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Review article

# Effects of health coaching on behavioral modification among adults with cardiovascular risk factors: Systematic review and meta-analysis

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ABSTRACT

*Objectives:* This meta-analysis examined effects of health coaching on physical activities, dietary behaviors, health responsibility, stress management, and smoking behaviors among populations with cardiovascular risk factors.
*Methods:* Multiple electronic databases were searched for randomized controlled trials utilizing health coaching for people with cardiovascular risk factors to lead behavioral changes. The included studies were pooled to estimate the effect size for health coaching interventions on each of the health behaviors.
*Results:* This meta-analysis included 15 randomized trials. Motivational interviewing and education sessions were common coaching interventions with telephone calls or face-to-face contacts as the main contact methods. Health coaching for health behaviors showed small but significant effect sizes on physical activities, dietary behaviors, health responsibility, and stress management except for smoking behaviors.
*Conclusion:* The study findings support that health coaching can induce positive behavioral changes among individuals with cardiovascular risk factors. Health coaching delivered by either expert or peer coaches would be easy to apply in clinical settings.
*Practical implications:* Health care professionals should be aware that health coaching could provide effective motivation strategies to improve compliance of those who need to initiate and maintain their health behaviors. Health coaching could be easily delivered via telephone calls, text messages, or short-term face-to-face coaching.



**Contents**



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## 1. Introduction

Cardiovascular diseases (CVDs) are the leading cause of premature death, responsible for an estimated 31% of all death worldwide [1]. A prospective study monitoring 5128 middle-aged British men for 20 years found that individuals with metabolic syndrome showed significantly higher relative risk of developing heart disease (RR = 1.64) and diabetes (RR = 3.57) than their healthy counterparts [2]. The common risk factors of hyperlipidemia, hyperglycemia, hypertension, and smoking were significant predictors of cardiovascular events [3].

Cardiovascular risk factors are closely associated with health behaviors [4,5]. This close association supports medical approaches for improving physiological outcomes through modifying unhealthy behaviors [6]. For example, increasing physical activity, maintaining low-fat and low-sodium diets, or stopping tobacco use are considered essential to effective treatment outcomes [7,8]. Stress management, which is known to be effective in decreasing blood pressure and HbA1c, is also recommended when caring for adults with cardiovascular risk factors [9,10]. Moreover, the health responsibilities of patients, such as taking medications, checking blood glucose, or visiting clinics as scheduled, are considered essential to risk management [11]. Effective interventions that are also feasible should be available for those with cardiovascular risk factors to change their unhealthy behaviors.

Health coaching is an educational strategy based on a motivational approach [12,13], with a strong emphasis on motivating subjects to change their health behaviors, and in which 'client-centered goal setting and solution searching' are encouraged [14,15]. In addition, personal counseling and coaching are possible based on a long and stable relationship between patients and health coaches [16,17]. Health coaching has been applied to various populations with chronic conditions including diabetes, obese, and hypertension. Most of the results have demonstrated that health coaching is effective in controlling body weight, blood glucose, or blood pressure, as well as changing health behaviors [15,16,18–21].

While the health benefits of health coaching were supported in previous reviews [15,16,18–21], several issues should be considered before implementing it for behavioral modification. First, health coaching has been applied to groups comprising subjects of various ages including children and the elderly. In addition, the participants have had wide variations of chronic diseases, not only CVDs but also arthritis, cancer, spinocerebellar degeneration, and mental illness, and hence different mechanisms of behavioral modification might have been applicable. Second, the effect of health coaching mainly focused on physiological outcomes (i.e., blood pressure, HbA1c, blood glucose, cholesterol, BMI, or body weight) and behavioral outcomes were often disregarded. Third, very few randomized controlled trials (RCTs) have evaluated the effects of health coaching in the previous reviews.

Based on the issues raised by previous review studies, the present study aimed to determine the pooled effect of a health coaching program on health behaviors by only including RCTs that involved adults with cardiovascular risk factors as the recipients of health coaching. The specific objectives of this study were to provide a descriptive assessment of the characteristics of the patients, intervention characteristics (i.e., providers, duration, medium, and intervention components), and health behavioral changes as outcomes, and to estimate the pooled effect size for health coaching on behavioral modifications of physical activities, dietary behaviors, health responsibility, stress management, and smoking behaviors.

## 2. Methods

The present study was a systematic review and a meta-analysis following the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis)-P 2015 statement [22].

### 2.1. Search strategy

#### 2.1.1. Electronic database searches

The present meta-analysis was performed on the basis of the principle of search strategy referred to Cochrane handbook for systematic reviews of intervention [22]. To retrieve RCTs related to health coaching, health behaviors, and cardiovascular risk factors, a literature search was performed of the Cochrane, CINAHL, MEDLINE, PubMed, SCOPUS, Nursing & Allied Health databases, and KoreaMed for Korean-language articles from their respective years of inception until June 2018. Additional manual searches were performed using Google Scholar and reference lists of identified publications. 'Coaching,' which is equivalent to 'mentoring' as a MeSH (Medical Subject Headings) term, and other search terms were combined as described in Appendix A.

#### 2.1.2. PICO framework

The following PICO framework was constructed for the research questions: (1) the participants were adults older than or equal to18 years with cardiovascular risks, (2) the intervention was a health coaching program that provides coaching sessions for behavioral modification, (3) the comparison was performed with a usual-care group, and (4) the outcomes were specific cardiac health behaviors including physical activities, dietary behaviors, health responsibility, stress management, and smoking behaviors.

### 2.2. Inclusion and exclusion criteria

The studies included in this systematic review and meta-analysis met multiple inclusion criteria. Only RCTs reported on in English or Korean were included. Interventions were considered only if health coaching sessions were provided to adult populations with cardiovascular risks (e.g., hypertension, diabetes, obesity or overweight, or coronary disease). Other chronic disease

populations and nonadults (patients younger than 18 years) were excluded.

### 2.3. Assessment of risk of bias of included studies

Two reviewers independently assessed the risk of bias of all of the included studies according to the Cochrane Handbook for Systematic Reviews of Interventions [22]. The employed tool contained 10 items in the following five domains: selection bias (i.e., random sequence generation and allocation concealment), performance bias (i.e., blinding of participants and personnel, blinding of the care provider to the intervention, and co-interventions similarity), detection bias (i.e., blinding to the outcome assessment, group similarity at baseline, and timing of outcome assessment), attrition bias (i.e., incomplete outcome data), and reporting bias (i.e., selective reporting). Each parameter was graded as low, high, or unclear risk. The reviewers were required to provide justifications for their evaluation of each study, with this information being used subsequently in discussions between the reviewers about any discrepancies in the generated consensus grades.

### 2.4. Data extraction and analysis

All qualitative and quantitative data extraction was performed independently. The health coaching interventions in each of the included studies were summarized based on the following categories: setting, participants, duration, providers, intervention components, and the significance of the outcomes. Statistical data were collected from measurements of physical activity, dietary behaviors, health responsibilities, stress management, and smoking behaviors among studies that provided sufficient data for meta-analysis, using a standardized template generated in Microsoft Excel. The effect size and homogeneity of included studies were computed using CMA (Comprehensive Meta-Analysis) software (CMA v3, Biostat, Inc. USA). Mean values and standard deviations (SDs) of the pre-test and post-test values for each group, or mean differences and $p$ values within groups were collected to calculate the effect size of an intervention. Some parameters such as standard errors or confidence intervals (CIs) were converted to SDs using standard conversion formulae [23]. For continuous data, Hedges' $g$ and 95% CI were calculated to estimate mean differences between groups for included randomized studies.

In this meta-analysis, a fixed effect model or a random effect was applied to calculate the effect size based on homogeneity test ($I^2$). If $I^2$ values are less than 50%, the effects from different studies can be considered as homogenous and a fixed model was utilized. In the case of over 50% of $I^2$ statistic, a random effect model was utilized, in which studies are more equally weighted and the intervention effects are differently estimated [22].

## 3. Results

### 3.1. Study selection and assessment of risk of bias

The database searching identified 1424 potentially relevant references. After excluding duplicated studies and those not consistent with the inclusion and exclusion criteria, 15 RCTs were included in the present review and meta-analysis. The search and review processes are depicted in the flow diagram shown in Fig. 1. The risks of bias of the 15 RCTs were assessed independently by two reviewers according to the Cochrane criteria [22]. In case of disagreement, consensus was achieved after reconciling discrepancies. Three of the studies were rated as biased in four or more areas. As depicted in Fig. 2, blinding of the participants, blinding of the care providers, and outcome assessments were the most highly biased areas in the selected studies. Considering the characteristics of health coaching as a selected intervention, however, blinding of the participants and care providers was not applicable in most studies. After assessing biased areas in each study, all 15 studies were included in the analysis.

### 3.2. Characteristics of included studies

The 15 studies had aimed to determine the effects of health coaching on health behavioral modification in patients with cardiovascular risk factors. They were all original RCTs reported on between 2003 and 2018. Four of the studies have been included in previous review studies and a meta-analysis [24–27]. The study of Ruggiero et al. [25] had two ethnic groups within each intervention condition with their unique control groups; these were treated as separate studies in analysis. Eight studies were conducted in the USA [24,25,27–32], three were conducted in Australia [26,33,34], and the others were conducted in Germany [35], Netherlands [36], and China [37]. The participants were recruited from community or primary-care clinics, a university hospital, a community hospital, medical centers, a diabetes-mellitus education center, and a veteran-affairs medical center. There were various types of providers of health coaching interventions, but they were mostly trained or certified experts in health education. Medical assistants [25,28], health coaches [27,33,37,38], dietitians [31,35], peer coaches [36], health professionals [34], nurses [32], and health educators [29] were identified as coaching providers. One study employed team coaching involving two dietitians and four nurses [26].

The pooled sample size of the studies was 4254, with 2187 adult participants randomized to health coaching interventions and 2067 randomized to usual care as the controls. The sample size in each study varied from 49 [32] to 792 [26]. Nine of the studies involved patients with type 2 diabetes mellitus [24,25,27,28,31,32,35–37], while three studies involved patients with cardiovascular problems [26,29,34], and the other three involved patients who were obese or overweight [24,33,38]. The duration of the coaching interventions ranged from 1 to 12 months, with a mean of 6 months. More details about each health coaching intervention are provided in Table 1.

### 3.3. Components and medium of health coaching

In the health coaching interventions, the contacts for initial assessments, goal setting, or coaching [25,30–32,37], group education [32,36], or individual education [30] were often prearranged. A protein-rich meal-replacement diet was implemented for 12 weeks as a preliminary intervention in one study [35]. In the main coaching session, conversations were usually focused on assessing individual health behaviors, reinforcing the disease-related knowledge, and checking the present status of health management. During the coaching, motivational interviewing was employed in order to encourage participants to change or maintain their health behaviors. While most studies applied telephone calls for delivering health coaching, text messages [28,33] or face-to-face contact [25,27,30–32,37] were also used.

### 3.4. Control groups

Most of the studies included inactive control groups such as usual care, in which participants received face-to-face education, educational brochures, or newsletters about their disease. One study [33] set standard practice as the control, in which participants received text messages only, without other forms of contact or interaction. Another study [31] controlled the contact frequency by calling and interviewing participants at the same time as when those in the intervention group received coaching.

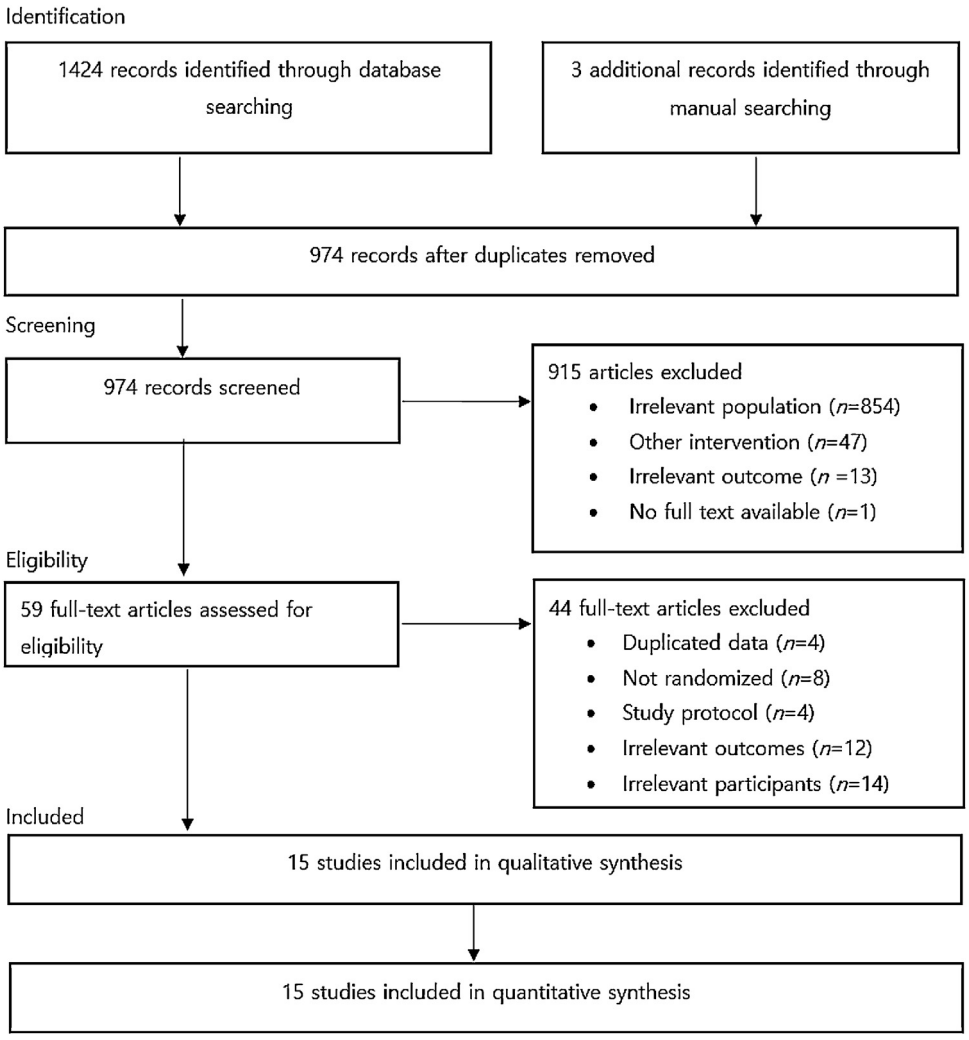



**Fig. 1.** Flow diagram of our literature search, which was in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines.

### 3.5. Study outcomes

#### 3.5.1. Physical activities

The effect of health coaching on physical activity was evaluated by analyzing 11 studies (Fig. 3A). The level of physical activity was measured by step counting [28], accelerometer score [33], sessions per week categorized into vigorous, moderate, moderate-vigorous, or walking [33,34], Summary of Diabetes Self-care Activities Questionnaire (SDSCA) [25], exercise [27,32,37], Physical Activity and Disability Scale [24], Patient Activation Measure [38], and activation score [27,36]. The pooled sample size was 1382 for the intervention groups and 1300 for the control groups. The studies showed moderate heterogeneity ($I^2$ = 17.54, $p$ = .27), supporting a fixed-effect model. Overall, health coaching showed a small but significant effect size for increasing physical activity (Hedges' $g$ = 0.16, 95% CI = 0.08 to 0.24, $p < .001$). The 'fail-safe $N$' was as large as 45, indicating a low risk of publication bias.

#### 3.5.2. Dietary behaviors

The effect size for health coaching on dietary behaviors was estimated by 9 studies (Fig. 3B). Again, the study of Ruggiero et al. was separated into two studies based on ethnic groups. Dietary behaviors were measured using the Fat Fiber Behavior Questionnaire [33], Three-factor Eating Questionnaire (TFEQ) [35], SDSCA [25], Healthy Eating Index 2010 [31], and Block 2005 Food Frequency Questionnaire [26,30]. The pooled sample size was 1216 for the intervention groups and 1117 for the control groups. The included studies did not show significant heterogeneity ($I^2$ = 0.00%, $p$ = .53), supporting a fixed-effect model. The 'fail-safe $N$' was 20, indicating a low risk of publication bias. The overall effect size for health coaching on dietary behaviors was small but significant (Hedges' $g$ = 0.14, 95% CI = 0.05 to 0.22, $p$ = .001).

#### 3.5.3. Health responsibility

Four studies were included to evaluate the effectiveness of health coaching on health responsibility such as medication adherence as measured by Morisky Adherence Scale [27] or the performance of diabetes-related self-care activities as measured by the SDSCA score [25,37]. The pooled sample size was 536 for the intervention groups and 454 for the control groups.

Due to the high heterogeneity ($I^2$ = 67.32%, $p$ = .01), a random-effects model was selected. Overall, there was a small but significant effect size for health coaching on improving health responsibilities from preintervention to postintervention (Hedges' $g$ = 0.29, 95% CI = 0.03 to 0.56, $p$ = .02) (Fig. 3C).

#### 3.5.4. Stress management

The effectiveness of health coaching on stress management was evaluated by analyzing five studies. Stress management was measured by a diabetes distress score [31,36], Problem Areas in Diabetes Survey [32], Perceived Stress Scale [27], and psychological distress (using the Kessler 10 scale) [37]. The pooled sample size

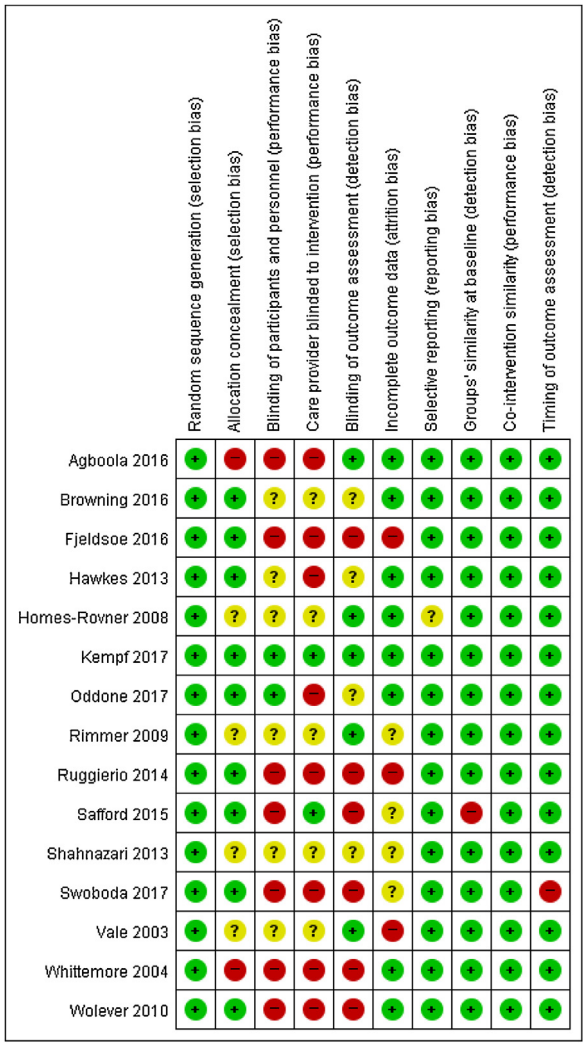



**Fig. 2.** Quality assessment of the included studies.

was 633 for the intervention groups and 554 for the control groups. The included studies did not show significant heterogeneity ($I^2$ = 0.00%, $p$ = .89), supporting a fixed-effect model, but the publication bias was high, as indicated by a 'fail-safe $N$' of 8. There was a small but significant effect size for health coaching on stress management (Hedges' $g$ = –0.21, 95% CI = –0.33 to –0.08, $p$ = .001) (Fig. 3D).

*3.5.5. Smoking behaviors*

Three studies were pooled for analyzing the effect of health coaching on smoking behaviors. Quantitative data were reported by percentages [26,34] and odds ratios for smoking cessation [29]. The pooled sample size was 838 for the intervention groups and 824 for the control groups. The lack of significant heterogeneity among the three studies ($I^2$ = 0.00%, $p$ = .43) supported a fixed-effect model. The small effect of health coaching on smoking behaviors was not statistically significant (SMD = –0.08, 95% CI = –0.25 to 0.08, $p$ = .32), as depicted in Fig. 3E.

## 4. Discussion and conclusion

### 4.1. Discussion

This study analyzed 15 RCTs that applied health coaching interventions with the aim of improving health behaviors among adults with cardiovascular risk factors. The present analysis of effect sizes included studies that applied health coaching to the following health behaviors: physical activities (11 studies), dietary behaviors (9 studies), health responsibility (4 studies), stress management (5 studies), and smoking behaviors (3 studies).

*4.1.1. Main findings from the systematic review*

Coaching interventions represent a significant shift of patient education strategies, from giving direct prescriptions to motivating people to perform health behaviors, while utilizing a wide range of health coaching strategies. The concept of health coaching was not clearly defined in the selected studies, which has been also criticized previously [4,5]. The common components of health coaching, however, were easily defined as including the initial assessment for goal setting, motivational interviewing, and collaboration with interdisciplinary teams as suggested in the previous review [20]. Health coaching classes were provided mostly by trained or certified experts in health education, but some studies also utilized peer coaches. Various types of providers were also included (i.e., physicians, nurses, fitness professionals, dietitians, behavioral psychologists, trained peers, health educators, medical assistants, and master-level coaches), but all of them were considered experts since they were either health professionals or had received appropriate training. Most of those professionals worked in interdisciplinary teams or in collaborations, while registered dietitians [31], trained dietetics students [30], and fitness professionals [24] provided health coaching. Olsen and Nesbitt [20] concluded that the involvement of primary health-care providers was one of the key features of effective health coaching programs [19]. The effect sizes for health coaching on behavioral modification tend to be larger when the coaching is delivered by trained coaches or medical experts [27,28,32,37], specifically for physical activity when coached by fitness professionals [24] or dietary behavior by dietitians [35]. Based on the studies with significant effects on behavioral modification, the optimal dosage of coaching was suggested as 30 or more sessions over a period from 6 months to 12 months. This result is consistent with previous reviews finding that health coaching interventions showed a positive effect after 3 weeks but not after 12 months [20,21].

The most common components of health coaching interventions were a combination of education enforcement and motivational interviewing, as summarized in Table 1. It is noticeable that telephone contact was the predominant coaching method, as also found in previous reviews [19], with face-to-face contact rarely being adopted as a coaching intervention. The length of the telephone calls was reported in several studies, and ranged from 15 to 30 min [25,27,29,30,35]. The overall number of coaching sessions via telephone calls or face-to-face contact also varied, from 2 to 33 sessions along with the use of text-message coaching (14 to 360 times). The use of telephone calls to deliver interventions may inhibit to the ability to develop relationships between health coaches and participants, yet this method might be an important foundation for facilitating the learning process [39,40]. It was not possible to compare the effectiveness between these two methods in the present study since only a few studies utilized each of two coaching methods only.

*4.1.2. Main findings from the meta-analysis*

The present meta-analysis revealed small but significant effect sizes for health coaching on individual health behaviors except for smoking behavior. The overall effect size of the 11 RCTs for physical activity was 0.16 ($p$ < .001). Previous meta-analysis with 27 randomized trials supported this finding, showing the small, significant effect size (SMD=0.27) to improve physical activity by health coaching among people aged 60 years or older [41]. The recent meta-analysis with 16 studies also found that behavioral counseling (including health coaching) has a small effect on

**Table 1**
Summary of reviewed studies on individuals with cardiovascular risks.

| First author and reference | Setting | Population (I/C) | Providers (duration/**dose**) | Description of intervention | Behavioral outcomes |
|---|---|---|---|---|---|
| Agboola [28] | Clinic center, USA | T2DM (64/62) | Drs, Nrs, psychologists, HEs, HCs, and SWs (6M/360TMs) | • Two automated text messages/day on health education, motivational coaching, and physical activity [from pool of 1000 text messages designed by physicians, nurses, behavioral psychologists, health educators, health coaches, and social workers regarding daily step counts (pedometer) and preset goals]<br>• Control: usual care | Step count by pedometer |
| Fjeldsoe [33] | New South Wales community, Australia | Obese and overweight (104/114) | Health coaches (6M/14∼50TMs +2CCs) | • Initial telephone call after GHS completion by a health coach<br>• GHSH text message regarding (1) weight monitoring, (2) goal check, (3) behavior check, and (4) goal reset<br>• A coaching telephone call at week 12<br>• Control: GHS (coaching message service without further contact) | Vigorous or moderate walking*; accelerometer score; intakes of vegetables, fruit, sweetened drinks, and takeaways; FFBQ total score*; and FFBQ fat fiber score* |
| Kempf [35] | Clinics or community, Germany | T2DM (102/100) | Trained diabetes coaches (3M/30PRMR servings+12CCs) | • PRMR intervention for 12 weeks<br>• Weekly telephone calls (20 min) on medical mental motivation techniques regarding (1) information about T2DM and medication, (2) Healthy diet and physical activity, (3) subjective possibility for lifestyle changes, and (4) discussion of self-checked step count and glucose level<br>• Control: Usual care | Eating behaviors* |
| Ruggiero [25] | Primary-care clinics, USA | T2DM (134/132) | Medical assistants (12M/4FFC +12CCs) | • Face-to-face coaching (30 min) at routine clinical visits (once every 3 months)<br>• Monthly telephone calls (15 min) regarding (1) follow-up self-care coaching, (2) answers patient questions, and (3) scheduling clinic visits<br>• Control: Usual care | General diet*, specific diet*, physical activity*, foot care*, and blood glucose testing* |
| Safford [36] | Communities, Alabama Black Belt, USA | T2DM (168/192) | Trained peer coaches (10M/1GE+18∼20CCs) | • Group education regarding diabetes mellitus basics, healthy eating, stress reduction, physical activity, social support, and getting the most from a clinical visit (60 min) plus counseling session and diabetes report<br>• Two initial contacts (45–60 min) through face-to-face contact or telephone call for getting to know each other, patient's diabetes mellitus report card, and selecting a personal goal<br>• Weekly telephone calls for 2 months and monthly telephone calls for the following 8 months<br>• Control: Usual care | Distress*, activation* |
| Swoboda [31] | Metropolitan area, Midwestern USA | T2DM (37/17) | Registered dietitian (4M/1FFC +7CCs) | • Face-to-face goal setting and decision coaching session for lifestyle changes<br>• Seven biweekly telephone coaching calls using motivational interviewing regarding (1) self-set goals (if needed, modify the goals) and (2) action plans for diet and physical activity<br>• Control: usual care | Diet*, stress* |
| Whittemore [32] | Diabetes mellitus education center, USA | T2DM women (26/23) | Nurse practitioners, internists, family practice specialists, and endocrinologists (6M/6FFC +2CCs) | • Six nurse coaching sessions according to the protocol of (1) assessment, (2) education reinforcement, (3) problem solving and motivational guidance (behavioral component), and (4) psychological support (affective component)<br>• Two brief telephone calls<br>• Control: usual care | Diet*, exercise, distress* |
| Wolever [27] | Medical outpatient center, USA | T2DM (30/26) | Master-level coaches (6M/1FFC +14CCs) | • Assessment visit and initial telephone call regarding (1) what is important to patients about diabetes care, (2) how well patients are managing their health, and (3) challenges to be supported<br>• Eight weekly telephone calls + four biweekly telephone calls + a final telephone call (30 min each) regarding (1) broken-down goals for realistic action steps and (2) patient medication adherence, diet, and exercise<br>• Control: usual care | Medication adherence*, activation* exercise*, stress* |
| Rimmer [24] | | Obese (African | Qualified fitness professionals (6M/24CCs) | • Weekly telephone consultations regarding (1) physical activity goals and specific exercises and | Physical activity* |

**Table 1** (*Continued*)

| First author and reference | Setting | Population (I/C) | Providers (duration/**dose**) | Description of intervention | Behavioral outcomes |
|---|---|---|---|---|---|
| | Medical outpatient center, USA | Americans) (61/31) | | activities based on the ability and interests of patients, (2) barriers (fears or challenges about being physically active), and (3) solutions and encouragement<br>• Control: usual care | |
| Shahnazari [30] | Veterans Affairs Medical Center, USA | Obese veterans (43/41) | Dietetics students (6M/1IE + 8FFC or 8CCs) | • Individual education (60 min)<br>• Nutrition coaching sessions (15 min) regarding (1) healthy eating habits and (2) decreasing the intakes of sugar, salt, meat, and other dietary components<br>• Control: Usual care | Intakes of energy*, fat*, sodium*, carbohydrates*, fiber, sugar*, protein*, and minerals*; servings of bread*, meat*, dairy products*, sweets*, vegetables, fruit, fiber, and whole grains |
| Vale [26] | University hospitals, Australia | CHD (398/394) | Two dietitians + four nurses (6M/1IE+4CCs) | • Initial contact for (1) explaining the program and (2) assessing CHD risk factors<br>• Three telephone calls at 6 week intervals + final telephone call at 24 weeks for (1) coaching the patient and obtaining CHD risk factors, and (2) education regarding targets and plans<br>• Control: usual care | Fat* and fiber intake, walking activity, and smoking |
| Homes-Rovner [29] | Community hospitals, USA | ACS (225/215) | Trained health educators (2M/6CCs) | • Six weekly telephone calls after discharge for health behaviors by using motivational interviewing (15–30 min each) regarding (1) identifying current behavioral problems and (2) setting goals<br>• Control: usual care (GAP QI) | Physical activity* and smoking |
| Hawkes [34] | Metropolitan hospitals, Australia | CHD (215/215) | Health coaches (highly trained health professionals) (6M/1IE +10CCs) | • Introductory session for (1) explaining the program and (2) assessing CHD risk factors<br>• Three weekly + three biweekly + four monthly sessions for (1) identifying any cardiac symptom changes, (2) assessment and health coaching on any CHD risk factors, (3) following up on progress toward achieving previous actions and goals, and (4) session review and scheduling next session<br>• Control: usual care | Sufficient activity*; intakes of vegetables*, fruit*, fat*, and sodium; and smoking* |
| Browning [37] | Primary health-care setting, China | T2DM (372/296) | Experienced clinicians (doctors, nurses, and psychologists) (12M/18 FFC +15CCs) | • Six face-to-face contacts and six telephone calls (first 3 months) + six face-to-face contacts and three telephone calls (next 3 months) + six face-to-face contacts and six telephone calls (last 6 months) using motivational interview for (1) explaining the program and (2) assessing CHD risk factors<br>• Control: usual care | General diet, specific diet*, blood glucose monitoring*, foot care*, exercise, and distress |
| Oddone [38] | Primary-care clinics, USA | Obese veterans (208/209) | Health coaches (1M/2CCs) | • Online health risk assessment (same as comparison group)<br>• Two telephone coaching calls using motivational interview regarding (1) developing a goal to reduce cardiovascular risk factors and (2) facilitating the understanding that patients have of their current risks and the effects of reducing risk factors for their health<br>• Control: usual care | Activity (at 1 month)<br>Participation in prevention program* |

Notes: I, intervention group; C, control group; Drs, doctors: Nrs, nurses; HEs, health educators; HCs, health coaches; SWs, social workers ; TMs, text messages; CCs, coaching calls; T2DM, type 2 diabetes mellitus; GHS, get healthy information and coaching service; GHSH, get healthy stay healthy; FFBQ, Fat and Fiber Behavior Index; PRMR, protein-rich meal replacement; FFC, face to face coaching; GE, group education; IE, individual education; CHD, coronary heart disease; ACS, acute coronary syndrome; GAP-QI, Guidelines Applied to Practice Quality Improvement.

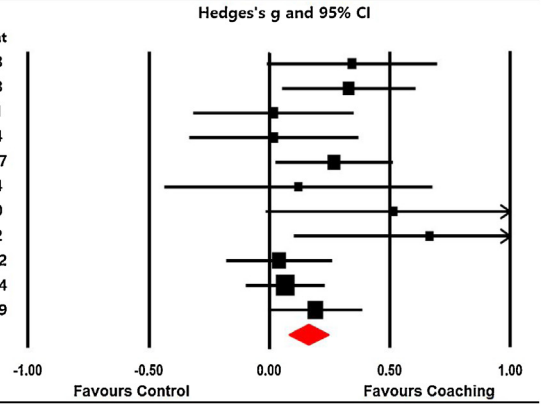
* Significant at $p<.05$.

increasing self-reported physical activity of adults with chronic musculoskeletal disease (SMD = 0.26) [42]. In six of 10 randomized studies included in a previous systematic review, adults with chronic disease significantly improved their physical activity compared to their counterparts after participating in health coaching [19].

We also found that health coaching had small but significant effect sizes for dietary behaviors (Hedges' $g = 0.14$, $p = .001$), health responsibility (Hedges' $g = 0.29$, $p = .02$), and stress management (Hedges' $g = -0.21$. $p < .001$). Only a few meta-analyses were available to explore the effects of health coaching on specific health behaviors, yet previous systematic reviews supported potential positive effects of health coaching on improving dietary behaviors, health responsibility [15,19,20], and stress management [20]. The pooled effect size of health coaching on smoking behaviors, however, was not significant in the present meta-analysis based on fixed effect model with 3 studies (SMD = –0.08, $p = 0.324$). Similarly, no review studies were found to confirm the effectiveness of health coaching on smoking behaviors, concluding unequivocal evidence on the effect of health coaching on smoking behaviors [15,19]. Further studies are required to determine the effect of health coaching on smoking behaviors.

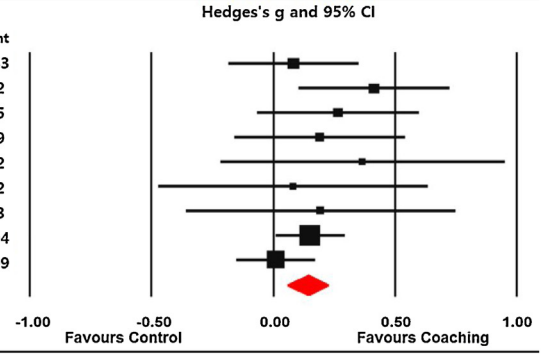
## A. Physical activities

| | Hedges's g | SE | LL | UL | p-value | Weight |
|---|---|---|---|---|---|---|
| Agboola2016 | 0.344 | 0.178 | -0.005 | 0.694 | 0.054 | 5.328 |
| Fjeldsoe2016 | 0.330 | 0.140 | 0.057 | 0.604 | 0.018 | 8.708 |
| AARuggiero2014 | 0.018 | 0.168 | -0.312 | 0.347 | 0.916 | 6.001 |
| LHRuggiero2014 | 0.019 | 0.177 | -0.328 | 0.367 | 0.914 | 5.404 |
| Safford2015 | 0.270 | 0.122 | 0.030 | 0.510 | 0.028 | 11.317 |
| Whittemore2004 | 0.121 | 0.282 | -0.431 | 0.674 | 0.667 | 2.134 |
| Wolever2010 | 0.516 | 0.269 | -0.010 | 1.043 | 0.055 | 2.350 |
| Rimmer2014 | 0.665 | 0.285 | 0.107 | 1.223 | 0.020 | 2.092 |
| Hawkes2013 | 0.042 | 0.111 | -0.175 | 0.259 | 0.706 | 13.862 |
| Browning2016 | 0.067 | 0.082 | -0.094 | 0.229 | 0.411 | 25.134 |
| Oddone2018 | 0.191 | 0.098 | -0.001 | 0.383 | 0.051 | 17.669 |
| Fixed effect model | 0.165 | 0.041 | 0.084 | 0.246 | 0.000 | |
| Heterogeniety | $I^2$=17.54%, $p$=.27 | | | | | |



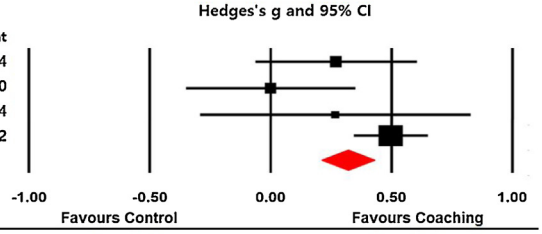

## B. Dietary behavior

| | Hedges's g | SE | LL | UL | p-value | Weight |
|---|---|---|---|---|---|---|
| Fjeldsoe2016 | 0.085 | 0.135 | -0.180 | 0.350 | 0.529 | 10.043 |
| Kempf2017 | 0.416 | 0.157 | 0.109 | 0.724 | 0.008 | 7.472 |
| AARuggiero2014 | 0.268 | 0.169 | -0.063 | 0.599 | 0.113 | 6.435 |
| HLRuggiero2014 | 0.192 | 0.178 | -0.156 | 0.541 | 0.279 | 5.819 |
| Swoboda2013 | 0.368 | 0.297 | -0.214 | 0.950 | 0.216 | 2.082 |
| Whittemore2004 | 0.084 | 0.282 | -0.469 | 0.636 | 0.767 | 2.312 |
| Shahnazari2012 | 0.195 | 0.281 | -0.356 | 0.746 | 0.487 | 2.323 |
| Vale2003 | 0.154 | 0.071 | 0.014 | 0.293 | 0.031 | 36.304 |
| Browning2016 | 0.013 | 0.082 | -0.148 | 0.174 | 0.874 | 27.209 |
| Fixed effect model | 0.142 | 0.043 | 0.058 | 0.225 | 0.001 | |
| Heterogeniety | $I^2$=0.00%, $p$=.53 | | | | | |



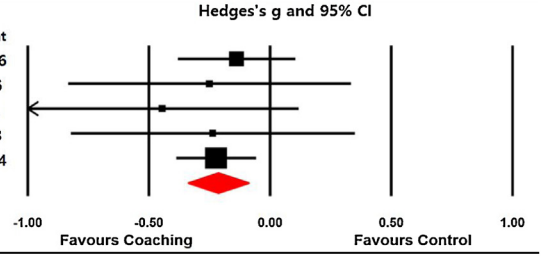

## C. Health responsibility

| | Hedges's g | SE | LL | UL | p-value | Weight |
|---|---|---|---|---|---|---|
| AARuggiero2014 | 0.270 | 0.169 | -0.061 | 0.601 | 0.110 | 25.034 |
| HLRuggiero2014 | 0.000 | 0.177 | -0.347 | 0.347 | 1.000 | 24.090 |
| Wolever2010 | 0.267 | 0.284 | -0.289 | 0.824 | 0.346 | 14.624 |
| Browning2016 | 0.525 | 0.077 | 0.374 | 0.675 | 0.000 | 36.252 |
| Fixed effect model | 0.297 | 0.135 | 0.032 | 0.562 | 0.028 | |
| Heterogeniety | $I^2$=67.32%, $p$=.01 | | | | | |




## D. Stress management

| | Hedges's g | SE | LL | UL | p-value | Weight |
|---|---|---|---|---|---|---|
| Safford2015 | -0.138 | 0.122 | -0.378 | 0.101 | 0.257 | 26.886 |
| Swoboda2013 | -0.251 | 0.296 | -0.830 | 0.329 | 0.397 | 4.576 |
| Whittemore2004 | -0.445 | 0.285 | -1.004 | 0.114 | 0.119 | 4.921 |
| Wolever2010 | -0.237 | 0.297 | -0.819 | 0.346 | 0.425 | 4.533 |
| Browning2016 | -0.223 | 0.082 | -0.384 | -0.062 | 0.007 | 59.084 |
| Fixed effect model | -0.213 | 0.063 | -0.337 | -0.089 | 0.001 | |
| Heterogeniety | $I^2$=0.00%, $p$=.89 | | | | | |




## E. Smoking behavior

| | SMD | SE | LL | UL | p-value | Weight |
|---|---|---|---|---|---|---|
| Hawkes2013 | -0.155 | 0.141 | -0.431 | 0.120 | 0.269 | -0.637 |
| Vale2003 | -0.071 | 0.110 | -0.286 | 0.144 | 0.520 | 0.193 |
| Homes-Rovner200 | 0.469 | 0.471 | -0.454 | 1.391 | 0.319 | 1.194 |
| Fixed effect model | -0.084 | 0.085 | -0.251 | 0.083 | 0.324 | |
| Heterogeniety | $I^2$=0.00%, $p$=.43 | | | | | |

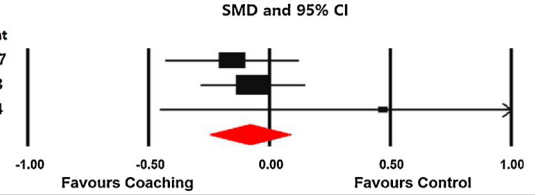



**Fig. 3.** Effect sizes for health coaching on behavioral modification.

#### 4.1.3. Limitations and strengths

Some limitations should be considered when interpreting the findings of the present study. First, only studies in English or Korean were included in the current systematic review, which may limit generalizability. Second, relatively few studies were available for estimating the effect sizes of health coaching on health responsibility and smoking behavior along with limitations in methodological quality, thus these findings should be considered suggestive, but not definitive. Finally, the problems of heterogeneity in the intervention and population among the included studies may has biased the results.

However, this review is the first comprehensive meta-analysis of health coaching on health behavioral outcomes for patients with cardiovascular risk factors. We followed rigorous systematic review procedures to analyze 15 RCTs, and so the present results might add valid evidence to the body of literature related to health coaching for CVDs and their risk factors.

### 4.2. Conclusion

This systematic review and meta-analysis showed that the core concept of health coaching consisting of motivational and education components can be effectively applied to individuals with cardiovascular risks for behavioral modification, while being provided in various forms and durations. The effectiveness of health coaching on improving the performance of physical activity, dietary behavior, health responsibility, and managing stress were found to be small but significant, providing evidence of the positive effects of motivational coaching on behavioral modification. However, the findings of this meta-analysis indicated that health coaching was not significantly effective in smoking cessation. Since few studies were available to analyze the effect of motivational coaching on smoking-related behavior, further studies are required to explore the underlying mechanisms of this specific behavior in order to develop effective strategies for behavioral modification in this population.

### 4.3. Practice implications

Motivational coaching reflects the shift of patient education strategies from giving direct prescriptions to motivating them to perform behavioral modification. Health care professionals should be aware that health coaching could provide effective motivation strategies to improve compliance of those who need to initiate and maintain their health behaviors. Health coaching could be easily delivered via simple methods such as telephone calls, text messages, or short-term face-to-face coaching. Given the global concern about cardiovascular risk factors, health coaching delivered by either expert or peer coaches over relatively short durations would be easily applicable in clinical settings for various populations in either rural or urban area.

## Declaration of Competing Interest

The authors have no conflicts of interest.

## Appendix A. Search terms applied to the electronic databases

| | |
|---|---|
| Search terms | (health coaching OR motivation coaching OR lifestyle intervention OR nurse coaching OR wellness coaching OR lifestyle coaching OR coaching OR health mentoring) AND (cardiovascular risk factors OR overweight OR obesity OR obese OR hyperglycemia OR hyperglycemia OR high blood sugar OR high blood glucose OR hyperlipidemia OR dyslipidemia OR hypercholesterolemia OR high cholesterol OR hypertension OR high blood pressure) AND (RCT OR randomized controlled trials OR randomized) NOT (children OR adolescent OR mental illness OR HIV OR pregnant) |

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