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Communication-related behavior change techniques used in face-to-face lifestyle interventions in primary care: A systematic review of the literature

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ABSTRACT

Objectives: To systematically review the literature on the relative effectiveness of face-to-face communication-related behavior change techniques (BCTs) provided in primary care by either physicians or nurses to intervene on patients' lifestyle behavior.

Methods: PubMed, EMBASE, PsychINFO, CINAHL and The Cochrane Library were searched for studies published before October 2010. Fifty studies were included and assessed on methodological quality. Results: Twenty-eight studies reported significantly favorable health outcomes following communica- tion-related BCTs. In these studies, 'behavioral counseling' was most frequently used (15 times), followed by motivational interviewing (eight times), education and advice (both seven times). Physicians and nurses seem equally capable of providing face-to-face communication-related BCTs in primary care. Conclusion: Behavioral counseling, motivational interviewing, education and advice all seem effective communication-related BCTs. However, BCTs were also found in less successful studies. Furthermore, based on existing literature, one primary care profession does not seem better equipped than the other to provide face-to-face communication-related BCTs.

Practice implications: There is evidence that behavioral counseling, motivational interviewing, education and advice can be used as effective communication-related BCTs by physicians and nurses. However, further research is needed to examine the underlying working mechanisms of

communication-related BCTs, and whether they meet the requirements of patients and primary care providers.

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INTRODUCTION

Patients' lifestyle behavior is significant for their physical and mental health. A healthy lifestyle (e.g. non smoking, minimal alcohol use, healthy diet and being physically active) can prevent or reduce the burden of chronic diseases such as type 2 diabetes, cardiovascular diseases, kidney diseases and chronic obstructive pulmonary disease (COPD) [1-3]. Regardless of the growing evidence of these preventive and therapeutic effects, the preva- lence of unhealthy lifestyle behaviors remains high. In the USA and many European countries the number of obese or overweight patients even increased in recent years [4] and tobacco dependen- cy and alcohol misuse continue to be major problems [5]. The high prevalence of unhealthy behaviors and chronic diseases has led to increased attention for a healthy lifestyle by governments around the world [6,7]. In the Netherlands for example, there is a renewed attention for the prevention of chronic diseases as stated in the prevention bill, aimed at reducing the incidence of smoking, alcohol abuse, obesity, type 2 diabetes and depression [8,9], by offering counseling to high risk patients in primary care. A general practitioner (GP) is the primary provider for patients at risk of developing lifestyle-related chronic illnesses. Interven- tions aimed at changing unhealthy lifestyles should therefore primarily take place in general practice [10]. In the UK, GPs have a contract since 1990 to promote health, which has encouraged a new structure of general practice, with practice nurses (PN) and nurse practitioners (NP) working alongside GPs [11]. Within the Dutch general practice this collaborative system is also common since 1999 [12]. This enables GPs in the UK, the Netherlands and other Western countries to delegate tasks, regarding patients with chronic diseases and their lifestyle, to practice nurses and nurse practitioners or assistants [12,13]. Nowadays, a PN is employed in about 80% of the general practices in the Netherlands [14]. Dutch patients with chronic diseases visit the PN more often than the GP (from 2% in 2003 to 39% in 2008), while the total number of general practice visits remains stable [15].

Yet, changing lifestyle behavior is difficult and requires effort, time and motivation from both health care provider and patient. Besides, patients are often ambivalent about behavior change [16,17]. Providing advice about behavior change to patients is a common approach used by health care providers, although previous studies show that the effectiveness of advice giving is uncertain [16,18]. Insight into effective behavior change techni- ques (BCTs) can help health care providers in primary care to contribute to a better lifestyle and improved health for patients and eventually reduce health care costs [17,19]. Michie and colleagues [20] listed 137 BCTs that are used by health care providers in daily practice or can be used as an intervention to change behavior, such as goal setting, screening and motivational interviewing. So far, it is not clear which of these face-to-face communication-related BCTs are most effective in changing a patient's unhealthy lifestyle behavior and which provider is more effective in using these face-to-face communication-related BCTs. Many studies in the field of lifestyle interventions focus on one single aspect of behavior such as smoking [21,22] or physical activity [22, 24], included studies are often a facu quality [25, 26] and interventions

activity [23,24]; included studies are often of low quality [25,26] and interventions are seldom theory based [20]. Many studies into BCTs do appear to be inspired by

theories, as for example Prochaska's and DiClemente's transtheoretical model, or Bandura's social cognitive theory [20].

Previous studies show that GPs and nurses (PN or NP) differ in their approach to patients and disease management; nurses spend more time on counseling patients than GPs and during the education and training of nurses there is more emphasis on patient education, lifestyle and disease prevention [27,29]. GPs, on the other hand, may traditionally be considered to have more authority to deliver care to patients. Nevertheless, several studies [27,30,31] suggest that care from GPs and nurses results in similar patient outcomes.

The current review study was set up to answer the following questions:

- 1. Which face-to-face communication-related behavior change techniques (BCTs) used in interventions are (most) effective for primary health care providers to intervene on patients' lifestyle behavior, i.e. smoking, alcohol, nutrition, weight and physical activity?
- 2. Which health care provider in primary care (physician or nurse) is more effective in using face-to-face communication-related BCTs?

2. METHODS

2.1. Inclusion criteria

A study was included in the review if (1) it concerned a randomized controlled trial (RCT) (2) the study was published in English, (3) the study population consisted of patients of 18 years or older, (4) the study focused on lifestyle communication about smoking behavior, alcohol use, nutrition intake (or diet/eating habits), weight or physical activity (exercise) and, in case of secondary prevention the following lifestyle related diseases: type II diabetes, COPD, asthma, cardiovascular disease, heart disease or kidney disease, (5) the population of professionals consisted of at least one health care provider (GP/physician, NP or PN) working within primary care, (6) the study included communication- related BCTs used in interventions by health care providers during individual face-to-face communication with the patient, (7) the study described outcomes on patient level regarding actual lifestyle behavior (self-reported or objective). 'Communication- related BCT' was defined as an interview technique delivered by one primary health care provider during face-toface communication with one patient. This technique is used to make patients aware of their lifestyle behavior and how to change or maintain this behavior. We included studies that aimed at primary prevention or/and secondary prevention following a diagnosis (see above criterion 4).

2.2. Search strategy

A computerized literature search was conducted to find studies that fulfilled all seven inclusion criteria. The following databases were searched in October 2010, without exclusions because of the date of publication or country: PubMed, EMBASE, PsychINFO, CINAHL and The Cochrane Library. Numerous keywords were used in combination in the search. The strategy was formulated in PubMed and adapted to the other databases (see Appendix A). From the selected search strategies; all references were extracted from the databases and imported in Reference Manager©; duplicates were removed.

2.3. Study selection

A total of 4397 non-duplicate references were found (see Fig. 1 for flowchart of the inclusion procedure and excluded studies). The first selection for inclusion was performed by two reviewers (JN and SvD) based upon title and abstract. Both reviewers checked

50% of the imported references on title and abstract. Studies were included if they met the above mentioned seven inclusion criteria. This resulted in 323 references. Thereafter, both reviewers checked each other's included references. Agreement between reviewers was high (90%). In case of doubt the full article was checked. In total 255 references were included after this first selection round.

In the second stage, the reviewers studied the full-text versions of the 255 articles to check the inclusion criteria. Six studies of the 255 could not be found in full text (neither in the Netherlands nor abroad). Ten percent of the 249 full text articles were studied by both reviewers (JN and SvD). Disagreements were resolved by discussion. Fifty-eight articles met all seven inclusion criteria and were therefore assessed on methodological quality. See Fig. 1 for information about the excluded studies.

2.4. Quality assessment

The methodological quality of the articles was assessed by two reviewers (JN and SvD) using the criteria list of the Cochrane Collaboration Back Review Group by Van Tulder et al. [32]. The list consists of the following 11 criteria (or questions) for internal validity (see Appendix B); (1) was the method of randomization adequate, (2) was the treatment allocation concealed, (3) were the groups similar at baseline regarding the most important prognostic indicators, (4) was the patient blinded to the intervention, (5) was the care provider blinded to the intervention, (6) was the outcome assessor blinded to the intervention, (7) were co-interventions avoided or similar, (8) was the compliance acceptable in all groups, (9) was the compliance acceptable in all groups, (9) was the compliance similar, and (11) did the analysis include an intention-to-treat analysis. Items could be scored as 'done', 'unclear' or 'not done'. All unclear scores were rated as 'not done'. Studies were considered of

'high quality' if at least five (instead of six) out of 11 criteria were scored as 'done'. This cut-off point is adjusted from Van Tulder et al. [32] and used because 'blinding' of health care providers in lifestyle interventions is often not (entirely) possible. Studies were considered of 'low quality' if they fulfilled less than five criteria. In case of doubt, the quality of the study was assessed after discussion between reviewers.

2.5. Multiple studies from the same dataset

We identified multiple articles from the same dataset, because these studies can cause a bias by affecting the results of the review more strongly [33]. Therefore, in line with previous research [34] we clustered studies from the same dataset together and referred to the first study (see Table 1).

[FIGURE 1 [TABLE 2]

2.6. Data extraction

Next, the following characteristics of each included study were described:

(First) author, year of publication, country where the study was conducted.
 Population/participants: number of patients, sex, age, primary/ secondary prevention, type of lifestyle behavior, number of health care providers and their profession.

- 3. Type of intervention(s).
- 4. Control group.
- 5. Study design.
- 6. If the intervention was based on a theoretical model.
- 7. Duration and frequency of the intervention(s).
- 8. Outcome measures and significant results.

9. Contribution of health care provider (GP/physician and/or nurse, alone or in combination with other health care providers).

Data were extracted from each article by two reviewers independently using a predefined data extraction form. These data were summarized in Tables 1 and 2. Findings on outcome

measures and significant effects for the effective studies are presented in Table 3.

2.7. Data synthesis

It was not possible to pool the data because of the different methods used to measure outcomes. Therefore, a 'Best Evidence Synthesis' was conducted based upon criteria developed by Van Tulder and colleagues [35] and adapted by Steultjens et al. [36]. This synthesis takes into account the design, quality and outcomes of studies. According to preset criteria (see Appendix C), the synthesis qualifies results from a sample of studies as 'evidence',

'moderate evidence', 'limited evidence', 'indicative findings' or 'no/ insufficient evidence'. At least one high quality RCT is necessary to establish some evidence for an intervention.

BCTs were considered as 'effective' if they provided enough evidence according to the 'Best Evidence Synthesis', taking into account the design (RCT), quality and significant positive outcomes of the studies.

3. RESULTS

In Table 1 an overview of the characteristics and quality of the 50 included studies (from 58 articles) is given.

[TABLE 2]

3.1. Included studies

3.1.1. Study characteristics

The publication year of the studies varied from 1991 [37] to 2010 [38–41]. Ten studies were carried out in the USA, eight studies in the UK, five in Australia, four in the Netherlands, in Denmark, and in Spain, three in New Zealand, Finland, and Italy, two in Canada and one in Thailand, Taiwan, Norway, and Sweden.

3.1.2. Methodology quality and design

The methodology quality assessment yielded 37 high quality studies and 13 studies with lower quality. The following criteria were most often disobeyed: blinding, allocation concealment and intention-to-treat analysis. All studies described randomized trials, either with a control (n = 39) or a comparison (n = 11) group (Table 1).

3.1.3. Population characteristics

Twenty-five of the studies focused on a participant's single lifestyle behavior; ten on physical activity [42–51], six on smoking behavior [37,40,52–56], six studies on alcohol [39,41,57–60], two on nutrition [61–63] and one study on weight [64]. The other twenty-five reported on several lifestyle behaviors; one on physical activity and nutrition [65], two studies on nutrition and weight [66,67], three studies on physical activity and weight [68–71], three on nutrition, physical activity and weight [72–74], two on smoking, physical activity and weight [75,76], two on smoking, physical activity and nutrition [77–81], three on smoking, weight, nutrition and physical activity [82–84], one on smoking, alcohol, weight and physical activity [85], four studies on smoking, alcohol, nutrition and physical activity [38,86-89]. Four studies reported on all lifestyle behaviors included for this study [90–94]. Most studies (n = 36) were aimed at primary prevention, seven focused on secondary prevention following a diagnosis and seven aimed at both primary- and secondary prevention (see Table 1). Of the studies aimed at secondary prevention, three described patients diagnosed with heart or vascular disease [77– 79,83,84], two reported on patients diagnosed with COPD [54,76] and two described patients with type II diabetes [82,88].

3.1.4. Theoretical basis

Twenty-three studies specified the theoretical basis of the intervention(s). Many interventions were based upon more than one theory. Prochaska's and DiClemente's transtheoretical model (TTM) or stages of change model was referred to as the theoretical idea behind interventions in twenty-one studies [37,39,40,42,46,47,49,51,54–56,61–63,65,69–71,73,80,81,83,88,89,93,94]. This model divides the process of behavioral change into five stages, from precontemplation to maintenance. In the articles, information on lifestyle behavior was adapted to a participant's readiness (stage of change) to adopt a new behavior. Eight studies [43,46,51,61,63,68,69,83] described an intervention based on Bandura's social learning theory or social cognitive theory (SCT). A central concept of this theory is self-efficacy. Self-efficacy is a person's sense of confidence in the ability to perform a particular behavior. Furthermore, one study [73] referred to Wagner's chronic disease care model. This model emphasizes the centrality of an informed activated patient within the care process. Another study [47] referred to the theory of planned behavior, which addresses attitudes and perceived behavioral control. Finally, the health belief model (HBM) was referred to [43]. This model uses perceived susceptibility, severity, benefits, barriers, cues to action and self-efficacy as constructs.

Six studies described which constructs of the theory were chosen and translated into BCTs [39,43,46,68,69,73]. For example, Grandes and colleagues [43] described for each BCT whether it was

based on the HBM model, SCT model or both. Seventeen studies were less explicit about the connection between theory and BCT [37,40,42,47,49,51,54–56,61–63,70,71,80,81,83,88,89,93,94].

3.1.5. Intervention characteristics and outcome measures

During the interventions, the face-to-face communication between patient and health care provider ranged from (seven studies with) one session [49,50,58,61,69–71,91] to (one study with) 15 sessions [83]. The number of face-to-face sessions does not include separate measurement sessions of biomedical or questionnaire data (only if part of the face-to-face BCT), telephone calls or written advice that were sometimes also part of the interventions. In three studies the frequency of the face-to- face communication sessions was not reported [44,82,88].

The face-to-face communication sessions lasted from 30 s [37,55] to 60 min [54–72,89]. Fourteen studies did not report the duration of the face-to-face sessions [40,44,46–48,65,70,75,76,82–84,88,90].

Most studies (n = 40) reported on both subjective (self- reported) and objective outcome measures. For example, Alterman and colleagues [52] described outcomes on cigarettes a day (subjective), carbon monoxide level and cotinine (objective measures). However, eight studies described self-reported out- comes only [44,48– 51,59,62,68,79,88] and two studies exclusively objective outcomes [64,92]. As described above, the intensity of interventions and BCTs (number of face-to-face sessions and duration of sessions) differed to a great extent. Therefore, we could not determine the impact of intensity on outcomes.

3.2. Face-to-face communication-related behavior change techniques

In Table 2 the BCTs of the studies are provided, together with significant outcomes and the contribution of the health care providers.

In about half of the studies (n = 27) more than one face-to-face communicationrelated BCT was used. These studies combined for example techniques such as advice and education [50,52,66,84,91] or goal setting, self-monitoring and motivational interviewing [42]. Twenty-three studies described single BCT, i.e. behavioral counseling or motivational interviewing or motivational message or patient-centered care (see Table 2). Hereby, a 'single' BCT refers to the label of the technique; i.e. a single technique could have more than one underlying working mechanism.

3.2.1. Effective face-to-face communication-related behavior change techniques

Twenty-eight of the 50 studies reported significant outcomes from the communication-related BCTs used in interventions. In principle, these BCTs were counted as effective. However, based on the principles of a 'Best Evidence Synthesis' twenty-six of the 28 studies provided some to moderate evidence for the BCT provided. This suggests that two studies [48, 91] provided only 'indicative

findings'. Therefore, the BCTs in these studies, namely 'behavioral counseling and education' [48] and 'patient-centered care, advice and education' [91], were not counted as effective. The 26 effective studies represent a wide range of outcome measures and significant effects (Table 3). For smoking behavior the outcome measures presented are self-reported smoking rates (i.e. cigarettes a day) [37,40,52,54,77,80,83,90] and biochemical measurement of carbon monoxide level [37,40,52,80]. With respect to alcohol use the studies present outcomes on self-reported alcohol use (i.e. drinks a day) [39,41,58,60,90] and blood alcohol concentration [39,41,58,60].

Outcome measures described on nutrition are self-reported diet behavior (e.g. fat, fiber, fruit, vegetable, calorie intake) [63,66,72,74,77,80,83,90] and measures as weight [66,80,92], body mass index [40,66,80,90] and waist circumference [72,74], among others. On physical activity behavior the presented outcome measures are self-reported physical activity level [43,44,46,49,70,72,74,77,80,83,90] and readiness for physical activity (self-efficacy) [49,51,69]. Studies also presented outcomes on blood pressure [46,66,80,90,92], lipid management [74,77] and quality of life [43,70,83], among others (see Table 3).

The effective studies were also aimed at different patient populations within the context of primary care. For example, three of the effective studies [58,63,74] were aimed at a (moderately) low income population, of which one study [63] specifically indicated that 'differences were maintained when analyses were restricted to participants with low incomes' (Table 3). Eighty-one percent (n = 21) of the effective studies were of high quality.

Table 4 shows the 26 effective face-to-face communication- related BCTs. Sixteen of these studies outlined single BCTs [39–41,46,49,51,58,60,62,63,69–

72,80,81,88,90,92] and ten studies described a combination of BCTs [37,43,44,52,54,55,66,68,74, 77–79,83]. 'Behavioral counseling' was most frequently used as an effective BCT (15 times out of 26), next to motivational interviewing (eight times out of 14), education (seven times out of 14) and advice (seven times out of 16). However, these results show that these techniques were also provided in less successful studies. These BCT were less successful because of the context of the study, as for example the design [56,75,84,86,94] or patient characteristics [47,64,65]. Although, all studies took place within the context of primary care and BCTs were always provided by a physician, nurse or both (in combination with other professionals, see Section 3.3). Besides, the less successful studies (19%). Feedback, risk-assessment, goal-setting, cognitive behavior therapy and selfmonitoring were less often provided, but also showed significant effects on patients' outcomes. The effective face-to-face communication-related BCTs did not focus exclusively on one particular lifestyle behavior (e.g. smoking).

[TABLE 4]

Sixteen of the 26 effective studies described their theoretical foundation [37,39,40,43,44,46,49,51,54,55,62,63,68–71,80,81,83,88], of which five studies [39,43,46,68,69] reported the chosen BCT constructs.

3.3. Contribution of health care providers

Table 2 shows the contribution of the different health care providers, both as providers of effective and less successful BCTs.

Five of the 26 effective communication-related BCTs in primary care were provided by physicians [44,49,66,69,88], eight by nurses [39,46,54,58,62,63,77–81,90] and five by both nurses and physi- cians [37,40,41,43,55,60,70,71]. In five studies the effective BCT was provided by physicians in combination with health educators [68], trained professionals [72], physical activity counselors [51], dieticians [92], or case managers [83]. In two studies the effective BCT was provided by nurses in combination with therapists [52], or nutritionists [74].

4. DISCUSSION AND CONCLUSION

4.1. Discussion

The present review shows that behavioral counseling, motivational interviewing, education and advice are most frequently evaluated as effective face-to-face communication-related BCTs. This overall conclusion could be drawn on the basis of finding relative many high quality studies in which communication- related BCTs prove to be effective. However, these techniques were also found in less successful studies due to differences in context, as design of the study and patient population, and to some extent the quality of the studies. Techniques such as feedback, riskassessment, goal-setting and cognitive behavior therapy seem to be less effective, although the number of studies on these techniques was rather small. Our findings are partly in line with other studies in the field of behavior change which suggest that simple advice is more effective to behavior change than intensive advice [95] and as effective as motivational interviewing [18]. However, other studies [24,26,96] suggest that advice and education are not effective, in contrast to more (intensive) patient-centered approaches. Our review did show that motivational interviewing (MI), which is considered a patient-centered approach [97], is also effective as BCT. Moreover, while MI is originally considered to be more a counseling style than a set of particular techniques [17], one can clearly describe MI as a set of techniques, containing the following elements: express empathy, develop discrepancy between present behavior and desired goals, avoid argumentation, roll with resistance and support self-efficacy [97,98]. In contrast, many of our included studies described the interventions and BCTs in general terms, like providing 'advice and education' or 'counseling sessions', which conceals underlying working mechanisms that may be crucial to the effectiveness of the BCT. In line with others, we recommend future authors to describe the content of their interventions and BCTs more precisely [26,99–101]. According to Davidson et al. [101] among others [99], published articles should therefore include: (a) the content or elements of the intervention, (b) the characteristics of those delivering the intervention, (c) the characteristics of the recipients, (d) the setting, (e) the mode of delivery (e.g. face-to-face), (f) the intensity (e.g. contact time), (g) the duration (e.g. number of sessions over a given period), and (h) adherence to delivery protocols. Michie et al. [20] plead for the use of theory-based interventions to understand the causal determinants of behavior change among other things. Our review demonstrates that no more than about half of the studies used a theory as basis for the intervention. However, sixteen out of the 26 effective studies described their

theoretical foundation. Yet, these interventions were mostly theory-inspired instead of theory-based, i.e. the authors seldom linked (aspects of) the theory to the BCT used. Hence, next to the guidelines presented by Davidson et al. [101] a published article should also describe the theoretical basis of the intervention and BCTs used to get insight into the underlying working mechanisms [99,100]. Furthermore, we imagine that other elements are also of importance to be routinely reported e.g. amount of training and supervision of professionals, follow-up contacts and implementation fidelity.

We also found that physicians, nurses or a combination of these (sometimes in combination with other professionals) can provide effective face-to-face communication-related BCTs in primary care. Within primary care one profession (physician) does not seem to be better than the other (nurse) in providing face-to-face communica- tion-related BCTs. However, we have to be cautious with this conclusion as we found only a few studies that included both physicians and nurses as health care providers. Since providing these BCTs can be time consuming for a single person or profession, an opportunity lies in dividing the workload or delegate certain tasks to another profession. Within this 'collaborative model of care' physicians provide care (e.g. provide diagnosis, screening, initiate treatment) and nurses deliver the counseling to patients (e.g. follow- up, support self-management) [55,102]. Therefore, proper task arrangements between physicians and nurses should be made. A recent study on cardiovascular prevention in the Netherlands did show that lifestyle intervention advice is in fact more frequently given by PNs than by GPs [28]. However, this study was based on self-reported information about lifestyle advice given, so we do not know if and how lifestyle is actually discussed in the consulting room. Future studies should therefore investigate how behavior change in lifestyle interventions is being discussed in the consulting room, both in quantity and content.

While population and public health approaches are widely used to change risk related to unhealthy lifestyle, governments more and more stress people's individual responsibility [103,104]. They claim that people can make their own decisions concerning lifestyle, although support and reliable information should be available to come to a conscious decision. This is fairly in line with the principle of motivational interviewing, which focuses on the motivation of patients to change behavior instead of health care providers telling them what to do. Depending on the patients' motivational 'stage of change' a health care provider can offer specific information and advice to help a patient overcome resistance toward behavior change [105]. The finding that goal setting does not seem to be an effective technique deserves further attention in this respect.

Lastly, this review demonstrates a lack of knowledge about face-to-face communication-related BCTs; there is a lack of theoretical foundation of interventions and BCTs, diversity in intensity of interventions and the content of techniques. Besides, we do not know whether every BCT is actually applicable within primary care and for every patient. Although Abraham and Michie [99] provide a crucial first step by presenting a taxonomy of BCTs, as far as we know this taxonomy has not yet been used in interventions within behavior change research and techniques were only identified for HIV/AIDS, physical activity and healthy eating.

4.1.1. Strengths and limitations

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This is the first review, to our knowledge, that examines physicians' and nurses' (working within primary care) provision of face-to-face communication-related BCTs to patients. Another strength of this review is that we only included studies with rigorous design (RCTs) that reported effects on actual patient behavior. Besides, our results were not dominated by large numbers of studies on a particular lifestyle behavior (e.g. smoking behavior); all lifestyle behaviors were addressed in relation to the (effective) BCTs. In addition, we specifically choose 'face-to-face' as form of delivery to avoid confounding with other modes of delivery. Some limitations should also be noted. First, while we made an effort to create a thorough search strategy, it is possible that we failed to include all studies in this area due to publication bias and excluding non-English language studies. Second, in our quality assessment we relied on the methodology information that was reported in the articles. When information was missing we scored the item as 'unclear', without verifying this by contacting the authors of the sometimes relatively 'old' articles. When an article referred to another (not included) article for methodological information, we did, however, base our quality assessment on all available methodological information described in both articles. In addition, it is possible that the large amount of 'high quality' studies in this review is due to our small adjustment of the number of quality criteria. Third, as mentioned before, the content of the interventions and BCTs were not always sufficiently described. Therefore, we could not report the underlying working mechaisms that may be critical to the effectiveness of the face-to-face communication-related BCTs. Also, this general description of the BCTs may suggest that when a technique is labeled as for example 'behavioral counseling' the content is always the same, while the technique could mean different things in different studies. Furthermore, we do not know whether the health care providers in the included studies delivered the face-to-face communication-related BCTs in a suitable and intended way, since this was not described. Besides, it was difficult to compare studies because of the different outcome measures they presented. However, it is still possible that some behaviors are more sensitive to BCTs than others. Lastly, although we only included studies with 'face-to-face' as form of delivery, it is possible that other elements of the intervention, for example providing medication or the intensity and duration of the intervention, also contributed to the outcomes of the BCT.

4.2. Conclusion

This review demonstrates that behavioral counseling, motivational interviewing, education and advice are all evaluated as effective communication-related BCTs. However, these BCTs were also found in less successful studies due to differences in context, as design of the study or patient population, and to some extent quality of the studies. Furthermore, based on existing literature, one primary care profession (physician) does not seem better equipped than the other (nurse) to provide face-to-face communication-related BCTs.

4.3. Practice implications

There is some evidence that behavioral counseling, motiva- tional interviewing, education and advice can be used as effective communication-related BCTs by physicians and nurses. However, further research is needed to examine the underlying working mechanisms of communication-related BCTs, and whether they

meet the requirements of patients and primary care providers. Observing real-life consultations between primary care professionals and patients can provide a first insight into the content and mechanisms of the communication-related BCT, used to intervene on patients' lifestyle behavior.

Conflict of interest

The authors declare that they have no competing interests.

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Appendix A. Search Strategy PubMed

Search Strategy PubMed dd. 11-10-2010

Search	Search terms	Results
#1	"Life Style" [Majr] OR "lifestyle" [tiab] OR "healthy behavior" [tiab] OR "healthy behaviour" [tiab] OR "health behavior" [tiab] OR "health behaviour" [tiab] OR "unhealthy behavior" [tiab] OR "unhealthy behaviour" [tiab] OR "behavior change" [tiab] OR "behavior change" [tiab] OR smoking [tiab] OR alcohol [tiab] OR nutrition [tiab] OR "eating habits" [tiab] OR "physical activity" OR "Exercise" [Majr] OR exercise [tiab] OR "Alcohol Drinking" [Majr] OR	545,534
#2	"Communication" [Majr] OR "Communication" [tiab] OR "advice" [tiab] OR "Health Education" [Mesh] OR "health education" [tiab] OR "Counseling" [Mesh] OR "counseling" [tiab] OR "Health Promotion" [Mesh] OR "health promotion" [tiab] OR intervention [tiab] OR prevention [tiab]	887,763
#3	"Primary Health Care" [Mesh] OR "primary care" [tiab] OR "Primary Nursing Care" [Mesh] OR "Physicians, Family" [Mesh] OR "family physician" [tiab] OR "family physicians" [tiab] OR "general practitioner" [tiab] OR "general practitioners" [tiab] OR "primary physician" [tiab] OR "primary physicians" [tiab] OR "family doctor" [tiab] OR "family doctors" [tiab] OR "practice nurse" [tiab] OR "practice nurses" [tiab] OR "Nurse Practitioners" [Mesh] OR "Nurse Practitioner" [tiab] OR "prurse practitioners" [tiab]	144,152
#4	"HIV"[Mesh] OR "Neoplasms"[Mesh] OR "cancer"[tiab] OR "Mental Health"[Mesh] OR "Review" [Publication Type]	3,653,987
#5	#1 AND #2 AND #3 NOT #4	3856

Tiab, title and abstract; Majr, major mesh term; Mesh, mesh term. Search #5 was selected and 3856 references were included in the original literature list.

Appendix B. Operationalization of criteria for assessment of methodological quality [32]

Validity criteria (yes, no, unclear):

- 1. Was the method of randomization adequate?1
- 2. Was the treatment allocation concealed?

3. Were the groups similar at baseline regarding the most important prognostic indicators?

- 4. Was the patient blinded to the intervention?
- 5. Was the care provider blinded to the intervention?
- 6. Was the outcome assessor blinded to the intervention?
- 7. Were co-interventions avoided or similar?
- 8. Was the compliance acceptable in all groups?
- 9. Was the drop out rate described and acceptable?
- 10. Was the timing of the outcome assessment in all groups similar?
- 11. Did the analysis include an intention-to-treat analysis?

Methodological quality:

High quality: the study adequately fulfilled 50% or more of the validity criteria (6 or more out of 11 criteria).

Low quality: the study fulfilled less than 50% of the validity criteria (<6 out of 11 criteria).

Operationalization of the criteria list

- 1. Was the method of randomization adequate, e.g. at patient level? Examples of adequate methods are computer generated random number table and use of sealed opaque envelopes. Score yes if the above is the case. Score no if a transparent system is used and score do not know when the method of randomization is not described in the article.
- 2. Was the assignment generated by an independent person not responsible for determining the eligibility of the patients? This person has no information about the persons included in the study and has no influence on the assignment sequence or on the decision about the eligibility of the patients. Score yes when the assignment has been taken place by an independent person. Score no if the above is not the case and score do not know if no information is given about who generated the assignment.
- 3. Are important prognostic indicators assessed at baseline? Are there no substantial differences between the intervention group and the control group (for example regarding age, sex, type of cancer, duration of the disease, stadium of the disease, cognitive status and type of treatment). Score yes if the above is the case and score no if there are differences regarding the prognostic indicators at baseline that could undermine post intervention differences. Score also no if no testing has been done to check if there were actual differences (a table with prognostic indicators without explanation is

not enough). Score do not know when no information had been given about prognostic indicators.

- 4. Was the patient blinded to the intervention? The reviewer determines if enough information is given in order to score a
- 5. 'yes'. Score do not know if no information is given.
- 6. Was the care provider blinded to the intervention? The reviewer determines if enough information is given in order to score a 'yes'. Score do not know if no information is given.
- 7. Was the outcome assessor blinded to the intervention? The reviewer determines if enough information is given in order to score a 'yes'. Score do not know if no information is given.
- 8. Were co-interventions avoided in the design or were they similar between the intervention groups and control group? Score yes if the above is the case. Score no if there were co- interventions, not similar for the different groups. Score also no when no information has been given about co interventions (so, not tested is also no). Note. This criterion cannot be decisive in determining low quality of an article.
- 9. Was the compliance rate among patients evaluated (e.g. did they view the received video or read the written material)?
- 10. Score yes if the percentage of patients that used the
- 11. intervention is above 70% in all groups. Score no if this percentage is below 70% and score do not know if no information about compliance has been given.
- 12. Is the number of patients described (and reasons given) that were included in the study but did not complete the intervention or were excluded from analysis? Is this percent- age of withdrawals or drop-outs acceptable? Score yes if there is information from 80 to 100% of the randomized patients about the outcome assessment of recall. Score no if there is information from less than 80% of the randomized patients and score do not know if no information about withdrawals or drop-outs has been given.
- 13. Was the timing of the outcome assessment in all groups similar? Score yes if the above is the case (score also yes if a range is described, provided that this range does not have a large spread, for example more than three months). Score no if the timing of outcome assessment was not similar for all groups and score do not know if no information about the timing was given.
- 14. Was all available data included for analysis (intention to treat)?
- 15. This means that all randomized patients were analyzed in the group they were assigned to regardless of noncompliance and co-interventions. Score yes if the above is the case, score no when the analysis did not include an intention to treat analysis. Score do not know if no information about intention to treat is given.

Appendix C. Principles of the best evidence synthesis [36]

Evidence: Provided by consistent, statistically significant findings in outcome measures in at least two high quality RCTs.

Moderate evidence: Provided by consistent, statistically significant findings in outcome measures in at least one high quality RCT and at least one moderate or low quality RCT.

Limited evidence: Provided by statistically significant findings in outcome measures in at least one high quality RCT.

Indicative findings: Provided by statistically significant findings in outcome measures in at least one moderate or low quality RCT (in the absence of high quality RCTs) No/insufficient evidence: If the number of studies that have significant findings is less than 50% of the total number of studies found within the same category of methodological quality and study design.

Or

In case the results of eligible studies do not meet the criteria for one of the above stated levels of evidence.

Or

In case of conflicting (statistically significantly positive and statistically significantly negative) results among RCTs.

Or

In case of no eligible studies.

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TABLES

Fig. 1. Flowchart of the inclusion procedure.



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No.	Study; country; quality; design	Population (patients)	Health care providers	Intervention group(s)	Control group	Type of lifestyle	Primary/secondary prevention or both ^a
	Aalto et al. [57]; Finland; high quality; RCT	118 Early-phase heavy drinkers; no men; aged between 20 and 60 years	41 General practitioners (GPs) and 15 nurses from five practices	(1) Seven brief sessions by GP and nurse consisting of FRAMES ingredients and self help booklet, (2) three brief sessions by GP consisting of FRAMES ingredients and self help booklet	Advised to reduce drinking at baseline and contact GP in case of health problem	Alcohol	Primary prevention
	Alterman et al. [52]; USA; high quality; RCT	240 Smokers, who smoked at least one pack of cigarettes daily; 51.2% men in intervention group1, 55% men in intervention group24 C42% men in intervention group3; aged between 21 and 65 years	3 Nurse practitioners (NPs)	(1) Low intensity: 8 weeks of NRT, 1 advice and education (A&E) session with NP, (2) middle intensity: NRT and 4 A&E sessions with NP, (3) high intensity: NRT, 4 A&E sessions with NP, 12 weeks of individualized comitive behavioral therapy	-	Smoking	Primary prevention
	Anderson et al. [68]; USA; high quality; RCT	874 Inactive patients; 54.8% men; aged between 35 and 75 years, free of serious chronic disease, and not found to have apparent ischemia on a	Physicians and health educators from 11 practices	 Advice only, (2) advice plus behavioral counseling, (3) advice plus behavioral counseling including telephone contact and behavioral 	-	Physical activity, weight	Primary prevention
	Armit et al. [42]; Australia; high quality; RCT	screening readmint test. 136 Inactive patients; 40% men; aged between 50 and 70 years	10 GPs and 3 exercise scientists (ES) from 2 practices	(1) GP group: received brief verbal and written advice, (2) GP +ES group; also received behavior change advice from an ES and follow up calls, (3) GP + ES +P group; also received a pedometer, Counseling was based on end exting a fird ponticing and MI	-	Physical activity	Primary preventior
	Aveyard et al. [53]; UK; high quality; RCT	925 Smokers; 47.3% men in basic support group, 49.8% men in weekly support group; age 18 years or above	Practice nurses (PNs) from 26 practices	get acting, services and the set of the set	-	Smoking	Primary prevention
	Beckham [58]; USA; lower quality; RCT	29 Hazardous drinkers in a low- income rural area; 46,4% men; aged 18 years or older	NP	One MI session with the NP (45-60 min)	No intervention	Alcohol	Primary prevention
	Beich et al. [59]; Denmark; high quality; RCT	906 Risky drinkers; 65.4% men in intervention group, 68.5% men in control group; aged between 18 and 64 years	39 GPs	Brief counseling consisting of FRAMES ingredients: based on the 'drink-less' protocol (WHO collaborative study 2001)	No intervention	Alcohol	Primary prevention
	Beresford et al. [61]; USA; high quality; RCT	2111 Patients; 31% men in intervention group, 33% men in control group; age 18 years or above	Physicians from 28 practices (1– 3 from each practice)	Self-help booklet and a brief motivational message	No intervention	Nutrition	Primary prevention
	Bo et al. [72]; Italy; high quality; RCT	375 Dysmetabolic patients; 41.4% men in intervention group, 42.2% men in control group; aged between 45 and 64 years	6 Physicians and 8 trained professionals (nutritionists, specialists in endocrinology, and internal medicine).	Detailed verbal and written individualized recommendations from trained professionals, 5 sessions (minimal 60 min), the first a one-to- one meeting, followed by group sessions based on behavioral courseling and focusing on practical lifetuited in the second second second second lifetuited in the second	Standard one time unstructured information given by the physician	Nutrition, physical activity, weight	Primary prevention
)	Bolognesi et al. [69]; Italy; lower quality; RCT	96 Overweight or (severely) obese patients; 46.9% men; age between 21 and 70 years	8 GPs	Counseling (15 min) with PACE protocol based on stage of change of the patient	Usual care by GP (15 min per visit)	Physical activity, weight	Primary prevention
	Burton et al. [86]; USA; lower quality; RCT	4195 Patients; 37.3% men in intervention group, 34.5% men in control group: aged 65 years or older	Physicians from 119 practices/ clinics	Yearly preventive visits (2 years) and optional counseling visits	Mailed a pamphlet describing good health practices	Smoking, alcohol, physical activity	Primary prevention
	Campbell et al. [77]; UK; high quality; RCT	1343 Coronary patients, without terminal illness or dementia and not housebound; 58,2% men, age under 80 years (mean age 66 years).	19 Clinics with 28 nurses (PN, district nurse, health visitors) and GPs	Advice, education, feedback, goal- setting: Symptoms and treatment of coronary heart disease reviewed, use of aspirin promoted, lifestyle assessed, blood pressure and lipid management reviewed. Follow-up: according to clinical circumstances	Usual care by GP	Smoking, physical activity, nutrition	Secondary prevention
	Efraimsson et al. [54]; Sweden; high quality; RCT	52 Patients with COPD; 50% men; mean age in intervention group 66 years, mean age in control group 67 years	1 Nurse from a primary care dinic	Standard care and two visits to a nurse specialized in COPD care for self-care education (1 h per session), based on motivational dialog and	Usual care (2 visits with 3–5 month interval)	Smoking	Secon dary prevention
	Elley et al. [70]; New Zealand; high quality; RCT	878 Sedentary patients; 33% men in intervention group, 34% men in control group; aged between 40 and 79 years	117 GPs and PNs from 42 practices and exercise specialists (ES)	Califore to patient GPs or PNs were prompted by patient to give oral and written advice on physical activity during usual consultations ('Green prescription programme', induding MI). ES continued support by telephone and	Usual care by GP	Physical activity, weight	Primary and secondary prevention
	Grandes et al. [43]; Spain; high quality; RCT	4317 Sedentary patients; 33.1% men in intervention group, 35.8% men in control group; aged between 20 and 80 years	56 Physicians from 11 practices	post Advice about physical activity and a physical activity prescription (goal setting) to the patients that attended an additional appointment, including self-monitoring	Usual care by GP	Physical activity	Primary prevention
	Hollis et al. [37]; USA; high quality; RCT	3161 Smokers; 38.4% men in control group, 40.2% men in intervention group1, 44.1% men in intervention group2, 41.4% in intervention	40 Physicians and nurse health counselors	Patient counseling; (1) self-quit training assisted by nurse, (2) recruitment to a group program assisted by nurse, (3) combination isoster pursely as a second by the sec	30-s GP advice message and a brief pamphlet	Smoking	Primary prevention
	Hollis et al. [55]; USA; high quality; RCT	groups; age between 18 and 70 years See Hollis et al. [37]	42 Physicians, 7 physician assistants, 11 NPs and nurse health	See Hollis et al. [37]	See Hollis et al. [37]	See Hollis et al. [37]	See Hollis et al. [37]
	Kastarinen et al. [90]; Finland; high quality; RCT	715 Hypertension patients (systolic blood pressure 140–179 mmHG and/ or diastolic blood pressure 90– 109 mmHG or antihypertensive drug treatment); 48% men in intervention group, 46% men in control group; aged between 25 and 74 years	counselors Nurses from 10 practices	Systematic health counseling given by nurses for 2 years: targeting weight, sait, alcohol and saturated fat consumption reduction, increase in physical activity.	Usual care by GP and nurse	Weight, nutrition, physical activity, smoking, alcohol	Primary prevention
	Kerse et al. [44]; Australia; high quality; RCT Kerse et al. [71];	267 Patients; 44% men in intervention group, 48% men in control group; aged 65 years or older 270 Sedentary patients; 37% men;	42 GPs See Elley et al. [70]	Health promotion advice based on an educational programme, including feedback See Elley et al. [70]	Usual care by GP See Elley et al. [70]	Physical activity See Elley et al. [70]	Primary prevention See Elley et al. [70]
	New Zealand; high quality; RCT Ketola et al. [75])	age 65 years or older	5 CBe 5 purses 1	Seen by CD and purse at baseling.	Standard care and -	Weight emoking	Primary and
,	Retota et al. [75]; Finland; lower quality; RCT	Lov Fatents wim existing cardiovascular disease or multiple risk factors; 48% men; aged between 33 and 65 years	o Grs, o nurses, 1 dietician, 1 physiotherapist	seen by GP and nurse at baseline, 6, 12 and 24 months over two years. Programme tailored to patient according to the risk factor status and needs. This could include booklets of healthy lifesple habits, individual dietary counseling by a nurse or a dietician, joining a weight reduction group, and physiotherapy programme	standard care and a booklet on healthy lifestyle habits	weignt, smoking, physical activity	rnmary and secondary prevention

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Table 1 ((Continued)						
No.	Study; country; quality; design	Population (patients)	Health care providers	Intervention group(s)	Control group	Type of lifestyle	Primary/secondary prevention or both ^a
20	Kinmonth et al. [82]; UK; high quality; RCT	360 Diabetic patients; 59% men in intervention group, 60% men in control group; age between 30 and 70 years	43 GPs and 64 PNs from 41 practices	Routine care plus additional training of doctors and nurses, based on patient-centered care and a patient held booklet encoursaing questione	Usual care by GP and nurse	Weight, nutrition, physical activity, smoking	Secondary prevention
21	Koelewijn-van Loon et al. [87]; Netherlands; high quality; RCT	615 Patients with risk at cardiovascular disease; 45% men; age 18 years or above (mean age 57 years)	24 PNs and GPs from 25 practices	Nurse-led cardiovascular risk management, including risk assessment, risk communication, a decision aid and adapted motivational interviewing	Minimal nurse-led intervention	Smoking, alcohol, nutrition, physical activity	Primary and secondary prevention
-	Koelewijn-van Loon et al. [38]; Netherlands; high	See Koelewijn-van Loon et al. [87]	See Koelewijn-van Loon et al. [87]	See Koelewijn-van Loon et al. [87]	See Koelewijn-van Loon et al. [87]	See Koelewijn-van Loon et al. [87]	See Koelewijn-van Loon et al. [87]
22	quality; RCT Lancaster et al. [56]; UK; high quality; RCT	497 Smokers; 44.6% men in intervention group1, 51.6% men in intervention group2; aged 18 years or above	GPs and PNs from 6 practices	 Brief verbal or written advice from a GP plus extended counseling and follow-up from a trained PN, (2) brief advice from a GP alone 	-	Smoking	Primary prevention
23	Lauritzen et al. [91]; Denmark; lower quality; RCT	1507 Patients; 48.7% men; aged between 30 and 49 years	9 GPs from 4 practices	(1) Group having questionnaires, a broad health test with written advice followed by a normal 10–15min consultation on demand, (2) same as intervention group 1, but with a planned 45min patient-centered consultation	Control group answering questionnaires	Smoking, weight, alcohol, nutrition, physical activity	Primary prevention
24	Lawton et al. [45]; New Zealand; high quality; RCT	1089 Physical inactive patients; no men; aged between 40 and 74 years	GPs and PNs from 17 practices	The green prescription': briefly counsel (7–13 min) patients using MI techniques to increase physical activity, six month follow-up visit and monthly telephone support over	Usual care by GP and PN	Physical activity	Primary prevention
25	Lear et al. [83]; Canada; high quality; RCT	302 Patients with ischemic heart disease; 83% men in intervention group, 82% men in control group; mean age 64.8 year in intervention group, mean age 63.4 year in control group	Physicians and case manager (dietician or exercise specialist if necessary)	nine months Exercise sessions, telephone follow- ups, lifestyle and risk factor counseling sessions, and reports to the participants' family physicians	Usual care by GP	Physical activity, nutrition, weight, smoking	Secondary prevention
26	Lee et al. [46]; Taiwan; high quality; RCT	202 Patients with mild to moderate hypertension; 62.7% men in intervention group, 54% men in control group; aged 60 years and over	Public health nurse and doctors	Six-month community-based walking intervention based on self- efficacy theory, nurse provided both face-to-face and telephone behavioral support designed to assist	Usual care by GP and/or nurse	Physical activity	Primary prevention
27	Little et al. [47]; UK: high quality; RCT	152 Sedentary patients with risk at cardiovascular disease; 45.6% men in intervention group 1, 41.4% men in intervention group 2, 46.5% men in intervention group 3, 44.3% men in control groups; aged 18 years or older	GPs and PNs from 4 practices	participants to increase their walking (1) Exercise prescription: GPS briefly discussed the benefits of exercise, targets, how to start, anticipating relapse, wrote a prescription for 30 min, 5 times a week of brisk walking, (2) counseling session: nurses discussed the same issues as with exercise prescription, a detailed motivational discussion, identifying a precise time and place to start, and agreed and signed a contrart, (3) booklet: the health education authority booklet Garting active, feeling fit was used	Control group for each intervention (no GP vs. GP, no nurse vs. nurse, no booklet vs. booldet or combination of interventions)	Physical activity	Primary prevention
28	Logue et al. [73]; USA; high quality; RCT	665 Obese or overweight patients; 338 men in intervention group 1,30% men in intervention group?; aged between 40 and 69 years	Physicians from 15 practices, dietician and weight loss advisor	(1) AUC: dietary and exercise advice, prescriptions, and three 24-h dietary recalls every 6 months, (2) TM-CD: included AUC elements plus "stage of change" (SOC) assessments for five target behaviors every other month, mailed SOC; target behavior- matched workbooks, monthly telephone calls from a weight-loss	-	Weight, physical activity, nutrition	Primary prevent
29	McManus et al. [85]; UK; high quality; RCT	400 Patients; 47% men, age between 35 and 75 years	GPs and PNs	advisor. Patients used electronic blood pressure machines(self-monitoring), received card with blood pressure target and advice to visit GP or PN if	Information sheet on self help measures to lower blood pressure	Smoking, alcohol, physical activity, weight	Primary prevent
30	Munoz et al. [84]; Spain; lower quality; RCT	983 Coronary patients; 75% men; age between 30 and 75 years	23 Practices with more than 200 GPs	pressure was above target (feedback) GPs followed guidelines on cardiovascular prevention, recommend healthy lifestyle, measuring blood pressure, weight,	Usual care by GP	Smoking, physical activity, nutrition (Mediterranean diet), weight	Secondary prevention
-	Murchie et al. [78]; UK; high quality; RCT	See Campbell et al. [77]	See Campbell et al. [77]	adjusting treatment and medication See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et [77]
-	Murchie et al. [79]; UK; high quality; RCT	See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et al. [77]	See Campbell et [77]
31	Noknoy et al. [39]; Thailand; high quality; RCT	117 Hazardous drinkers; 91% male; age between 18 and 65 years	Nurses in 8 practices	Three 15 min counseling sessions: motivation to change (MI) according to stage of change on day 1, at 2 and 6 weeks	Patients completed research assessment only	Alcohol	Primary prevent
32	Pritchard et al. [92]; Australia; high quality; RCT	273 Patients with hypertension and/ or diabetes type 2 and/or overweight; 285 men, age between 25 and 65 years	GPs and dieticians	(1) Dertician group: 6 individual conneeling sessions spaced equally over 12 months, focusing on nutrition and exercise (first 45 min, next 15 min) by dietician, (2) doctor/ dietician group: same as group 1, but doctor invited patients to the study and reviewed progress at 2 of the 6 sessions (5 min)	Control group received results of initial measurements and if they had queries were advised to discuss these with whom they had made an appointment	Weight, nutrition, physical activity, smoking, alcohol	Primary and secondary prevention
33	Ramos et al. [40]; Spain; high quality; RCT	287 Smokers who were in the preparatory phase; 46% men; mean age 45 years	Physicians and nurses from 10 practices	(1) Intensive group: counseling, psychological support based on ML 5 Follow-up sessions, pharmacological treatment, (2) intensive individual: counseling, psychological support based on ML 5 Follow-up sessions, pharmacological treatment	Minimal: pharmacological treatment, basic MI counseling	Smoking (also baseline data on alcohol, physical activity and nutrition)	Primary prevent
34	Reed et al. [48]; USA; lower quality; RCT	237 Patients; 25.9% men in intervention group, 28.8% men in control group1, 26.3% in control group2; age 18 years or older	12 Physicians, 4 nurses and 1 NP	Counseling (using "6 As" method) and educational map (with geographic information of all recreational facilities within 2 mile radius)	(1) Counseling only group, (2) standard care	Physical activity	Primary prevent
35	Reid et al. [65]; Australia; high quality; RCT	45 Patients with history of hypertension; 43% men in withdrawal group, 50% men in continued group; age between 18 and 60 years	13 GPs	(1) Continued medication: medication, counseling regarding lifestyle change, self-help material, (2) Withdrawal: medication stop over 2-week period, counseling regarding lifestyle change, self-help material	-	Physical activity, nutrition	Primary prevent

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Control group	Type of lifestyle	Primary/secondary prevention or both ^a	
GPs not receiving a MI course	Smoking, alcohol, nutrition, physical activity	Secondary prevention	
Patients received a booklet on general health issues and were followed-up at 6, 12 months	Alcohol	Primary prevention	
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No.	Study; country; quality; design	Population (patients)	Health care providers	Intervention group(s)	Control group	Type of lifestyle	Primary/secondary prevention or both ^a
36	Rubak et al. [88]; Denmark; high	265 Diabetic patients; age between 40 and 69 years	65 GPs	GPs received a motivational interviewing (MI) course	GPs not receiving a MI course	Smoking, alcohol, nutrition, physical	Secondary prevention
37	quality; RCT Rubio et al. [41]; Spain; high quality; RCT	752 Binge drinkers; 65% men; age between 18 and 65 years	74 Family physicians and office nurses	Brief intervention: 2 short counseling sessions 4 weeks apart (10–15 min). physicians used script workbook, 2 follow-up sessions by nurse	Patients received a booklet on general health issues and were followed-up	Alcohol	Primary prevention
38	Sacerdote et al. [66]; Italy; high quality; RCT	3186 Patients who were not obese or affected by chronic or severe diseases; 50% men; age between 18 and 65 years	33 GPs	Educational personalized intervention and brochure on basic healthy diet based on Italian guidelines for correct nutrition.	at 6, 12 months A similar and non- personalized conversation without the use of a	Nutrition, weight	Primary prevention
39	Schaus et al. [60]; USA; lower quality; RCT	363 High-risk drinking students; 48% men; age 18 years and older (mean age 20.6 years)	Primary care providers (intervention: 2 physicians, 1 physician's assistant, 1 NP)	Follow-up advice every 6 months 2 Brief sessions based on MM techniques and cognitive behavioral skills training (20 min)	Participants were assigned to university health services providers who received no training in the MI	Alcohol	Primary prevention
10	Spink et al. [49]; Canada; high quality; RCT	90 Patients who were regularly active, but were thinking about increasing their activity level ('contemplators'); 17% male in intervention group 1, 19% male in intervention group 2; age 18 or older	24 Physicians	(1) Counseling: physician-directed- modified PACE protocol, (2) Enhanced counseling: physician- directed-modified PACE protocol and telephone counseling	-	Physical activity	Primary prevention
41	Steptoe et al. [80]; UK; lower quality; RCT	(mean age 43 year) 883 Patients with increased risk of coronary heart disease (regular cigarette smoking, high serum cholesterol concentration and/or high body mass index combined with low physical activity); 46% men; mean age 46.7 years	PNs in 20 practices (one PN in each of the 10 intervention practices was trained)	Brief behavioral counseling based on stage of change model to reduce smoking, dietary fat intake and increase physical activity. Patients with 2 risk factors invited for 3 sessions, with 1 risk factor for 2 sessions (20 min per session). In	Usual care by PN	Smoking, nutrition, physical activity	Primary prevention
-	Steptoe et al. [62]; UK; lower quality; RCT	365 Patients with elevated cholesterol; 49% men; mean age 52.1 years	See Steptoe et al. [80]	between telephone counseling. Brief behavioral counseling based on stage of change model to reduce dietary fat intake. Patients with 2 risk factors invited for 3 sessions, with 1 risk factor for 2 sessions (20 min per session). In between telephone counseline.	See Steptoe et al. [80]	Nutrition	Primary prevention
-	Steptoe et al. [81]; UK; lower quality;	See Steptoe et al. [80]	See Steptoe et al. [80]	See Steptoe et al. [80]	See Steptoe et al. [80]	See Steptoe et al. [80]	See Steptoe et al. [80]
42	Steptoe et al. [63]; UK; high quality; RCT	271 Patients from a low income and ethnically mixed population; 39% men; aged between 18 and 70 years (mean age 43 year)	Nurses from one practice in a deprived inner city area	(1) Brief individual behavioral counseling based on stage of change model (15 min), (2) time matched nutrition education counseling (15 min)	-	Nutrition	Primary prevention
13	Swinburn et al. [50]; New Zealand; high quality; RCT	456 Sedentary patients; 41% men in intervention group 1, 36% in intervention group 2; mean age 49 years	37 GPs in two practices	(1) Verbal advice + written advice (education), (2) verbal advice only	-	Physical activity	Primary prevention
44	Ter Bogt et al. [64]; Netherlands; lower quality; RCT	457 Overweight or obese patients with hypertension and/or dyslipidemia; 48% men; mean age 56 years	NPs and GPs from 11 practices (varying from 1 to 7 GPs and 1 to 3 NPs	4 Individual visits to NP and one feedback session by telephone for lifestyle counseling with guidance of NP using a standardized	Usual care by GP	Weight	Primary prevention
45	Tonstad et al. [89]; Norway; lower quality; RCT	51 Patients with hypertension; 67.7% men in intervention group; 83.3% men in control group; aged 30–69 years	per iocation) 1 Nurse, physicians	computerized software program Nurse-led lifestyle counseling based on stages of change: monthly for 6 months (first 60min, next sessions 30min)	Brief advice, recommended to visit their physician for care during the study and recalled for the final evaluation after 6 months	Smoking, nutrition, physical activity, alcohol	Primary prevention
46	Van den Bemt et al. [76]; Netherlands; high quality; RCT	189 Patients with COPD; 56% men in intervention group, 47% men in control group; age 25 years or older	GPs from 34 practices, respiratory experts and lung function technicians	Ongoing monitoring of COPD patients with respiratory expert recommendations (feedback) for GP	Usual care, with spirometry at baseline and 2 years	Weight, smoking, physical activity	Secondary prevention
47	Van Sluijs et al. [51]: Netherlands; high quality; RCT	358 Patients diagnosed with hypertension, hypercholesterolemia and/or non-insulin-dependent diabetes and not in the maintenance stage for regular physical activity; 50.8% men; aged between 18 and 70 years (mean age 555 years)	29 GPs	2 Visits with GP and 2 telephone booster calls by a physical activity counselor: both using PACE physical activity program.	10 min session at baseline by GP	Physical activity	Primary and secondary prevention
48	Whittemore et al. [74]; USA; lower quality; RCT	58 Patients at risk for diabetes type 2, metabolic syndrome or impaired glucose tolerance (IGT), moderately low-incore sample; 8% men; age 21 years or above	7 NPs from 4 practices, 1 nutritionist	Lifestyle change program: culturally relevant education on nutrition, exercise and diabetes type 2 prevention, behavioral support in identifying lifestyle change goals and barriers, MI when participants were unable to achieve lifestyle goals	Enhanced standard care program	Nutrition, weight, physical activity	Primary prevention
49	Willaing et al. [67]; Denmark; high quality; RCT	503 Patients with high BMI, dyslipidemia and/or type 2 diabetes; 29% men in dietician group, 34% men in GP group; age 18 years or older	60 GPs and 2 dieticians	(1) Nutritional counseling by GP (first session 30 min, later 12 min) GP was trained in MI, (2) nutritional counseling by dietician (first session 1b, later 30 min)	-	Nutrition, weight	Primary and secondary prevention
50	Woollard et al. [94]: Australia; lower quality; RCT	212 Patients with hypertension, type 2 diabetes or coronary heart disease; 44% men in control group, 52% men in intervention group, 51% men in intervention group2; aged between 20 and 74 years	PNs and GPs from 7 practices	(1) Low level: one individual face-to- face counseling session and monthly telephone contacts for a year (10- 15 min), (2) high level: individual face-to-face counseling up to 1 h monthly for 1 year. Counseling was based on ML.	Usual care by GP	Nutrition, weight, physical activity, alcohol, smoking	Primary and secondary prevention
-	Woollard et al. [93]; Australia; lower quality: RCT	See Woollard et al. [93]	See Woollard et al. [93]	See Woollard et al. [93]	See Woollard et al. [93]	See Woollard et al. [93]	See Woollard et al. [93]

Table 1 (Continued)

Table 2

Effects of	communication.	related	hohmior	chan an	techniquee	i.e.	etudioe	(m-	5 (N) 3
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Communication-related behavior change	Number of studies	Positive significant	Contribution GPs (or physicians), nurses,
techniques (used in interventions)		effects (%) ^b	other health care provider
Advice, behavioral counseling	3 High quality studies	66.7%	1 Study: GPs and health educator [68],
	[37,55,56,68]		2 Studies: GPs and nurses [37,55,56]
Advice, behavioral counseling, self-monitoring	1 High quality study [73]	-	1 Study: GPs, dietician, weight loss advisor [73]
Advice, education	3 High quality studies [50,52,66],	50%	1 Study: nurses [52], 4 studies: GPs [66,91,50,84]
	2 Lower quality studies [84,91]		
Advice, education, cognitive behavior therapy	1 High quality study [52]	100%	1 Study: nurses and therapists [52]*
Advice, education, feedback	1 High quality study [44]	100%	1 Study: GPs [44]*
Advice, education, feedback, goal setting	1 High quality study [77-79]	100%	1 Study: nurses [77-79]*
Advice, education, goal setting, self-monitoring	1 High quality study [43]	100%	1 Study: GP and nurses [43]*
Behavioral counseling/support	10 High quality studies	76.9%	6 Studies: nurses [46,62,63,80,81,90] [53,89],
	[41,46,49,51,53,63,65,72,90,92],		1 Study: GPs and trained professionals [72],
	3 Lower quality studies		1 Study: GPs and dieticians [92], 1 Study:
	[62,69,80,81,89]		GPs and PA counselors [51], 3 studies:
			GPs [49,69] [65], 1 study: GPs and nurses [41]
Behavioral counseling, education	1 Lower quality study [48]	100%	1 Study: GPs and nurses [48]
Behavioral counseling, feedback	1 Lower quality study [64]	±	1 Study: nurses [64]
Behavioral counseling, motivational interviewing	1 High quality study [67]	±	1 Study: GPs [67]
Education, motivational dialog/interviewing,	2 High quality studies [47,54],	66.7%	1 Study: 1 nurse [54], 1 study: GPs and
behavioral counseling	1 Lower quality study [74]		nurses [47], 1 study: nurses and nutritionist [74]*
Feedback, responsibility, advice, menu, empathy, self-efficacy	2 High quality studies [57,59]	-	1 Study: GPs and nurses [57], 1 study: GPs [59]
Goal setting, self-monitoring, motivational	1 High quality study [42]	-	1 Study: GPs and exercise scientist [42]
interviewing			
Monitoring, feedback	1 High quality study [76]	-	1 Study; GPs [76]
Motivational interviewing	5 High quality studies	75%	3 Studies: nurses [39,58,45], 4 studies:
	[39,40,45,70,71,88],		GPs and nurses [40,60,70,71,93,94] ,
Marken Marken Marken and	3 Lower quality studies [58,60,93,94]		1 Study: GPs [88]
Motivational message	1 High quality study [61]	±	1 Study: GPS [61]
Patient-centered care	1 High quality study [82]	-	1 Study: GPs and nurses [82]
Patient-centered care, advice, education	1 Lower quality study [91]	100%	1 Study: GPS [91]
Risk/need assessment (screening),	1 High quality study [83],	33,3%	1 Study: GPs and case managers [83],
behavioral counseling	2 Lower quality studies [75,86]		1 Study: GPs and nurses (and some dietician,
			physiotherapist) [75], 1 study; GPs [86]
Risk assessment, risk communication,	1 High quality study [38,87]	-	1 Study: nurses [38,87]
decision support, motivational interviewing			
Self-monitoring, feedback	1 High quality study [85]	±	1 Study: GPs and nurses [85]

-, not significant; ±, partly significant. ^a Number of studies in table exceeds 50 because several studies reported more than one intervention group which resulted in different behavior change techniques (BCTs) within one study.

^b Percentage of studies with significant improvement divided by total number of studies on this technique, as earlier used in a review of Van Achterberg et al. [26].

^c If in both intervention and control group the same BCT (for example motivational interviewing) was used, but in different intensity or form of delivery, and there was a significant effect in both groups but not between groups, we indicated that there was a significant effect for this BCT. But, if a BCT was partly significant we did not count this effect as significant. Significant contribution of health care provider (in case of significant effect on BCT).



Table 3

Outcome measures and significant effects of studies with effective communication related behavior change techniques (n=26).

Study	Outcome measures	Significant effects
Alterman et al. [52]	Self-reported: cigarettes a day. Objective: biochemical measurements (carbon monoxide	High biochemically abstinence rates through one year for groups 1 and 3. Significant lower abstinence rates for group 2.
Anderson et al. [68]	level and urine samples) Self-reported: stress, body function, self-efficacy, physical activity recall, social support	Reduction in daily stress and improvement in satisfaction with body function for woman in groups 2 and 3. For men reduction of stress in all groups.
Beckham [58]	Self-reported: alcohol use (drinks a day), symptoms of alcohol withdrawal or treatment for alcohol problems. Objective: gamma-dutamyltransferase (GGT) blood test	Significant decrease in GGT and average number of drinks a day for treatment group. Control group a smaller reduction in number of drinks a day.
Bo et al. [72]	Self-reported: fat intake, fiber intake, calories intake, physical activity level. Objective: weight, waist circumference, body mass index (BMI), diastolic blood pressure, fasting glucose, triglycerides, hs-CRP, and uric acid values	Intervention significantly reduced total/saturated fat intake and increased polyunsaturated fat/fiber intake and exercise level compared to the controls. Intervention group: reduced metabolic syndrome, absolute risk reduction, the prevalence of central obesity, hypertriglyceridemia, incidence of diabetes. Weight, waist circumference, BMI, diastolic blood pressure, fasting glucose, triglycerides, hs-CRP, and uric acid values decreased in intervention group, while most variables worsened in the controls.
Bolognesi et al. [69]	Self-reported: readiness for physical activity and self- efficacy. Objective: BMI and abdominal girth	The experimental group had significantly better BMI and abdominal girth compared with the control group after a 5- to 6-month follow-up. The experimental group progressed in their stage of physical activity readiness and increased their self-efficacy.
Campbell et al. [77]	Self-reported: aspirin use, diet, smoking, exercise. Objective: blood pressure, lipid management	Reduced mortality, coronary event rated in medium term. Improved moderate exercise, diet, aspirin management, blood pressure, lipid management in intervention group at one year.
Efraimsson et al. [54]	Self-reported: smoking, symptoms of cough, phlegm, dyspnea and wheezing, quality of life. Objective: respiratory function, oxygen saturation	Increase in the intervention group on quality of life, the number of patients who stopped smoking and patients' knowledge about COPD, compared to control
Elley et al. [70]	Self-reported: quality of live, physical activity level and total energy. Objective: blood pressure, BMI, cholesterol concentration, rick at cardiovascular disease	Mean total energy expenditure increased and leisure exercise more in the intervention group than in the control group. Measures of self rated general health, role physical, vitality, and bodily pain improved sign more in the intervention group.
Grandes et al. [43]	Self-reported: physical activity level, quality of life. Objective: maximum oxygen uptake, estimated by an exercise test	Intervention group Intervention patients increased physical activity more than controls. The proportion of the population achieving minimal physical activity recommendations was higher in the intervention group
Hollis et al. [37]	Self-reported: smoking (quit) rates, stage of change. Objective: carbon monoxide level	Subjects in the three intervention conditions were more likely to report a serious quit attempt than control group. Quit rates at 3 months were also higher.
Kastarinen et al. [90]	Self-reported: lifestyle data on nutrition, physical activity, smoking, alcohol. Objective: lipids, blood pressure, BMI	Among participants with no antihypertensive drug treatment, the net reductions after 1 and 2 year in blood pressure were significant in favor of the intervention group. Weight decreased and physical activity level increased at 12, 24 months in intervention group compared to control. Alcohol decreased only in year 1.
Kerse et al. [44]	Self-reported: physical activity level, functional status, health, immunization status, social contacts, psychological well-being, drug usage, rate of influenza vaccination	Patients in the intervention group had increased walking, frequency of pleasurable activities and self-rated health compared with the control group.
Lear et al. [83]	Self-reported: lifestyle (physical activity, nutrition, smoking), cardiovascular risk scores (Framingham), quality of life. Objective: blood pressure, cholesterol, exercise capacity,	Cardiovascular risk score, cholesterol and systolic blood pressure were significantly improved in the intervention group. There were no significant differences with respect to lifestyle factors between the groups
Lee et al. [46]	BMI, waist circumference, lipid Self-reported: self-efficacy, walking frequency. Objective: systolic and diastolic blood pressure	Mean change in systolic blood pressure decreases both in intervention and control group, but significantly more in intervention group. Improvement in exercise self-efficacy scores was greater among intervention group participants. Intervention group participants were more likely to report walking more, but no differences were observed in diastolic blood pressure.
Noknoy et al. [39]	Self-reported: alcohol consumption. Objective: serum gamma-glutamyl transferase	Self-reported drinks per drinking day, frequency of hazardous drinking assessed either on a daily or weekly basis, and of binge drinking sessions were reduced in the intervention group more than in the control group after both 3 and 6 months. However, serum gamma-glutamyl transferase increased in both groups
Pritchard et al. [92]	Objective: weight, blood pressure, BMI, height	Both intervention groups reduced weight and blood pressure compared with the control group. Patients in intervention group 2 (doctor-dietician) were more likely to complete the 12 month programme than those in intervention group 1 (dietinian)
Ramos et al. [40]	Self-reported: continued smoking abstinence. Objective: carbon monoxide	No significant differences between the results of individual and group interventions. Continued abstinence at 12 months highest for intensive individual intervention group. The effectiveness of intensive smoking interventions was lower than expected; only overall visit length showed a statistically significant association with smoking cessation
Rubak et al. [88]	Self-reported: patient-doctor relationship, type of counseling, degree to which behavior tends to be self- determined, beliefs and understanding of type 2 diabetes, self-care activities related to type 2 diabetes	Patients in the intervention group were significantly more autonomous and motivated in their inclination to change behavior after 1 year compared to the control group. Patients in the intervention group were also significantly more conscious of the importance of controlling their diabetes, and had a significant better understanding of the possibility of preventine complications
Rubio et al. [41]	Self-reported: frequency of binge drinking episodes and weekly alcohol intake. Objective: gamma-glutamyl transferase	At 12-months significant reductions in binge-drinking status, number of episodes of binge drinking, number of drinks weekly and frequency of excessive alcohol intake in 7 days

Table 3 (Continued)

Study	Outcome measures	Significant effects
Sacerdote et al. [66]	Self-reported: food frequency, healthy diet score. Objective: weight, blood pressure, BMI	The intervention group showed a slightly reduced net intake of meat and a slightly increased net intake of fruits and vegetables, fish products, and olive oil. BMI changed only in the intervention group. The 'healthy diet score' in intervention group was significant higher in the end, and also compared to control group.
Schaus et al. [60]	Self-reported: alcohol consumption, high-risk drinking alcohol-related harms. Objective: blood alcohol concentration	Brief interventions results in significantly decreased alcohol consumption, high-risk drinking, and alcohol-related harms.
Spink et al. [49]	Self-reported: physical activity readiness (stages of change), levels of physical activity (frequency, intensity, duration), energy expenditure	Mean energy expenditure and frequency, frequency of moderate activity, and duration significantly increased over time. No significant interactions between group and time were found. The effectiveness of telephone support over and above that of physician counseling was not supported.
Steptoe et al. [80]	Self-reported: diet, exercise, smoking habits. Objective: blood pressure, serum total cholesterol concentration, weight, BMI, and smoking cessation (with biochemical validation)	Favorable differences were recorded in the intervention group for dietary fat intake, regular exercise, and cigarettes smoked per day at 4 and 12 months. Systolic blood pressure was reduced to a greater extent in the intervention group at 4 but not at 12 months. No differences were found between groups in changes in total serum cholesterol concentration, weight, body mass index, diastolic pressure, or smoking cessation.
Steptoe et al. [63]	Self-reported: number of portions of fruit and vegetables eaten per day. Objective: plasma beta carotene, alpha tocopherol, and ascorbic acid concentrations, and 24 h urinary potassium excretion.	Consumption of fruit and vegetables increased from baseline to 12 months in both intervention groups. The proportion of participants eating five or more portions a day increased. Plasma beta carotene and alpha tocopherol concentrations increased in both groups, but the rise in beta carotene was greater in the behavioral group. There were no changes in plasma ascorbic acid concentrations or urinary potassium excretion. Differences were maintained when analysis was restricted to participants with incomes $\leq \pounds 400$ (€596, \$640) a week.
Van Sluis et al. [51]	Self-reported: self-efficacy, benefits of physical activity, barriers to physical activity (smoking), social support, processes of change	Significant positive effect was observed on self-efficacy, use of cognitive and behavioral processes of change, at 8 weeks and 6 months. The intervention group also perceived fewer barriers for regular physical activity at 6 weeks and used behavioral processes of change more at 1 year.
Whittemore et al. [74]	Self-reported: nutrition and exercise level, depressive symptoms, satisfaction. Objective: weight loss, waist circumference, insulin resistance, and lipid profiles	Significant trends or improvement in both groups for nutrition and exercise behavior. Participants of intervention group demonstrated trends for better high density lipoprotein (HDL) as well as exercise behavior. Twenty-five percent of lifestyle participants met treatment goals of 5% weight loss compared to 11% of standard care participants.

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Table 4

Effective communication related behavior change techniques (BCTs), combined and single (n=26 studies).

Communication-related BCTs/number of studies	Behavioral counseling	Feedback	Risk assessment	Education	Goal setting	Advice	Self- monitoring	Motivational interviewing	Cognitive behavior therapy
1				х		х			х
2	х					х			
1				х		х			
1				х	х	х	х		
1		х		х		х			
1		х		х	х	х			
2	х			х				х	
1	х		х						
6								х	
10	х								
Total ^a	15/26	2/7	1/4	7/14	2/3	7/16	1/6	8/14	1/1

* For example; behavioral counseling was 15 times used as effective technique out of a total of 26 times used as technique.