group received telephone coaching intervention on glycemic control, risk factor status and adherence to self-care and monitoring requirements. Description of control group: Usual care Length of follow up: 12 months

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Table 1 (continued)

Study	Whittemore et al (2004) United States
Objective Methods	To determine the efficacy of a 6-month nurse-coaching intervention that was provided after diabetes education for women with type 2 diabetes Design: Pilot study RCT. Selection: A convenience sample of women with type 2 diabetes was recruited from an outpatient diabetes education centre in northeastern Connecticut, US.
Participants	Inclusion criteria: 1) female; 2) diagnosed with type 2 diabetes; 3) between the ages of 30 and 70 years; 4) cleared for exercise by a primary care provider; 5) no advanced complications of diabetes; 6) A1C level greater than 7%; 7) fluent in English; 8) previous participation in diabetes education Sample: N=53 Intervention: n=not specified; Control: n=24 Follow up n: Intervention: n=26; Control: n=23 Mean age overall (SD): Intervention: not stated; Control: not stated Gender (male %): Intervention: not stated; Control: not stated Race/ethnicity (white %): Intervention: not stated; Control: not stated Mean BMI (SD): Intervention: n=36.5 (7.0); Control: n=34.8 (7.0) Baseline A1C % (SD): Intervention: n=7.7 (1.0); Control: n=7.6 (1.0) Follow up A1C % (SD): Intervention: n=7.5 (1.0); Control: n=7.5 (1.0)
Intervention	Intervention duration: 26 weeks Description of intervention: Nurse-coaching intervention plus standard diabetes care Description of control group: Standard diabetes care Length of follow up: 6 months post baseline
Study	Wolever et al (2010) United States
Objective Methods	To evaluate the effectiveness of integrative health coaching on psychosocial factors, behaviour change and glycemic control in patients with type 2 diabetes Design: RCT Selection: Participants were recruited through flyers, newspaper and online advertisements, targeted mailings and prior study pools. Inclusion criteria: 1) English speaking; 2) at least 18 years of age; 3) having a diagnosis of type 2 diabetes for at least 1 year; 4) be taking oral diabetes medication for at least 1 year; 5) have medical and pharmacy benefits available to the study team Exclusion criteria: 1) dementia; 2) Alzheimer disease; 3) schizophrenia; 4) other cognitive impairment that would preclude informed consent
Participants	Sample: N=56 Intervention: n=30; Control: n=26 Follow up n: Intervention: n=27; Control: n=22 Mean age overall (SD): Intervention: n=53.1 (8.29); Control: n=52.8 (7.64) Gender (male %): Intervention: n=27; Control: n=19 Race/ethnicity (white %): Intervention: n=33; Control: n=46 Mean BMI (SD): Intervention: not stated; Control: not stated Baseline A1C % (SD): Intervention: n=7.7 (1.94); Control: n=8.1 (1.92) Follow up A1C % (SD): Intervention: n=7.5 (1.76); Control: n=8.2 (1.92)
Intervention	Intervention duration: 26 weeks Description of intervention: IH coaching by telephone for 14 30-minute sessions Description of control group: Usual care Length of follow up: 6 months post baseline

Table 2
Summary of study risk of bias assessments*

Study	Sequence generation	Allocation concealment	Blinding participants and personnel	Blinding outcome assessment	Incomplete reporting	Selective reporting	Other risk of bias	Overall risk of bias
Cinar, 2014	U	U	H	H	L	L	SS	U
Cho, 2011	U	U	H	H	L	L	-	U
Frosch, 2011	L	L	H	H	L	L	-	U
Orsama, 2013	L	U	H	H	L	L	SS	U
Ruggiero, 2010	H	H	H	H	L	L	SS	H
Varney, 2014	L	L	H	H	H	U	-	H
Whittemore, 2004	H	H	H	H	U	U	SS	H
Wolever, 2010	H	H	U	L	U	L	SS	

H, high risk; L, low risk; SS, sample size; U, unclear risk.

Note: Sample size may comprise studies that did not include a sample size calculation or studies with less than 30 participants per arm.

* Risk of bias assessments were performed using the Cochrane risk of bias tool (38).

in the coaching intervention (i.e. the fifth or sixth coaching session) (39,43,45). Finally, combinations of internet, phone and face-to-face strategies were used with the assistance of decision support platforms (i.e. web-based applications) or the inputting of health parameters such as blood pressure to facilitate coaching discussions and interactions (40,42). The control group received usual diabetes education, support and/or educational literature (39,46). The foci of coaching interventions across the included studies comprised 1) goal setting and attainment (39,41–44,46); 2) increasing self-care knowledge (39,43,45); 3) individualized care

recommendations (39–46); and 4) regular and frequent follow up (39–46). All health coach intervention characteristics are described in Table 3. Usual care comprised traditional or standard diabetes education and/or support in the context of their healthcare systems and included medical care, formal educational and resources (i.e. brochures).

Glycated hemoglobin levels

All 8 studies reported the effect of coaching intervention on A1C levels. Random-effects analysis was used because of the degree of

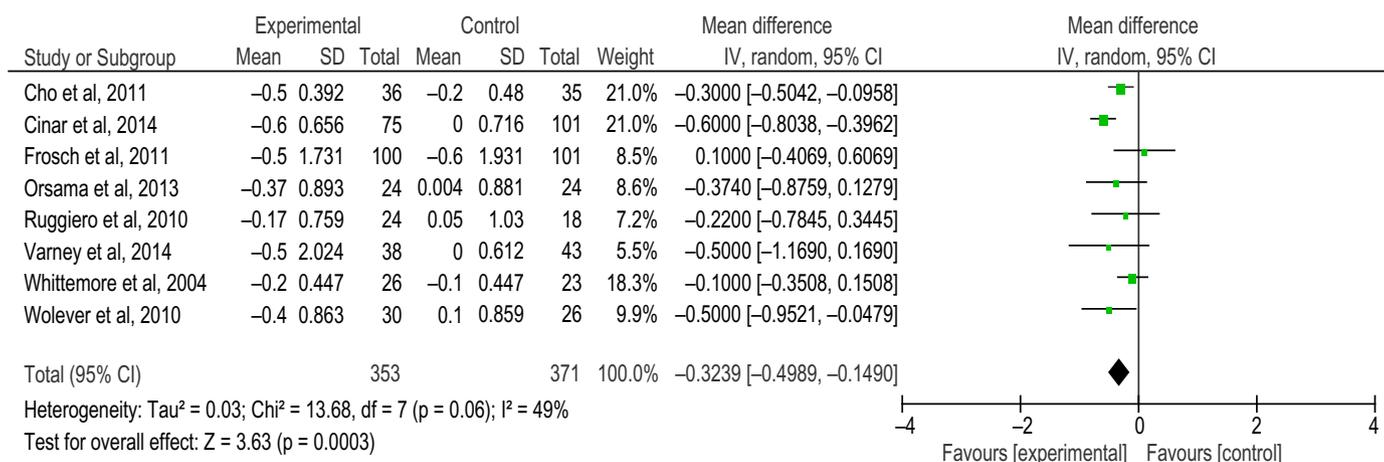
Table 3
Characteristics of health coach intervention

Study	Cinar, Schou (2014) Turkey
Who	A coach with a dental professional background
What	Focus of coaching interaction: Empowerment of patients for daily diabetes and oral health-related practices, building up health-related capacities, building skills and taking responsibility for one's own health
Where	Location: outpatient clinics at 2 hospitals in Istanbul, Turkey
When	Frequency and duration of coaching interactions: 5 or 6 face-to-face sessions and 3 or 4 phone-coaching sessions during a 10-month intervention Duration of coaching intervention: 10-month initiation and maintenance, 6-month follow up
How	Mode of coaching interaction: face-to-face and telephone coaching sessions Self-monitoring approaches: patients set up target goals and action plans focusing on improvement of lifestyle and clinical measures. Each coaching session was used to monitor patients' progress toward the achievement of their target goals.
Study	Cho et al (2011) Korea
Who	Nurses
What	Focus of coaching interaction: to test whether A1C levels improved after 3 months in a controlled trial
Where	Location: public healthcare posts associated with Chung-ju city in Korea
When	Frequency and duration of coaching interactions: once per week Duration of coaching intervention: 12 weeks
How	Mode of coaching interaction: recommendations sent via internet once a week, and patients' questions were answered within 24 hours by a physician. The nurse contacted the patients and answered any questions. The nurse could educate the patient face-to-face according to the physician's recommendations. Self-monitoring approaches: none mentioned.
Study	Frosch et al (2011) United States
Who	Nurse educator
What	Focus of coaching interaction: to collaborate with participants in identifying desired and attainable behavioural goals that could have a positive impact on their diabetes management
Where	Location: 3 academic primary care practices and 1 community-based safety-net clinic in the Los Angeles, California, USA, area.
When	Frequency and duration of coaching interactions: up to 5 sessions of telephone coaching; the first session was up to 60 minutes in length, the second and third sessions were each up to 30 minutes in length, the fourth and fifth sessions were each up to 15 minutes in length. Duration of coaching intervention: The total amount of telephone coaching time experimental participants could receive was 2.5 hours. The time interval between telephone coaching sessions was left to the nurse educator and individual participant to determine.
How	Mode of coaching interaction: telephone coaching Self-monitoring approaches: none described
Study	Orsama et al (2013) Finland
Who	Computer-generated feedback and physician- or nurse-originated feedback
What	Focus of coaching interaction: to strengthen patients' self-care practices
Where	Location: N/A; determined by patients
When	Frequency and duration of coaching interactions: The decision support system is activated and feedback is provided when a new measurement is remotely reported by the patients. Patients were instructed to take 2 blood pressure, 1 weight and 3 to 6 blood glucose measurements per week and to upload their health parameter data directly after taking each measurement. Duration of coaching intervention: 10 months
How	Mode of coaching interaction: mobile telephone Self-monitoring approaches: Patients were encouraged to initiate and maintain lifestyle changes appropriate to self-care of diabetes and hypertension by providing personalized, information-, motivation- and behavioural skills-rich feedback, based on patients' self-measured remote health parameters.
Study	Ruggiero et al (2010) United States
Who	Certified medical assistant with specific diabetes training
What	Focus of coaching interaction: to increase diabetes care knowledge and skill to empower and equip individuals to reach their diabetes care goals, to reduce diabetes-related problems, to eliminate barriers to care, and to improve health outcomes as measured by A1C levels
Where	Location: primary care clinic at a federally qualified health centre clinic in Chicago, Illinois, USA.
When	Frequency and duration of coaching interactions: 2 face-to-face sessions during quarterly clinic visits (less than 30 minutes in duration) and 4 monthly telephone calls between visits (less than 15 minutes in duration) Duration of coaching intervention: 6 months.
How	Mode of coaching interaction: face-to-face in a private counselling room within the same building as the clinic and telephone sessions Self-monitoring approaches: Coaches supported patients in setting and achieving personal self-care goals based on provider recommendations/practice guidelines, overcoming barriers to care and arranging appointments.
Study	Varney et al (2014) Australia
Who	Dietitian with experience in cardiovascular disease and type 2 diabetes
What	Focus of coaching interaction: progress toward treatment goals, glycemic control, risk factor status and adherence to self-care and monitoring requirements
Where	Location: N/A; coaching took place over the phone.
When	Frequency and duration of coaching interactions: Intervention group participants received 6 coaching sessions. The duration of coaching sessions was flexible and determined by the time required to establish participants' goals, typically 20 to 45 minutes. Duration of coaching intervention: 6 months
How	Mode of coaching interaction: telephone Self-monitoring approaches: Discrepancies between participants' adherence to self-care activities and monitoring requirements were highlighted, and the appropriate management schedule was explained.

(continued on next page)

Table 3 (continued)

Study	Whittemore et al (2004) United States	
Who	Nurse	
What	Focus of coaching interaction: to facilitate integration of diabetes self-management into the women's daily lives, relationships and self-concepts	
Where	Location: outpatient diabetes education center in northeastern Connecticut, USA.	
When	Frequency and duration of coaching interactions: coaching sessions were provided every 2 weeks for 3 sessions, every month for 2 sessions and 1 session after 3 months. Duration of coaching intervention: 6 coaching sessions were provided over 6 months with an additional 2 brief phone calls between the fifth and sixth coaching sessions.	
How	Mode of coaching interaction: face-to-face coaching sessions Self-monitoring approaches: education reinforcement, psychosocial support and motivational guidance were the primary strategies used in the intervention.	
Study	Wolever et al (2010) United States	
Who	Type of coach not specified; coaches had master's-level degrees in social work or psychology.	
What	Focus of coaching interaction: patients were guided in creating visions of health, and long-term goals that aligned with those visions were discussed.	
Where	Location: N/A; participants were recruited and screened by telephone.	
When	Frequency and duration of coaching interactions: coaching was conducted by telephone for 14 30-minute sessions (8 weekly calls, 4 biweekly calls and a final call 1 month later). Duration of coaching intervention: 6 months.	
How	Mode of coaching interaction: telephone coaching. Self-monitoring approaches: participants were asked what was important to them in terms of diabetes care, how well they were managing their health, and what they perceived to be their challenges or areas of required support. Additionally, participants received a binder of educational materials.	

**Figure 2.** The effect of coaching interventions on A1C levels.

heterogeneity across studies (chi-square=13.68; I²=49%). The pooled effect for diabetes coaching was a decrease in A1C levels of 0.32 (95% CI, -0.50 to -0.15), significantly favouring the intervention (Figure 2). To evaluate the impact of intervention duration, the studies were dichotomized based on whether the coaching intervention was short term (≤6 months) or of longer duration (>6 months). Of the studies, 6 had coaching intervention durations of 6 months or fewer (40,41,43–46), whereas 2 studies were longer than 6 months (39,42). The pooled effects of shorter coaching interventions showed a significant decrease in A1C levels of 0.23% (95% CI, -0.37 to -0.09). The longer interventions resulted in significantly greater decreases in A1C levels of 0.57% (95% CI, -0.76 to -0.38) (Figure 3).

Discussion

Diabetes health coaching is emerging as a novel health-service intervention that may supplement existing diabetes healthcare to improve glycemic control (i.e. A1C levels). This review demonstrates that health coaching for patients with diabetes is an effective intervention, resulting in a pooled decrease in A1C levels of -0.32% (95% CI, -0.50 to -0.15), with the greatest effects seen in long-term coaching (>6 months) for A1C levels (-0.57%; 95% CI, -0.76 to -0.38). Recognizing that health coaching for those with diabetes

comprises a variety of complex components and strategies, this review found that all coaching interventions included elements of goal setting, acquisition of knowledge about diabetes, individualized care and frequent follow up.

This review is not without limitations. First, although we searched comprehensively across multiple databases for diabetes health-coaching literature, we included only studies published in English. Second, we were limited to analyzing only data for glycemic control (i.e. A1C levels). This was reflective of the limitation of the reporting of patient-relevant outcomes in the literature, such as quality of life and/or self-efficacy. Finally, although this review considered only randomized control trials, all 8 studies were found to be of limited quality, thus the findings must be interpreted with caution.

This review does have strengths. This is the first comprehensive meta-analysis of health coaching for those with diabetes. Second, we used rigorous systematic review procedures that are consistent with conducting high-quality reviews, such as comprehensive search strategies and citation screening and data extraction in duplication.

Our review builds on the growing body of literature related to diabetes health coaching, specifically by describing the components of health coaching and assessing the effects of the totality of diabetes health coaching on A1C levels. Our review found statistical significance across all studies in favour of diabetes health

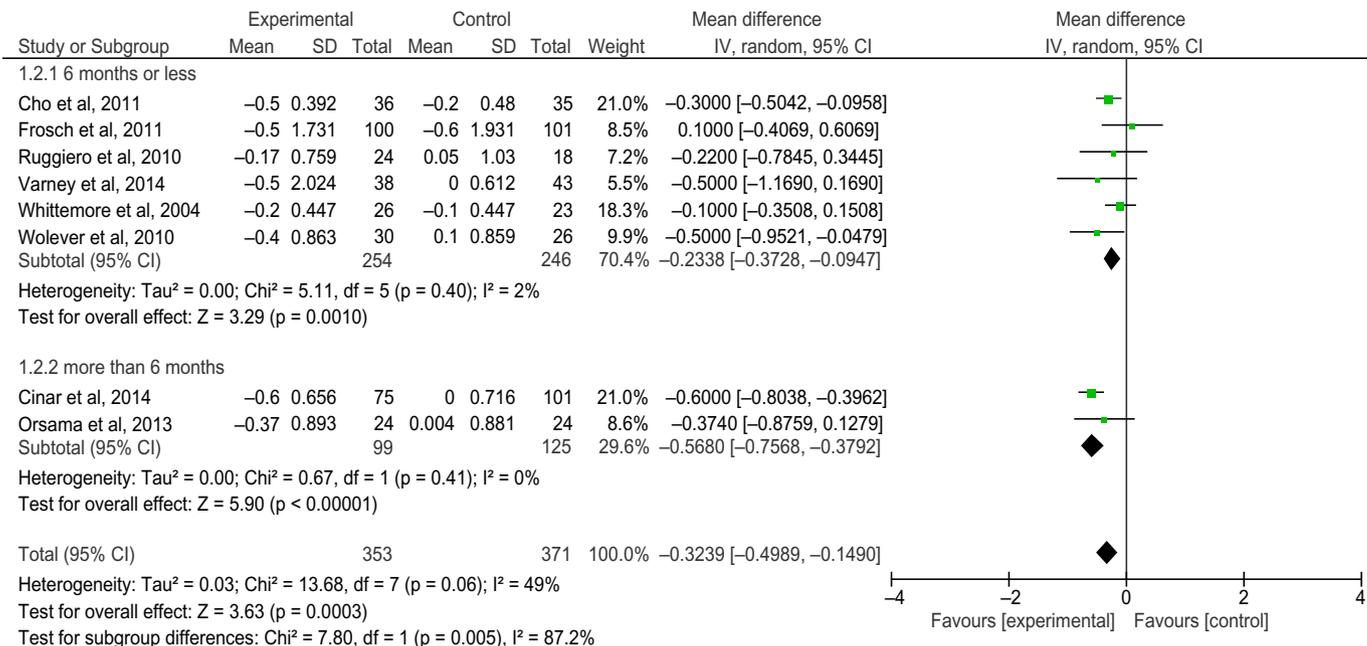


Figure 3. The effect of coaching interventions on A1C levels by duration of intervention (≤6 months or >6 months).

coaching and decreasing A1C levels, with greater decreases seen beyond 6 months. Although the primary studies informing this review were of limited quality, the meta-analyzed results demonstrate that coaching may be advantageous when supplemented by routine or standard diabetes-care practices. Further research is necessary to examine the structure, process and impact of coaching on additional diabetes-related outcomes, such as healthcare utilization, quality of life and self-efficacy. Additional research examining the fidelity of coaching, including training, implementation and adaptation of coaching across differing healthcare system settings, is also needed to consider the contextual factors that may facilitate or hinder the adoption and uptake of coaching at a system, clinical or patient level.

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Conflicts of Interest

DS is supported by an Early Career Research Award from Hamilton Health Sciences. DS is the guarantor of this work and, as such, had full access to all the data in the review and takes responsibility for the integrity of the data and accuracy of the data analysis.

Author Contributions

DS, VV, JWB and RMUA contributed to the study question, methodology, data extraction, interpretation and manuscript preparation. RMUA completed all analyses.

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Appendix: Diabetes Coaching Search Strategy

MEDLINE-OVID

1946 to January 20, 2015

1. Diabetes Mellitus, Type 2/
2. *counseling/ or directive counseling/
3. coaching.mp.
4. “one on one”.tw.
5. (individual* adj2 counsel*).tw.
6. (“face to face” not (face-to-face adj2 interview*)).tw.
7. Telemedicine/
8. *Internet/
9. diabetes specialist nurs*.tw.
10. “telephone counsel?ing”.tw.
11. *telephone/
12. 2 or 3 or 4 or 5 or 6 or 7 or 8 or 10 or 11
13. 1 and 12
14. 9 or 13
15. limit 14 to (comment or editorial or letter or news)
16. 14 not 15
17. limit 16 to english language

EMBASE-OVID

1980 to January 20, 2015

1. *non insulin dependent diabetes mellitus/
2. directive counseling/ or patient counseling/
3. coaching.mp.
4. “one on one”.tw.
5. (“face to face” not (face-to-face adj2 interview*)).tw.
6. diabetes specialist nurs*.tw.
7. Internet/
8. telemedicine/ or teleconsultation/ or telehealth/
9. “telephone counsel?ing”.tw.
10. 2 or 3 or 4 or 5 or 8 or 9
11. non insulin dependent diabetes mellitus/
12. 10 and 11
13. 6 or 12
14. *internet/
15. 1 and 14
16. 13 or 15
17. limit 16 to (book or book series or conference abstract or editorial or letter or note)
18. 16 not 17
19. limit 18 to english language

PsycInfo-OVID

1967 to January 20, 2015

1. diabetes mellitus/
2. counseling/ or psychotherapeutic counseling/
3. coaching/
4. coaching.mp.
5. “one on one”.tw.
6. (counsel?ing not genetic counsel?ing).tw.
7. (“face to face” not (face-to-face adj2 interview*)).tw.
8. telemedicine/ or computer mediated communication/ or exp telecommunications media/
9. 2 or 3 or 4 or 5 or 6 or 7 or 8
10. 1 and 9
11. diabetes specialist nurs*.tw.

12. 10 or 11
13. limit 12 to (chapter or “column/opinion” or “comment/reply” or editorial or letter)
14. 12 not 13
15. limit 14 to english language

Cochrane Central-OVID

1991 to January 20, 2015

1. Diabetes Mellitus, Type 2/
2. counseling/ or directive counseling/

3. coaching.mp.
4. “one on one”.tw.
5. (individual* adj2 counsel*).tw.
6. (“face to face” not (face-to-face adj2 interview*)).tw.
7. Telemedicine/
8. internet/
9. “telephone counsel?ing”.tw.
10. telephone/
11. 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10
12. 1 and 11
13. diabetes specialist nurs*.tw.
14. 12 or 13

CINAHL-EBSCO

1982-January 20 2015

S20	S18 NOT S19	Search modes: Boolean/Phrase
S19	S18	Limiters: Publication type: book, book chapter, commentary, editorial, letter
S18	S15 OR S16	Search modes: Boolean/Phrase
S17	S15 OR S16	Limiters: English language; exclude MEDLINE records
S16	TX diabetes specialist nurs*	Search modes: Boolean/Phrase
S15	S13 AND S14	Search modes: Boolean/Phrase
S14	(MM “Diabetes Mellitus, Type 2”)	Search modes: Boolean/Phrase
S13	S5 OR S6 OR S8 OR S9 OR S10 OR S11 OR S12	Search modes: Boolean/Phrase
S12	TX telephone counsel*	Search modes: Boolean/Phrase
S11	(MH “Telenursing”)	Search modes: Boolean/Phrase
S10	(MH “Telemedicine”) OR (MH “Telehealth”)	Search modes: Boolean/Phrase
S9	(MM “Internet”)	Search modes: Boolean/Phrase
S8	TX face to face NOT TX face to face N2 interview*	Search modes: Boolean/Phrase
S7	TX . (individual* N2 counsel*).	Search modes: Boolean/Phrase
S6	TX coaching OR one on one	Search modes: Boolean/Phrase
S5	MM “Counseling”	Search modes: Boolean/Phrase
S4	A nurse-coaching intervention for women with type 2 diabetes	Search modes: Boolean/Phrase
S3	S1 AND S2	Search modes: Boolean/Phrase
S2	TX coaching	Search modes: Boolean/Phrase
S1	(MH “Diabetes Mellitus+”)	Search modes: Boolean/Phrase