

Promoting physical activity in primary care: a systematic review and meta-analysis

Abstract

Background: Promoting physical activity is an important part of patient care in primary care and has been investigated in many studies with a wide range of intervention characteristics often including external support. It is unclear, however, if promoting physical activity is effective.

Aim: To investigate the effectiveness of behaviour change interventions to promote physical activity in primary care.

Design and Setting: This is a systematic review and meta-analysis to evaluate physical activity promotion in a primary care setting.

Method: Embase, Medline, PsycInfo and the Joanna Briggs Institute Database were searched for 'physical activity', 'interview', 'motivation', 'primary care' and equivalent words to identify randomized controlled trials with physical activity as outcome at patient level.

Results: The review identified 23 eligible studies. The quality appraisal showed that most studies reported insufficient details regarding randomization, group allocation, blinding and fidelity of intervention delivery. The included studies reported a wide range of interventions with varying numbers of follow-up visits or phone calls. The overall effect size for interventions with a 6 months follow-up interval was 0.04 (95% CI -0.05 to 0.13), for interventions with a 12 months follow-up interval 0.2 (95% CI 0.04 to 0.36). Only one intervention based on three motivational interviewing sessions achieved a moderate effect.

Conclusion: Counselling to promote physical activity in primary care has a limited effect on patients' behaviour and might not be, on its own, enough to change physical activity behaviour.

Keywords: primary health care, family practice, physical activity, behaviour change, motivation

How this fits in:

While there is evidence that behaviour change promotion can have a positive effect when implemented across different settings, it is unclear how successful these interventions are when delivered in primary care without links to other support components (e.g. exercise classes). This systematic review and meta-analysis investigated physical activity promotion interventions exclusively delivered in primary care. Results indicated that interventions delivered by primary care providers only are unlikely to be sufficient and might need to be part of a comprehensive support system to successfully change behaviour.

Background

Exercise and physical activity reduce the risk of cardio- and cerebrovascular disease, cancer, obesity and falls, and improve mental health, osteoporosis and diabetes (1). The evidence for multiple benefits is strong and shows that physical activity is key for healthy ageing.

Physical activity is defined as 'any bodily movement produced by skeletal muscles that results in energy expenditure' (2). Exercise is a particular type of physical activity, defined as 'physical activity that is planned, structured, repetitive, and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective' (2).

Current physical activity guidelines (3) recommend that adults do at least 150 to 300 minutes of moderate intensity or 75 to 150 minutes of high intensity aerobic physical activity per week, preferably spread throughout the week. In addition, adults should complete muscle-strengthening activities at least twice a week and avoid sedentary behaviour for long, uninterrupted periods.

However, in Europe only about 30% of adults are sufficiently physically active, figures ranging from 23% in Sweden to 44% in the Netherlands (4). Physical inactivity is associated with considerable costs for health-care systems, particularly in high-income countries (5). These costs are predicted to increase over the next decades due to the ageing of the population (6).

Primary care physicians are often the first point of contact for people to discuss their health. A consultation may present a suitable opportunity for patients to discuss physical activity levels, as this falls within the remit of primary care physicians (7, 8). A systematic literature review showed that barriers to physical activity counselling included lack of incentives for the primary care physicians, time constraints, the perception of insufficient knowledge and training, and the lack of a counselling protocol and behaviour change (8). A survey indicated that about 75% of primary care physicians found it difficult to provide lifestyle modification counselling (7).

At present, it is unclear which behaviour change strategies and support mechanisms primary care physicians should use to promote physical activity in their counselling sessions. There is a broad spectrum of behaviour change techniques, with at least 93 techniques available (9). A meta-analysis of 43 randomised controlled trials (RCTs) investigating behaviour change techniques for weight management and physical activity across settings showed that goal setting and self-monitoring were positively associated with intervention effect at short and long term, while exploring pros and cons of behaviour change produced inverted effects (10). In addition, giving feedback, setting graded tasks and adding objects to the environment (e.g. diet logbook), were associated with positive long-term effects (10). The study did not find any differences in effects when comparing different settings or weight management with physical activity.

In relation to primary care specifically, Noordman et al. (11) showed that a wide range of behavioural counselling interventions were effective. In addition, a health-economics analysis indicated that most physical activity interventions set in primary care were cost-effective (12). However, both studies included interventions with characteristics that are usually not available in a primary care context (e.g. exercise coaches, health advisors, physiotherapy programmes). Therefore, it remains unclear, which interventions would be successful in supporting physical activity engagement when delivered in primary care settings. This systematic review of the literature and meta-analysis aimed to investigate interventions to promote physical activity that were delivered within a primary care context to evaluate their effectiveness. The research objectives were:

1. To identify the types of behaviour change interventions that take place in primary care practices to support engagement in physical activities.
2. To evaluate how effective behaviour change interventions delivered in a primary care context are.
3. To determine which type of intervention is associated with moderate or large effect sizes.

Methods

The protocol for this systematic literature review was published on PROSPERO (CRD42020154879).

Searches in Ovid (databases were combined)

- Embase (1974 to 15 October 2019)
- Medline (1946 to 15 October 2019)
- PsycInfo (1906 to October week 1 2019)
- Joanna Briggs Institute EBP database (current to 15 October 2019)

Search Terms [abstract, keywords, MeSH term, subject heading, title]

- Primary care OR family practi* OR GP OR general practi* OR physician* OR primary health
- AND
- Interview* OR advice OR consultation* OR promotion* OR counselling OR counseling
- AND
- Motivation OR behaviour* change* OR behavior* change* OR lifestyle change*
- AND
- Physical activit* OR exercise* OR physiotherap* OR physical therap*

Where possible, the search was limited to humans. The search was repeated for the years 2019 and 2020 on 30 October 2020 for articles up to that date.

Eligibility criteria

Inclusion: peer-reviewed randomised controlled trials investigating behaviour change consultations promoting physical activity engagement in a primary care setting; outcome parameter include physical activity levels; outcomes are at the patient (i.e. not clinician) level; articles reporting primary research studies in English, German, Italian, Spanish, French or Dutch; eligible studies retrieved through the reference lists of literature reviews.

Exclusion: studies investigating interventions without reporting behaviour change consultations; studies examining consultations not pertaining to behaviour change and physical activity; abstracts, protocols, editorials, discussion papers, comments (unless relating to one of the included studies).

Data Management and Screening

All records identified were imported into Mendeley, and duplicate records were removed. Title and abstracts were screened by one author (VvdW) to determine whether or not they met the eligibility criteria. The abstracts that did not meet the eligibility criteria were rejected and numbers were recorded. If the eligibility was uncertain, the article was retained and its full text retrieved to determine eligibility.

Full text articles for all candidate eligible studies based on titles and abstracts were retrieved and assessed by two co-authors (VvdW and CDL) to determine eligibility. Any uncertainties concerning the appropriateness of reviews for inclusion were resolved through discussion with a third reviewer (AV). Reasons for non-eligibility were recorded.

Data Extraction

Data from the selected articles were extracted by one author (VvdW) using a custom-designed form. Data extracted included author; year and country of publication; study characteristics including design, inclusion and exclusion criteria; participants; intervention characteristics including frequency and duration; outcome measures (primary and secondary) and effect of consultation on outcome measures (if possible).

Assessment of Risk of Bias

Two authors (VvdW and CDL) appraised the quality of the included studies independently using the Cochrane Collaboration's tool for assessing risk of bias in randomised controlled trials (13). Any disagreements were resolved through a discussion with a third reviewer (AV).

Data Analysis

For research question 1, a descriptive analysis was completed to report who delivered the intervention (e.g. primary care physician or practice nurse) and what type of behaviour change consultations was delivered. For research question 2, two meta-analyses were completed for interventions with a follow-up assessment at 6 and at 12 months. These time points were chosen as those were the most commonly reported ones. As some studies included more than one PA measure (e.g. min PA per week and MET-hours per week), the analysis was completed for results with the smallest effect size to provide a conservative estimate of the overall effect size. Effect sizes were based on standard mean differences for two samples. When more than one intervention was tested, effect sizes for each individual intervention were used in the meta-analyses. For the meta-analysis, effect sizes were weighted by sample size. For research question 3, studies with moderate or large effect sizes were identified and their characteristics described.

Results

In total, 1701 articles were identified. Upon titles and abstracts screening, 1604 articles were excluded. After full-text examination of the remaining 97 articles, 73 studies were excluded. The review included 24 articles. The screening process and reasons for exclusion of full-text articles is shown in figure 1 through a PRISMA flow diagram (14).

The characteristics of the included studies are reported in Supplementary Table 1. In brief, the studies were published between 1995 and 2020, with five articles from the United States of America, four each from Australia, the Netherlands and the United Kingdom, two from Germany and one each from Canada, Finland, Mexico and Spain. The sample sizes ranged from $n = 20$ to $n = 4317$ participants.

[insert figure 1 here]

Quality appraisal

Most studies lacked details on randomization and allocation concealment, as well as blinding of clinicians, researchers and participants, though blinding was not possible in most study designs (see Table 2). All studies except one (15), which did not show follow-up data, reported data loss. Thirteen studies used an intention-to-treat analysis, the other studies did not report how they approached the missing data in the analyses. Further bias might have been introduced in 18 studies by either not reporting fidelity data, or through low fidelity to the intervention.

[insert table 1 here]

Objective 1

In nine studies, the intervention was delivered by primary care physicians, in ten by practice nurses and in five by both. Fourteen studies evaluated a physical activity intervention and ten a lifestyle intervention. Three studies included a single behaviour change consultation as intervention (16-18), ten studies a baseline behaviour change consultation with follow-up visits or phone call (19-28). Three studies evaluated an intervention comprising telephone consultations (29-31) and five studies tested interventions that included behaviour consultation visits, as well as additional support mechanisms such as assessment of motivational readiness report, posters or pedometers (32-36). Two studies only reported on the training for the practice staff but not on the implementation at the patient level (37, 38), and one study included an intervention consisting of two physical examinations plus an optional behaviour change consultation (15).

Objective 2

While all interventions were consultation-based, they still included a wide range of formats, types and support mechanisms (see above) with different follow-up periods. Therefore, we decided to complete the meta-analyses for studies with equal follow-up periods to enable a comparison of effects of the different interventions at a set time point. Due to a lack of detail in reporting, effect sizes could not be calculated for two of the studies (22, 29).

For the seven interventions with a follow-up assessment at 6 months, the overall effect size was 0.04 (95% CI -0.06 to 0.14). Effect sizes and CIs are presented in figure 2.

[insert figure 2 here]

Seven interventions had follow-up assessments at 12 months. The overall effect size was 0.2 (95% CI 0.04 to 0.36; see figure 3).

[insert figure 3 here]

Objective 3

The effect of primary care counselling to increase physical activity levels was small for most studies and better in studies designed to change behaviour over a longer period of time (12 months), compared with studies with a shorter follow-up periods (6 months). No further patterns identifying a

successful intervention could be detected regarding specific intervention characteristics such as counselling strategy, population, training of intervention staff or theoretical underpinning of the intervention.

The only study that achieved a medium effect size was by Christian et al.(32) , which included participants diagnosed with type 2 diabetes. The intervention was delivered by the primary care physician and included three motivational interviewing sessions based on a personal report outlining the computer-assessed motivational readiness to increase physical activity and make dietary changes. The tailored report provided feedback to the participant, addressed behaviour change barriers and listed two or three dietary and/or physical activity self-management goals, which the participant had chosen as target behaviour. The participants were also given a 30-page planning guide with additional information about a healthy lifestyle. The physician received a summary of the participant's report for the counselling visit to discuss goals.

Discussion

Summary

Physical activity promotion may have a limited effect if restricted to primary care settings, despite different consultation approaches being used. Some studies included intervention investigating single counselling sessions, others had follow-up visits or telephone calls. Different support mechanisms, such as tailored reports, goalsetting or activity prescriptions were added and a range of health psychology approaches were used as theoretical underpinning of the counselling element. There was no clearly superior counselling strategy, and only seven out of 24 interventions increased physical activity levels significantly more compared to their control interventions.

The effect sizes in the individual studies were generally small and a meta-analysis of interventions with a 6 or 12 months follow-up period confirmed these findings. The difference in results between the meta-analyses with 6 and 12 months follow-up data also indicated that interventions developed for a long-term behaviour change (here 12 months) might be more effective than those developed for a shorter-term follow-up. Due to the lack of reporting on details regarding the content of the counselling sessions, it remains unclear if the prospect of a 12 months follow-up affected the counselling approach.

The only study including an intervention that showed a moderate effect size was by Christian et al. (32). Their intervention design included characteristics (e.g. detailed assessment of readiness, goal setting) that have been shown to support behaviour change in overweight and obese people (10). The findings of the review by Sambal et al. showed that goalsetting and self-monitoring were significantly associated with a positive intervention effect both in the short and long term. This would suggest that interventions to increase physical activity might work better for certain subgroups, as the sample of Christian et al. (32) study included people with type 2 diabetes.

Strengths and limitations

This systematic literature review is the first to investigate effect sizes of physical activity promotion counselling in primary care settings. While only interventions based on counselling were included, the review examined different approaches without external support that might not be available for primary care patients. The meta-analysis contained studies based on the length of the follow-up interval (6 and 12 months) but these included a wide range of intervention characteristics. Overall, the quality of the included studies was acceptable, though some studies did not report sufficient

details on randomisation, blinding of participants and intervention deliverers (primary care physicians and praxis nurses). Fidelity reporting was lacking in many studies and it was therefore not always clear if the small effect was due to the intervention itself, or if the intervention had not been implemented as intended. Process evaluation and adherence reporting are an essential part of a randomised controlled trial (39). Without these, the findings lack the required context to conclude if the intervention itself was inefficient, or if the implementation of the intervention was unsuccessful. Any future randomised controlled trials should include a well- designed process evaluation following MRC guidelines (39).

Furthermore, due to different follow-up periods, not all studies could be included in the meta-analyses and there were not enough studies to compare the effect of different counselling approaches.

Another limitation was the number of literature databases used for the search, which was due to time and resource constraints. While the literature databases used in this review included large scientific databases for medical research, additional articles might have been identified with a search in a wider range of databases.

Comparison with existing literature

The review excluded interventions that contained elements not delivered in a primary care context such as exercise classes, external support (e.g. from psychologists or exercise trainers) and/or community groups. In addition, additional motivation support strategies, such as fitness trackers can support self-monitoring and exercise adherence (40, 41). Linking primary care counselling with additional elements of physical activity support might lead to larger effects on physical activity behaviour. A more comprehensive approach to behaviour change with multiple support mechanisms would also better reflect the behaviour change wheel by Michie et al. (9), which suggests that a comprehensive behaviour change support system is required rather than one source to support the person to change their behaviour. Three components, motivation (brain processes that energise and direct behaviour), capability (a person's capacity to engage in the targeted activity) and opportunity (external factors that make the behaviour possible or prompt it) are required to achieve a positive behaviour change (9). A successful intervention should focus on all three components to provide a supporting context for the individual to adopt a healthy lifestyle.

Implications for research and practice

The findings indicate that counselling to promote physical activity in primary care has a limited effect on patients' behaviour. Strategies to increase physical activity levels should include a more comprehensive approach with multiple mechanisms to support motivation, capability and opportunity, rather than a single point of encouragement for behaviour change in primary care. Future interventions should use a comprehensive approach as outlined in Michie's Behaviour Change Wheel (9) to develop interventions and report these in sufficient detail to allow replication of the research. The randomised controlled trials testing the interventions need to include a process evaluation to assess the implementation of the intervention and to clarify causal mechanisms and context factors. The combined information from the intervention development reporting and the results of the RCT, as well as the process evaluation could then enable a detailed analysis of which intervention components enable behaviour change mechanisms.

Funding: the review did not receive funding.

References

1. Warburton DE, Nicol CW, Bredin SS. Health benefits of physical activity: the evidence. *CMAJ*. 2006;174(6):801-9.
2. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep*. 1985;100(2):126-31.
3. World Health O. WHO | Global recommendations on physical activity for health. WHO.
4. Sjöström M, Oja P, Hagströmer M, Smith BJ, Bauman A. Health-enhancing physical activity across European Union countries: the Eurobarometer study. *Journal of Public Health*. 2006;14(5):291-300.
5. Ding D, Lawson KD, Kolbe-Alexander TL, Finkelstein EA, Katzmarzyk PT, van Mechelen W, et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *The Lancet*. 2016;388(10051):1311-24.
6. Dallmeyer S, Wicker P, Breuer C. How an aging society affects the economic costs of inactivity in Germany: empirical evidence and projections. *European Review of Aging and Physical Activity: Official Journal of the European Group for Research into Elderly and Physical Activity*. 2017;14:18.
7. Bock C, Diehm C, Schneider S. Physical activity promotion in primary health care: Results from a German physician survey. *European Journal of General Practice*. 2012;18(2):86-91.
8. Hébert ET, Caughy MO, Shuval K. Primary care providers' perceptions of physical activity counselling in a clinical setting: a systematic review. *British Journal of Sports Medicine*. 2012;46(9):625-31.
9. Michie S, van Stralen MM, West R. The behaviour change wheel: a new method for characterising and designing behaviour change interventions. *Implementation science: IS*. 2011;6:42.
10. Samdal GB, Eide GE, Barth T, Williams G, Meland E. Effective behaviour change techniques for physical activity and healthy eating in overweight and obese adults; systematic review and meta-regression analyses. *The International Journal of Behavioral Nutrition and Physical Activity*. 2017;14(1):42.
11. Noordman J, van der Weijden T, van Dulmen S. Communication-related behavior change techniques used in face-to-face lifestyle interventions in primary care: A systematic review of the literature. *Patient Education and Counseling*. 2012;89(2):227-44.
12. Garrett S, Elley CR, Rose SB, O'Dea D, Lawton BA, Dowell AC. Are physical activity interventions in primary care and the community cost-effective? A systematic review of the evidence. *Br J Gen Pract*. 2011;61(584):e125-33.
13. Higgins JPT, Altman DG, Gøtzsche PC, Jüni P, Moher D, Oxman AD, et al. The Cochrane Collaboration's tool for assessing risk of bias in randomised trials. *BMJ*. 2011;343.
14. Moher D, Liberati A, Tetzlaff J, Altman DG, Group TP. Preferred Reporting Items for Systematic Reviews and Meta-Analyses: The PRISMA Statement. *PLOS Medicine*. 2009;6(7):e1000097.
15. Burton LC, Paglia MJ, German PS, Shapiro S, Damiano AM, Steinwachs D, et al. The effect among older persons of a general preventive visit on three health behaviors: Smoking, excessive alcohol drinking, and sedentary lifestyle. *Preventive Medicine*. 1995;24(5):492-7.
16. Ackermann RT, Deyo RA, LoGerfo JP. Prompting primary providers to increase community exercise referrals for older adults: A randomized trial. *Journal of the American Geriatrics Society*. 2005;53(2):283-9.
17. Galaviz K, Levesque L, Kotecha J. Evaluating the effectiveness of a physical activity referral scheme among women. *Journal of Primary Care & Community Health*. 2013;4(3):167-71.
18. Galaviz KI, Estabrooks PA, Ulloa EJ, Lee RE, Janssen I, Lopez y Taylor J, et al. Evaluating the effectiveness of physician counseling to promote physical activity in Mexico: an effectiveness-implementation hybrid study. *Translational Behavioral Medicine*. 2017;7(4):731-40.

19. Grandes G, Sanchez A, Sanchez-Pinilla RO, Torcal J, Montoya I, Lizarraga K, et al. Effectiveness of physical activity advice and prescription by physicians in routine primary care a cluster randomized trial. *Archives of Internal Medicine*. 2009;169(7):694-701.
20. Jansink R, Braspenning J, Keizer E, van der Weijden T, Elwyn G, Grol R. No identifiable Hb1Ac or lifestyle change after a comprehensive diabetes programme including motivational interviewing: a cluster randomised trial. *Scandinavian journal of primary health care*. 2013;31(2):119-27.
21. Koelewijn-van Loon MS, van der Weijden T, Ronda G, van Steenkiste B, Winkens B, Elwyn G, et al. Improving lifestyle and risk perception through patient involvement in nurse-led cardiovascular risk management: A cluster-randomized controlled trial in primary care. *Preventive Medicine*. 2010;50(1-2):35-44.
22. Lakerveld J, Bot SD, Chinapaw MJ, van Tulder MW, Kostense PJ, Dekker JM, et al. Motivational interviewing and problem solving treatment to reduce type 2 diabetes and cardiovascular disease risk in real life: a randomized controlled trial. *International Journal of Behavioral Nutrition & Physical Activity*. 2013;10:47.
23. Leonhardt C, Keller S, Chenot J-F, Luckmann J, Basler H-D, Wegscheider K, et al. TTM-based motivational counseling does not increase physical activity of low back pain patients in a primary care setting--A cluster-randomized controlled trial. *Patient Education and Counseling*. 2008;70(1):50-60.
24. McCallum Z, Wake M, Gerner B, Baur LA, Gibbons K, Gold L, et al. Outcome data from the LEAP (Live, Eat and Play) trial: a randomized controlled trial of a primary care intervention for childhood overweight/mild obesity. *International Journal of Obesity*. 2007;31(4):630-6.
25. Sims J, Smith F, Duffy A, Hilton S. The vagaries of self-reports of physical activity: a problem revisited and addressed in a study of exercise promotion in the over 65s in general practice. *Family Practice*. 1999;16(2):152-7.
26. Valve P, Lehtinen-Jacks S, Eriksson T, Lehtinen M, Lindfors P, Saha MT, et al. LINDA - a solution-focused low-intensity intervention aimed at improving health behaviors of young females: a cluster-randomized controlled trial. *BMC public health*. 2013;13:1044.
27. van der Weegen S, Verwey R, Spreeuwenberg M, Tange H, van der Weijden T, de Witte L. It's LiFe! Mobile and Web-Based Monitoring and Feedback Tool Embedded in Primary Care Increases Physical Activity: A Cluster Randomized Controlled Trial. *Journal of medical Internet research*. 2015;17(7):e184.
28. Westland H, Schuurmans MJ, Bos-Touwen ID, de Bruin-van Leersum MA, Monnikhof EM, Schröder CD, et al. Effectiveness of the nurse-led Activate intervention in patients at risk of cardiovascular disease in primary care: a cluster-randomised controlled trial. *Eur J Cardiovasc Nurs*. 2020:1474515120919547.
29. Dubbert PM, Cooper KM, Kirchner KA, Meydrech EF, Bilbrew D. Effects of nurse counseling on walking for exercise in elderly primary care patients. *Journals of Gerontology - Series A Biological Sciences and Medical Sciences*. 2002;57(11):M733-M40.
30. Jolly K, Sidhu MS, Hewitt CA, Coventry PA, Daley A, Jordan R, et al. Self management of patients with mild COPD in primary care: randomised controlled trial. *BMJ*. 2018;361:k2241.
31. Mehring M, Haag M, Linde K, Wagenpfeil S, Frensch F, Blome J, et al. Effects of a general practice guided web-based weight reduction program--results of a cluster-randomized controlled trial. *BMC family practice*. 2013;14:76.
32. Christian JG, Bessesen DH, Byers TE, Christian KK, Goldstein MG, Bock BC. Clinic-Based Support to Help Overweight Patients With Type 2 Diabetes Increase Physical Activity and Lose Weight. *Archives of Internal Medicine*. 2008;168(2):141-6.
33. Goldstein MG, Pinto BM, Marcus BH, Lynn H, Jette AM, McDermott S, et al. Physician-based physical activity counseling for middle-aged and older adults: A randomized trial. *Annals of Behavioral Medicine*. 1999;21(1):40-7.
34. Harris T, Kerry SM, Limb ES, Victor CR, Iliffe S, Ussher M, et al. Effect of a Primary Care Walking Intervention with and without Nurse Support on Physical Activity Levels in 45- to 75-Year-

Olds: The Pedometer And Consultation Evaluation (PACE-UP) Cluster Randomised Clinical Trial. *PLoS Medicine*. 2017;14(1).

35. Little P, Dorward M, Gralton S, Hammerton L, Pillinger J, White P, et al. A randomised controlled trial of three pragmatic approaches to initiate increased physical activity in sedentary patients with risk factors for cardiovascular disease. *British Journal of General Practice*. 2004;54(500):189-95.

36. Marshall AL, Booth ML, Bauman AE. Promoting physical activity in Australian general practices: a randomised trial of health promotion advice versus hypertension management. *Patient Education and Counseling*. 2005;56(3):283-90.

37. Harris MF, Parker SM, Litt J, van Driel M, Russell G, Mazza D, et al. An Australian general practice based strategy to improve chronic disease prevention, and its impact on patient reported outcomes: evaluation of the preventive evidence into practice cluster randomised controlled trial. *BMC health services research*. 2017;17(1):637.

38. Kerse NM, Flicker L, Jolley D, Arroll B, Young D. Improving the health behaviours of elderly people: randomised controlled trial of a general practice education programme. *BMJ*. 1999;319(7211):683-7.

39. Moore GF, Audrey S, Barker M, Bond L, Bonell C, Hardeman W, et al. Process evaluation of complex interventions: Medical Research Council guidance. *BMJ*. 2015;350:h1258.

40. Finkelstein EA, Haaland BA, Bilger M, Sahasranaman A, Sloan RA, Nang EEK, et al. Effectiveness of activity trackers with and without incentives to increase physical activity (TRIPPA): a randomised controlled trial. *The Lancet Diabetes & Endocrinology*. 2016;4(12):983-95.

41. Lynch C, Bird S, Lythgo N, Selva-Raj I. Changing the Physical Activity Behavior of Adults With Fitness Trackers: A Systematic Review and Meta-Analysis. *American journal of health promotion: AJHP*. 2020;34(4):418-30.

Figure 1:

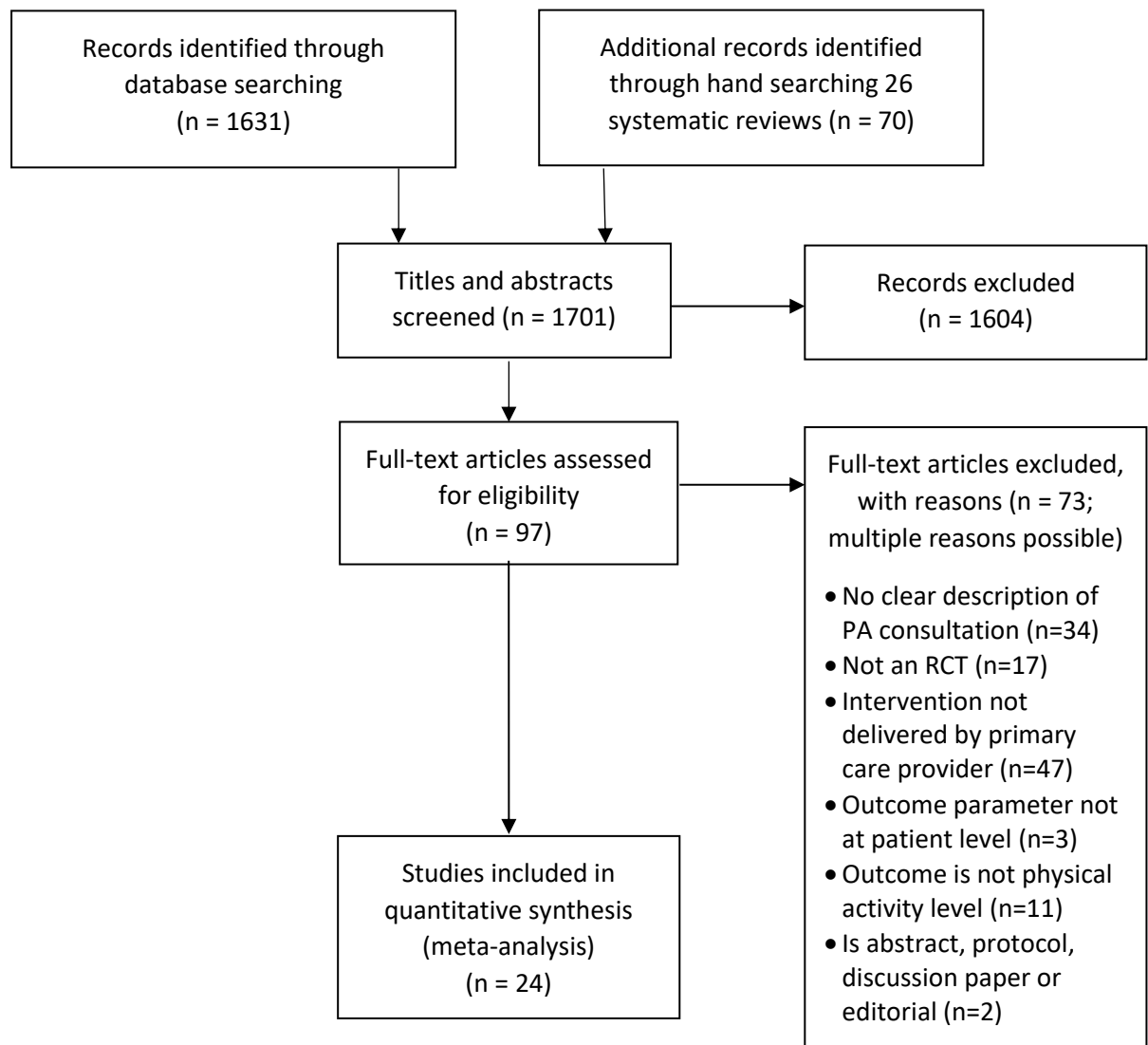


Figure 1: Prisma flow diagram

Table 1: risk of bias assessment based on Higgins et al. (13)

Author	Random sequence generation	Allocation concealment	Blinding of participants and personnel	Blinding of outcome assessment	Incomplete outcome data	Selective reporting	Other bias
Ackermann 2005 (16)	+	+	+	+	+	+	+
Burton 1995 (15)	?	?	?	?	?	?	-
Christian 2008 (32)	+	+	+	?	+	+	?
Dubbert 2002 (29)	?	?	?	+	?	+	?
Galaviz 2013 (17)	?	?	-	?	+	+	+
Galaviz 2017 (18)	?	?	-	?	?	+	-
Goldstein 1999 (33)	?	?	-	?	?	+	-
Grandes 2009 (19)	+	-	-	+	+	+	?
Harris 2017a (37)	?	?	-	?	+	+	+
Harris 2017b (34)	+	+	-	-	+	+	+
Jansink 2013 (20)	?	?	-	?	-	+	?
Jolly 2018 (30)	?	-	-	+	+	+	-
Kerse 1999 (38)	?	+	-	+	+	+	-
Koelewijn-van Loon 2010 (21)	?	?	-	+	+	+	?
Lakerveld 2013 (22)	+	+	-	+	-	+	?
Leonhardt 2008 (23)	?	?	-	?	-	+	+
Little 2004 (35)	?	?	?	+	+	+	?
Marshall 2005 (36)	?	?	-	+	+	+	-
McCallum 2007 (24)	+	+	-	+	+	+	-
Mehring 2013 (31)	+	+	-	-	+	+	-
Sims 1999 (25)	?	?	?	?	?	+	?
Valve 2013 (26)	+	?	-	?	+	+	?
Van der Weegen 2015 (27)	?	+	-	+	+	+	+
Westland 2020	+	+	-	-	?	+	-

+ = low risk of bias; - = high risk of bias; ? = unclear risk of bias; allocation concealment as well as blinding of participants and clinicians delivering the intervention was not possible in most study designs. All studies reporting follow-up data, had reported data loss. If data loss is less than 15% loss and loss even across groups OR the loss was accounted for conservatively in data analysis (e.g. ITT with replacing missing follow-up data with baseline values), the data loss was rated as low risk of bias; if adherence to the intervention was either not reported or below 80%, this was rated as high risk of bias in 'other bias'.

Figure 2

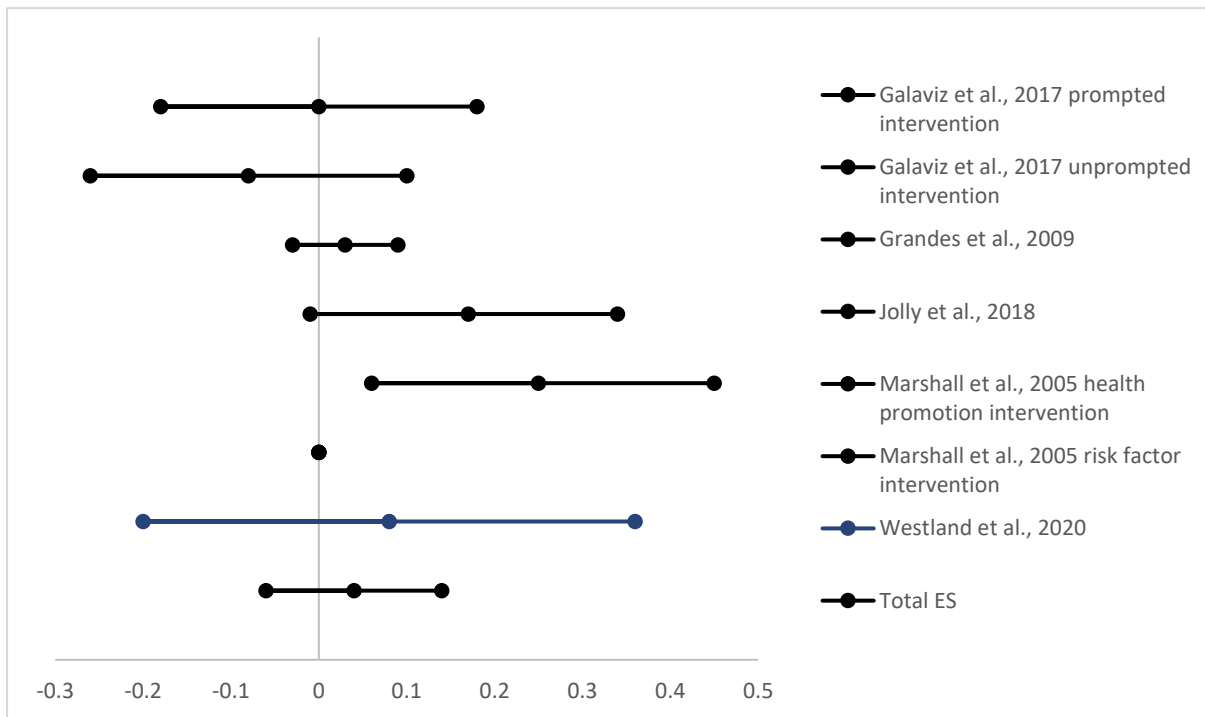


Figure 2: Diagram of effect sizes (ES) and 95% CIs of interventions with a follow-up assessment at 6 months

Figure 3

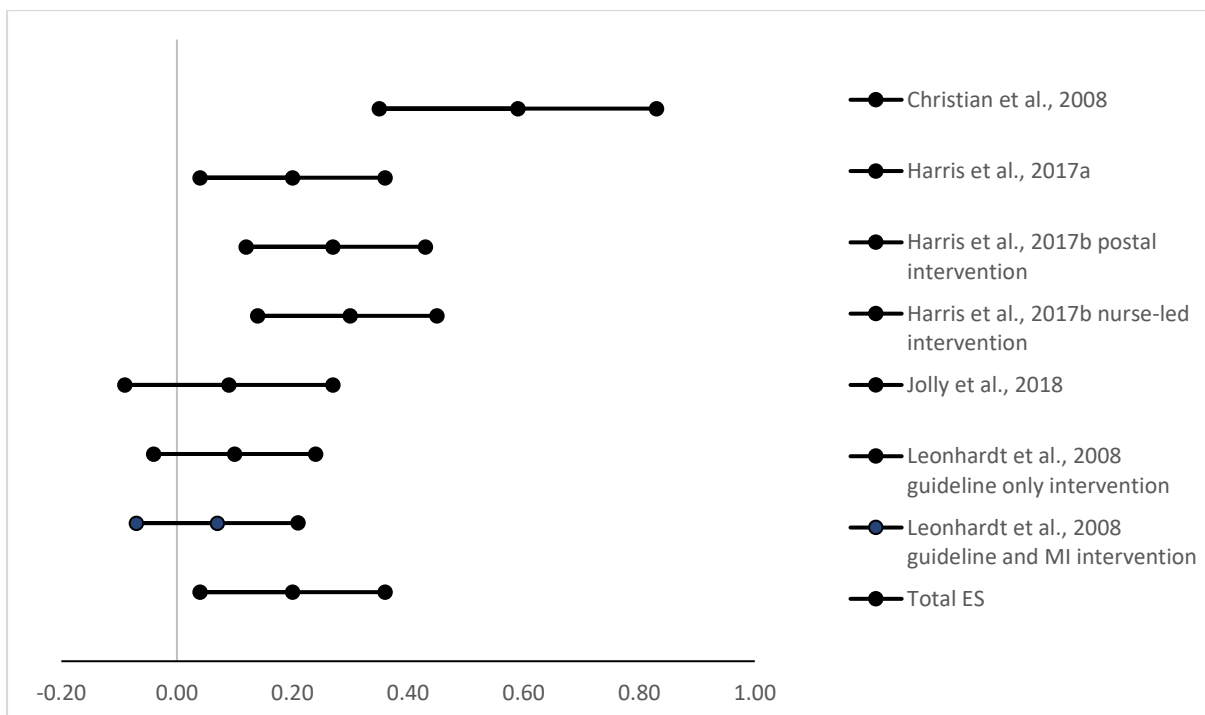


Figure 3: Diagram of effect sizes (ES) and 95% CIs of interventions with a follow-up assessment at 12 months

Supplement Table 1: Articles included in the systematic review

Author, year, country	Design and type of intervention	Sample size and characteristics	Intervention (consultation)	Intervention duration and frequency; intervention fidelity	Intervention deliverer	Training for deliverer	Additions to consultation	PA outcome measures	Results
Ackermann et al., 2005; USA. (16)	2-arm cluster RCT with assessments at baseline and 8-12 weeks; PA intervention.	N=336; 1% women; mean age = 66 yrs; eligibility: enrolled in local PC providers of the Seattle Veterans Affairs; age 50 years or older.	Intervention included PC provider training to deliver PA promotion using prompts from patients. Prompt sheets to determine motivational level were completed by participants before consultations and handed to PC provider. Control group received care as usual.	Single baseline consultation. Intervention fidelity: 38% of participants in control group and 59% of intervention group were given exercise advice (p<0.05)	PC provider (physicians and non-physicians).	10 min individualised training session to PC providers incl. introduction to handouts, behaviour prompts and to focus on patients that are inactive but interested in increasing activity levels.	Patient handouts with results of prompt, community exercise resource guide, information about benefits of PA, how to start safely and individualised exercise prescription	PACE scale for physical activity stage indicating the percentage of people regularly exercising.	No sig. difference between groups in increase in engagement in regular exercise (adjusted OR 1.5 (95% CI 1.0 – 2.3)).
Burton et al., 1995; USA. (15)	2-arm RCT with assessments at baseline and 2 yrs; lifestyle intervention.	N=3097; 62.7% (control group) and 65.5% (intervention group) women; age 65 years or older (no mean reported); Medicare beneficiaries.	Vouchers for preventive examinations at baseline and 1 year including a complete history, physical exam, screening and immunisation as well as a review of lifestyle behaviour. A lifestyle risk assessment completed prior to the visit was sent to the physician. A 20 min follow-up counselling session was offered at 6 months after baseline. The control group	Two preventive examination visits (baseline and year 1) and the offer of an additional 20 min lifestyle counselling session. Intervention fidelity: only 50% of intervention participants	PCP.	One training session for PCPs to review components of preventive and counselling sessions (duration not reported).	None	Self-rated PA level (performing PA such as walking, gardening or heavy housework less than 3 times a week) indicating percentage living a sedentary lifestyle	No sig. difference in PA level increase between groups (percentage people improving intervention vs control for persons in good health 41.8% vs 42%; in poor health 20.4 % vs 17.7%).

			received information regarding good health practices.	attended the year 1 visit, and only 30% attended follow-up visit.					
Christian et al., 2008; USA. (32)	2-arm RCT with assessments at baseline, and 12 mths; PA and weight loss intervention	N=310; 68% women in control group, 65% in intervention group; mean age in both groups 53yrs (SD 11); eligibility: Latino/Hispanic ethnicity, diagnosed with type 2 diabetes, BMI \geq 25, 18-75 yrs old, Medicaid eligible or Medicare beneficiary.	Intervention: completion of a computer-based assessment of motivational readiness to increase PA levels and make dietary changes resulting in a 4-5-page personal report with feedback regarding barriers to improving PA levels and diet. Participant then set 2-3 diet and/or PA goals and received a 30-page planning guide with additional healthy lifestyle information. PC physician received short companion report with counselling recommendations. Control group: received packet of health education materials.	Intervention group: baseline visit based on readiness report, MI counselling and goalsetting; at 3, 6 and 9 mths: review of goals, MI counselling to reinforce patient's lifestyle changes; control group: at mths 3, 6 and 9: usual care visit. No intervention fidelity data reported.	PC physician	3-hour training session on how to use the goal-setting sheets and provide brief motivational interviewing.	Computer-based assessment report for participant and PC physician of motivational readiness to change diet and PA level plus information material.	Energy expenditure (MET-min/wk) estimated with 7-day physical activity recall questionnaire	Change in MET-min/wk (mean increase intervention group: 354 MET-min/wk (SD 574; 95% CI 257.5-451.4) compared to control group: 51 MET-min/wk (SD 443; 95% CI -25.72-127.72) $p < 0.001$. Cohen's $d = 0.59$.
Dubbert et al., 2002; USA. (29)	3-arm RCT with assessments at 6 and 12 mths. PA intervention.	N=212; 1% women; mean age 69 yrs (SD 4.7); eligibility: age 60-80 yrs, independent in activities of daily living, noninstitutionalised, stable health,	All participants watched a motivational and a walking safety video and set individual goals for a walking programme in discussion with a practice nurse. Intervention groups	20 phone calls over 12 months. Calls were tapered (first one a week for a month then decreased in frequency).	Practice nurse.	Not reported.	Motivational and walking safety video.	Adherence to walking at least 20 min 3 times per week. 7-day Physical Activity Recall (PAR) questionnaire score of moderate activity.	No sig. difference in increase in total wkly hours of moderate PA between groups (data per group not reported). Adherence to walking target

		willing to increase walking for exercise and satisfactory performance on a 6-min walking test. Participants already walking for exercise at least 20 min per day were excluded.	received 20 phone calls (either 20 personal calls with tailored counselling or 10 personal and 10 automated calls with standard reminders) from practice nurse. Control group received no calls.	Intervention fidelity: Data on phone call delivery not reported.					sig. better in intervention groups compared to control group (at 6 mths: F (2,178) = 4.75; at 12 mths: F (2, 178) = 4.49). Effect size could not be calculated.
Galaviz et al., 2013; Canada. (17)	3-arm RCT with assessment at baseline and 8 wks; PA counselling intervention. Only the group that had counselling and a prescription was included in this review as the second intervention group participated in a program not delivered by PC providers.	N=35, 100% women, mean age 36 years; eligibility: between 25 and 45 years old, BMI ≤35, viewed by their physicians as patients who could benefit from intervention and were unlikely to meet Canadian PA guidelines.	Prescription only (PO) intervention: brief counselling session based on 7A model (address, ask, advise, assess/agree, assess, assist and arrange). The control group received care as usual. Prescription Plus (PP) group outside remit of this review (included an external exercise programme).	Single 3-min counselling session. Intervention fidelity: all intervention participants completed the single counselling session.	PCP.	30 min face-to-face training for all physicians about counselling and prescription based on 7A model.	PA prescription.	Number of patients meeting Canadian PA guidelines; Godin Leisure-Time Exercise Questionnaire: 1) total PA score based on MET values, 2) weekly PA min.	The increase proportion of participants meeting Canadian PA guidelines was not sig. MET based PA score as well as wkly PA minutes increased sig. in both intervention groups but not the control group Cohen's d for total PA score for PO = 0.04, for PP = 0.23; Cohen's d for weekly PA min for PO = 0.44; for PP = 0.35.
Galaviz et al., 2017; Mexico. (18)	3-arm RCT with assessments at baseline and 1 and 6	N= 687, 77% women, mean age was 48.6 yrs; eligibility: 18 yrs or older, not pregnant, not meeting PA	PA counselling based on 5A model (assess, advise, agree, assist, arrange). The intervention arms included a prompted	Single 3-5-min counselling session. Fidelity of PA counselling	PCP.	Training duration was 3 hours; training included discussion PA consultation	Arrangement of follow-up referrals to PA resources in the clinic or community.	Based on the Godin Leisure-Time Exercise Questionnaire (translated into Spanish) assessing	No sig. difference between control or intervention groups at 1 or 6 months. Cohen's d for unprompted

	months; PA intervention.	guidelines, not involved in other PA programmes, without impediment to engage in PA.	(patient prompted the physician with a card to initiate PA counselling session) or unprompted (the physician started the PA counselling without prompt) intervention. Control group physicians had no training for PA counselling and patients received care as usual.	based on report of patients remembering session.		barriers, behaviour change techniques, counselling using the 5A model, educational training materials and role-playing to reflect on perceptions of control.		PA time over an average week.	intervention at 1 months: $d = 0.02$ (95% CI $-0.18 - 0.20$); at 6 months: $d = 0$ (95% CI $-0.18 - 0.18$); for prompted intervention at 1 month: $d = -0.05$ (95% CI $-0.24 - 0.12$); at 6 months $d = -0.08$ (95% CI $-0.26 - 0.10$).
Goldstein et al., 1999; USA. (33)	2-arm cluster RCT with assessments at baseline, 6 wks and 8 mths; PA intervention.	N=355, 65% women, mean age 66 yrs (SD 9); eligibility: 50 yrs or older; excluded if too active (moderate exercise for ≥ 30 min for at least 5 days/wk or vigorous exercise for ≥ 20 min 3 days/wk) or if unable to provide information on the telephone.	Each participant was interviewed briefly before seeing the physician to assess stage of motivational readiness, PA preferences and barriers to PA. Intervention: Based on the Transtheoretical model and using the 5A-framework (address the agenda, assess, advise, assist and arrange follow-up) the physician used the interview findings and counselled the participant appropriately. Participants also received a written prescription (PA advice) and a PA manual. In addition, participants in the intervention group	Initial 5 min counselling session and one follow-up visit, at which the participant received a PA poster. Intervention fidelity: 93% of intervention participants recalled PA counselling, 67% recalled PA prescription.	PC physician	Physicians in the intervention group attended a one-hour training session in their offices where the information in a 28-page manual for the study was reviewed and counselling techniques practiced. They the manual, a desk prompt with summary information and an office poster on PA promotion.	Manual, written prescription and PA poster.	Physical Activity Scale for the Elderly (PASE): recall of PA over the past 7 days.	No sig. difference between control and intervention group PASE scores at 6 wks (Cohen's $d = 0.04$) or 8 mths (Cohen's $d = 0.02$).

			received 5 monthly mailings (manual again plus 4 newsletters). Participants in the control group received care as usual.						
Grandes et al., 2009; Spain. (19)	2-arm RCT with assessments at baseline and 6 months; PA intervention.	N= 4317, 66% women, mean age 50 years; eligibility: 20-80 years old who did not meet recommended aerobic PA levels (moderate intensity PA for ≥ 30 min for 5 days/wk or vigorous intensity PA for ≥ 20 min 3 days/wk). Not eligible unstable or chronic condition that would preclude safe participation in regular PA.	Participants in the intervention arm received brief advice and the offer for one additional 15-min appointment to prescribe an individualised PA plan. Control group received care as usual.	Single PA advice session plus offer of individualised session to develop PA plan. Intervention fidelity: all participant received, single PA advice session, uptake of additional prescription session not reported.	PCP.	24 hours of training on study protocol and PA counselling.	Advice on PA according to individualised PA plan (for those who attended the additional session)	7-Day PA Recall (PAR): moderate and vigorous PA min/wk, moderate and vigorous PA MET-hour/wk; proportion participants meeting PA guidelines	All outcome parameter improved sig. more in the intervention group compared to the control group (adjusted mean difference for min PA/wk 18.15 (95%CI 5.66- 30.65), Cohen's d=0.03; for MET-h/wk 1.27 (95%CI 0.38- 2.16), Cohen's d=0.03.
Harris et al., 2017a; Australia. (37)	2-arm cluster RCT with assessments at baseline and 12 months; lifestyle intervention.	N=739, 69% women, mean age 56 years; eligibility: age 40-69 years without known diabetes, cardiovascular disease or renal impairment who had visited a study practice within the last year. Exclusion criteria were severe mental illness,	Practice level intervention for both GPs and practice nurses including clinical education in small groups with presentation of guidelines, behaviour change techniques and MI. Further support and feedback including facilitation visits from trained preventive care specialists was	Not reported on patient level. Intervention fidelity practice level: all intervention training sessions were provided as planned. In 3/2 practices all facilitator	GPs and practice nurses	Single 3-hour training session.	None	National Health Survey including question about PA level.	No sig. difference in PA in either group. Cohen's d for the effect of the intervention on PA was 0.16.

		substance abuse or pregnancy.	available. Control group received care as usual.	visits were delivered in the 3 rd practice 67% were delivered.					
Harris et al., 2017b; UK. (34)	3-arm cluster RCT with assessments at baseline, 3 and 12 months; PA intervention.	N=1023, 64% women, mean age not reported; eligibility: age 45-75 yrs; without contraindications to increasing MVPA, excluded were care home residents and those considered unsuitable.	Intervention duration: 3mth. Postal pedometer intervention: received pedometer, PACE handbook and PA diary with individualised walking programme. Nurse-led intervention: received pedometer, PACE handbook, PA diary with individualised walking programme and 3 individually tailored practice nurse-led consultations incl. goalsetting and feedback. Control group: usual care.	The nurse supported group received 3 individually tailored practice nurse consultations (10-20 min each) in approx. wk 1, 5 and 9. Intervention fidelity: 74% of the participants of the nurse-led intervention attended all 3 consultations.	Practice nurses	Not reported.	None.	Step count assessed by accelerometer over 7 days between baseline and 12 months incl. changes in step count between baseline and 3 months, changes in time spent in weekly MVPA in ≥ 10 min bouts, time spent sedentary between baseline and 12 months	At 3 and 12 mths: sig. difference between intervention groups and control group, with sig. higher step counts and MVPA in the intervention grps compared to the control grp (For daily step count, Cohen's d for the postal grp intervention at 3 and 12 mths was 0.27; for the nurse grp intervention Cohen's d at 3 mths was 0.47, at 12 mths 0.30; for MVPA, Cohen's d for the postal group at 3 months was 0.43, at 12 mths 0.36; for the nurse grp intervention Cohen's d at 3 mths was 0.59, at 12 mths 0.41). Sedentary time

									was similar between groups with no sig. change (Cohen's d for postal grp intervention at 3 mths 0.0, at 12 mths 0.01; for the nurse grp intervention at 3 mths 0.01, at 12 mths 0.05).
Jansink et al., 2013; Netherlands. (20)	2-arm cluster RCT with assessments at baseline and 14 months; lifestyle intervention.	N= 336, 45% women, mean age 64 yrs; eligibility: <80 years, type 2 diabetes, HbA1c > 7%, BMI > 25, exclusion criteria were complex comorbidity and treatment in hospital.	Intervention: lifestyle counselling and telephone follow-ups using MI. Control: usual care.	Not reported. Intervention fidelity: not reported.	Practice nurse.	4 half-day group training sessions over 6 months including MI training, record keeping, diabetes information and use of an instruction chart.	Recording tools and guidelines for the practice nurses.	Self-report of activity during an average week (min/day); min/day of low, medium and high activity recorded on activity monitor;	No sig. difference in any measures between groups. Cohen's d for PA min/day was 0.06, for low activity min/day 0.01, for medium activity min/day 0.0, for high activity min/day 0.13.
Jolly et al., 2018; UK. (30)	2-arm RCT with assessments at baseline, 6 and 12 months; lifestyle intervention.	N= 577, 36% women, mean age 70 yrs; eligibility: On practice COPD register, had respiratory symptoms consistent with COPD, mild dyspnoea grade 1 or 2, had a forced expiratory volume in one second/ forced vital capacity <0.7 after post-bronchodilator	Intervention: the telephone health coaching intervention was underpinned by the Social Cognitive Theory and included education, monitoring, assessment of progress, and taught skills with the aim of increasing self-efficacy. Control: usual care.	Initial call lasted 35 to 60 min, calls at week 3, 7 and 11 took 15 to 20 min. Intervention fidelity: 86.4% of scheduled calls were delivered and 75.4 of all participants received all 4 calls.	Practice nurse	Two days of training and practice of coaching sessions with research team.	Written documents, pedometer and self-monitoring diary.	Accelerometer (MVPA min /wk), International Physical Activity Questionnaire (total MET-min/wk, walking MET-min/wk, moderate MET-min/wk and vigorous MET-min/wk).	At 6 months, the intervention group had sig. higher levels of PA in all measures compared to the control group. These were non-sig. at 12 months. For MVPA min/wk, Cohen's d at 12 mths was 0.12; for total MET min/wk Cohen's d at 6

		spirometry at baseline, considered appropriate for the study.							mths was 0.25, at 12 mths 0.14. For walking MET min/week at 6 mths Cohen's d was 0.25, at 12 mths 0.17. For moderate MET min/wk Cohen's d at 6 mths was 0.17, at 12 mths 0.11. For vigorous MET min/wk, Cohen's d at 6 mths was 0.16, at 12 mths 0.09.
Kerse et al., 1999; Australia. (38)	2-arm cluster RCT with assessments at baseline and 1 yr; lifestyle intervention.	N= 267; 54% women, mean age 73.5 yrs (SD 0.59); eligibility: age ≤65yrs, English speaking, attended practice in last 18 mths, attended enrolled PCP for 3 out of 5 last visits.	Practice level educational intervention for PCP covering social and physical activity, prescribing and vaccination for elderly patients. Educational programme was delivered in 5 stages: clinical practice audit with feedback, educational detailing, card-based prompt system, seminar or home-based learning and distribution of resource directory for elderly patients.	Practice level education programme: duration 2 to 3 mths, frequency and duration of educational sessions not reported. Intervention fidelity: after the trial period, 32% in the intervention and 19% in the control group remembered discussing exercise with	PCP.	Practice level education programme took 2—3 months.	None.	Self-report questionnaires for: 1) minutes walking previous day, 2) minutes walking last 14 days, 3) minutes total PA in last 14 days.	Minutes walking in the last 14 days increased sig. more in the intervention group compared to the control group. Cohen's d could not be calculated. No sig. difference in minutes walking previous day or total PA between intervention and control group.

				their physician.					
Koelewijn-van Loon et al., 2010; Netherlands. (21)	2-arm cluster RCT with assessments at baseline and 12 weeks; lifestyle intervention.	N=615; 55% women, mean age 57 yrs (SD 10); eligibility: 1) blood pressure \geq 140 mmHg or already treated for hypertension, 2) total cholesterol \geq 6.5 mmol/l or already treated for high cholesterol, 3) smoking (men \geq 50 yrs, women \geq 55 yrs), 4) having diabetes, 5) having a family history of cardiovascular disease, 6) having visible obesity.	Intervention: risk assessment and communication, distribution of a decision support tool, adapted MI. Control: usual care plus risk assessment training for practice nurses in control clusters.	Two 20-min face-to-face consultations plus 10-min telephone or face-to-face consultation. Intervention fidelity: not reported.	Practice nurse	Two-day training course covering the intervention components (risk assessment and communication, distribution of a decision support tool, adapted MI)	None	Dutch version of Communities Health Activities Model Program for Seniors (CHAMPS) min/wk of moderate and vigorous PA.	No significant differences between groups at follow-up (Cohen's d = 0.10).
Lakerveld et al., 2013; Netherlands. (22)	2-arm RCT with assessments at baseline, 6 and 12 months; lifestyle intervention.	N=622; 58% women, mean age 44 (SD 5.3); eligibility: age 30-50, self-administered waist circumference (\geq 101 for men, \geq 87 for women), type 2 diabetes and/or cardiovascular disease risk with at least 10% with no known prevalent type 2 diabetes or cardiovascular disease.	Intervention: based on the theory of planned behaviour and the theory of self-regulation. Included MI to strengthen the attitude and intention to change behaviour and problem-solving treatment plus tools to overcome barriers to the behaviour change. Control: standard brochure containing guidelines regarding PA and healthy eating.	Six face-to-face counselling sessions each 30 min, followed by 3-monthly telephone sessions (duration not reported). Intervention fidelity: not reported.	Practice nurse	18 hours of specific training from experienced psychologists (12 hours on MI, 6 hours on problem solving treatment)	Treatment manual for practice nurses	1) Self-reported physical activity translated into MET-min/day. 2) Number and proportion of participants who completed \geq 30 min of physical activity at least 5 days/wk	No significant difference between intervention and control group at 6 or 12 months. Cohen's d could not be calculated.

<p>Leonhardt et al., 2008; Germany. (23)</p>	<p>3-arm cluster RCT with assessments at baseline and 6 and 12 months; PA intervention;</p>	<p>N=1378; 58% women, mean age 49 yrs (SD 13); eligibility: patients who had presented with lower back pain in the previous 11 yrs; exclusion criteria were insufficient language skills, pregnancy, isolated thoracic pain.</p>	<p>Intervention A included lower back pain guideline implementation. Intervention B was based on additional transtheoretical model-based motivational counselling. Training of practice nurses included information about lower back pain, general counselling skills, identification of stages of change and support of patient self-efficacy to promote PA. Control: usual care.</p>	<p>Up to 3 motivational counselling sessions (max. 15-20 min each) by practice nurse. Intervention fidelity: 97% of practice nurses put counselling into practice; 80% of patients in intervention B received MI sessions.</p>	<p>Intervention A: PCP; intervention B: practice nurses.</p>	<p>Intervention A training included 3 interactive 2-hour quality circles and providing extensive information material. Intervention B training included 20 h in 2 full day workshops plus 1-3 supervision sessions.</p>	<p>None</p>	<p>Freiburger Questionnaire on Physical Activity asking about health-related PA; scores were converted to MET-hours/wk</p>	<p>No sig. difference in score change between groups at 6 or 12 months. Cohen's d could only be calculated for the intervention effects at 12 months. At this point, Cohen's d for both interventions was 0.1.</p>
<p>Little et al., 2004; UK. (35)</p>	<p>2x2x2 factorial RCT with assessments at baseline and 1 month; PA intervention.</p>	<p>N=151, 52.6% - 58.6% female depending on group, mean age 57- 60 (SD 11 -13) yrs depending on group; eligibility: 1 or more risk factor for coronary heart disease, diagnosis by GP of hypertension or hyperlipidaemia, BMI >25, or diabetes; exclusion: unable to perform moderate exercise, unable to complete questionnaire, under age of 18.</p>	<p>Interventions included: 1) PCP prescription of exercise (brief discussion of exercise, targets, how to start and anticipating relapse plus prescription for 30 min, 5x per week brisk walking); 2) nurse counselling (detailed motivational discussion based on theory of planned behaviour including precise time and place to start exercise, as well as an agreed and signed contract for exercising); 3) a booklet (standard public resource health advice).</p>	<p>Not reported. Intervention fidelity: not reported.</p>	<p>PCP and practice nurse.</p>	<p>Not reported.</p>	<p>A general health advice booklet was one of the intervention factors.</p>	<p>Godin Leisure-Time Exercise Questionnaire (weighting mild, moderate and strenuous activity according to energy expenditure per week).</p>	<p>No sig. difference between control and intervention groups at follow-up. Cohen's d depending on intervention combination between 0.01 (GP prescription) and 0.26 (GP prescription and nurse counselling).</p>

<p>Marshall et al., 2005; Australia. (36)</p>	<p>2x2x2 factorial design cluster RCT with assessments at baseline, 2 and 6 mths</p>	<p>N= 767, 53.6 % - 64.2% women depending on group, mean age 53.5 – 56.9 yrs depending on group (SD 8.0-8.9); eligibility: age 40-70 yrs, attending the surgery for themselves, insufficiently physical active, able to walk independently for at least 10 min, literate in English, no medical contra-indications for moderate-intensity PA. For the Risk factor (RF) intervention and control group, also diagnosis of hypertension.</p>	<p>Health promotion (HP) intervention: health promotion with materials and advice that encouraged them to be more active for their general health; Risk factor (RF) intervention: materials and ‘medicalised’ advice focussed on being more active to manage their hypertension. For both groups, PCPs discussed the benefits of PA, identify preferred types of PA and develop a programme of activity that was then recorded as ‘Active Prescription’. HP and RF control groups received case as usual.</p>	<p>Duration of PA advice consultation not reported. Intervention fidelity: 30% of HP and 34% of RF intervention participants received all components (advice, Active Prescription and booklet).</p>	<p>PCP.</p>	<p>Group or individual training was offered to physicians. Duration and attendance not reported.</p>	<p>Intervention groups also received one of two self-help booklets based on motivational readiness for PA. It included support strategies for either reinforce the health benefits of PA (for HP group) or the role of PA in hypertension control (RF group).</p>	<p>Proportion meeting sufficient PA criterion (≥ 700 MET min per wk assessed with the International Physical Activity Questionnaire (IPAQ)).</p>	<p>There was no significant difference between intervention and control groups at 2 or 6 mths.(For HP: OR at 2mths 0.84 (95% CI 0.52-1.34), at 6 mths 1.52 (95% CI 0.93-2.28); for RF: OR at 2 mths 0.97 (95% CI 0.54-1.75), at 6 mths 1.09(95% CI 0.58-2.05).</p>
<p>McCallum et al., 2007; Australia. (24)</p>	<p>2-arm RCT with assessments at baseline, 9 and 15 mths; lifestyle intervention.</p>	<p>N= 163, 52% girls, mean age 7.4 (SD1.6); eligibility: children classified as overweight or mildly obese in a BMI survey who were not receiving ongoing weight management; excluded if having any chromosomal, endocrine or medical condition,</p>	<p>Intervention: PCPs used a solution-focused approach to set appropriate, healthy lifestyle goals with the family and provided a 20-page, personalised brochure designed at a 12-year old reading level with topic sheets, modelled solutions to barriers and suggestions for how to achieve the</p>	<p>4 PCP visits over 12 wks. Intervention fidelity: 41% of intervention participants attended all 4 sessions, 21% attended 3 sessions, 17% each 2 or 1 session, 4%</p>	<p>PC physician.</p>	<p>3 information evenings including standardized education package regarding delivery of intervention including solution-focused therapy techniques.</p>	<p>Personalised brochure.</p>	<p>Activity diaries recorded parents’ ratings of children’s PA intensity in 15 min intervals on a scale from 1 to 7 (% of MVPA and total daily PA).</p>	<p>No sig. difference between intervention and control group at 9 and 15 mths. At 9 mths,, Cohen’s d for % MVPA was 0.37, for total daily PA 0.18. At 15 mths, Cohen’d was 0.2 for both outcomes.</p>

		which could have an impact on their weight or growth.	goals. Control: Care as usual.	did not visit the PCP.					
Mehring et al., 2013; Germany. (31)	2-arm cluster RCT with assessments at baseline and 12 wks; PA intervention.	N = 186, 70% women in intervention group, 63% women in control group; mean age intervention group 47 yrs (SD 11), mean age control group 51 yrs (SD 15); eligibility: BMI \geq 25, \geq 18 yrs, sufficient German language skills, internet access. Exclusion criteria for several health issues, pregnancy and breast feeding applied.	Intervention: health data and PA advice was documented by the PCP online creating an individual coaching programme based on cognitive behavioural and behavior change theories. The programme included individualized education, motivation and exercise guidance structured into 12 modules. It provided daily text message reminders, allowed online self-monitoring and prompted 3 phone calls by the PCP or practice nurse to patients. Control: care as usual.	Phone calls from PCP or practice nurse at week 1, 5 and 12; duration of initial visit and phone calls not reported. Intervention fidelity: mean completion rate of modules was 6.4/12 (SD 4.2) taking 72.7 (SD 28.7) days (out of 12 weeks).	PCP and practice nurse.	PCPs and nurses of intervention group received detailed instructions regarding study processes and coaching programme. No further details regarding training reported.	Access to online coaching modules.	Self-rated PA on a scale from 1 to 4.	Sig. increase in in self-rated PA. Cohen's d = 0.54.
Sims et al., 1999; UK. (25)	2-arm RCT with assessments at baseline and 8 wks; PA intervention.	N= 20; 35% women, mean age 72 yrs (SD 4.3); eligibility: excluded if diagnosed with poorly controlled angina, heart failure, uncontrolled hypertension or any other sig. or progressive disabling condition.	Intervention: based on the transtheoretical model of change. Nurse and patient developed an individualised, planned activity schedule as part of a motivational interview. The implementation of the plan was discussed along with barriers to exercise on the phone at 2 and 6 wks. Control: standard PA advice.	One in person discussion plus 2 phone calls; duration not reported. Intervention fidelity: not reported.	Practice nurse.	Practice nurse received training about the transtheoretical model and MI; duration of training not reported.	None.	PA assessed using the Godin and Shepard form recording 15 min periods of mild, moderate or strenuous PA in the previous week.	No sig. difference between groups. Both groups sig. increased number of moderate PA 15-min periods. Effect size could not be calculated.

<p>Valve et al., 2013; Finland. (26)</p>	<p>2-arm cluster RCT with assessments at baseline and 1.5 – 2.5 years; lifestyle intervention</p>	<p>N= 3059, 100% women, median age 19 years; eligibility: age 17-21 and participating in a human papilloma virus vaccination trial, pregnancy was exclusion criterion.</p>	<p>Intervention was based on positivity, encouragement, and building collaborations; it included positive feedback, goal setting and discussions on how to reach the goal.</p>	<p>The initial intervention session took approx. 15 min and was followed up by further sessions every 6 months over 1.5 to 2.5 years. Intervention fidelity: No further details reported</p>	<p>Practice nurse</p>	<p>Two 4-hour group training sessions for collaborations and empowerment themes. These initial sessions were followed up with 2-hour group supervisions after the intervention had started plus an option to consult a psychologist.</p>	<p>None.</p>	<p>Self-report physical activity level using 4 categories (inactivity, moderate activity for at least 4 hours per week vigorous activity for at least 3 hours per week, competitive sports or exercise several times a week).</p>	<p>No sig. difference in between groups. Effect size could not be calculated.</p>
<p>Van der Weegen et al., 2015; Netherlands. (27)</p>	<p>3-arm cluster RCT with assessments at baseline, after the intervention at 4-6 mths and 9 mths; PA intervention.</p>	<p>N= 199, 51% women, mean age 58 yrs (SD 7.6); eligibility: age between 40 and 70 yrs with diagnosis of diabetes type 2 (DM2) or chronic obstructive pulmonary disease (COPD), not following Dutch guidelines for PA; for DM2: BMI >25; for COPD: diagnosis acc. To Gold criteria 1-3, stable in their respiratory function for at least 6 wks and on stable drug regimen; able to access computer</p>	<p>Intervention consultation was based on 5 As (assess, advise, agree, assist, arrange) and consisted of consultations in 1st wk (booklet, discussion of risks due to physical inactivity), after 2 wks (goal setting and exploration of local activities), after 2-3 mths (feedback, review goals, discuss barriers and facilitators, agree on follow-up) and after 4-6 mths (feedback, discuss barriers and facilitators, development of habits, agree on follow-up). Intervention group 1</p>	<p>4 intervention sessions, duration not reported. Intervention fidelity: intervention group 1, 12 participants did not receive the number of intervention sessions as intended; in group 2, 7 participants did not receive the intended number of</p>	<p>Practice nurse</p>	<p>Online Web lecture and personal instruction sessions at the nurse's workplace. Information about the 4 A model, associated counselling techniques and instructions charts for each consultation.</p>	<p>Booklet at first consultation with information about intervention, activity questionnaire and list of local PA activities and activity monitor.</p>	<p>PAM accelerometer (average minutes moderate or vigorous PA per day for 8 days) converted into MET units.</p>	<p>Sig. increase in PA at 4-6 and 9 mths. No sig. difference between intervention groups at follow-up assessments. Cohen's d at 4-6 mths for consultation only = 0.26, at 9 mths d= 0.11; Cohen's d at for consultation plus activity monitor and feedback at 4-6 mths = 0.39; at 9 mths = 0.30.</p>

		with Internet connection and sufficient language skills.	received consultations plus an activity monitor with online feedback, intervention group 2 received consultations only. The control group received care as usual.	intervention sessions.					
Westland et al., 2020; Netherlands. (27)	2-arm cluster RCT with assessments at baseline, 3 and 6 mths; PA intervention.	N= 195, 39% women, mean age 66.33 (SD 8.7); eligibility: age between 40 and 75 yrs at risk of CVD, less than 30 min of moderate to vigorous PA on 5 or more days a week, mastering Dutch language, exclusion criteria were not being able to give informed consent, mental or physical impairment, participation in a structured exercise programme in the past 2 yrs.	Intervention was based on Behaviour Change Wheel and consisted of 4 consultations in wk 1, 3, 7 and 12. Wk 1 included information about trial, websites, apps, risks of CVD, benefits of and tips for PA, patients received activity logs and forms for action planning; in the 2 nd consultation the information was repeated. In the 2 nd , 3 rd and 4 th consultation, nurses provided feedback, adjusted goals and action plans if needed; in 3 rd and 4 th consultation, nurses also discussed relapse prevention and formation of new activity habits. During intervention patients self-monitored PA using an accelerometer and keeping an activity log.	4 intervention sessions, each 20-30 min. Intervention fidelity: in total 73 participants attended all 4 consultation sessions (78.5%).	Practice nurse	One day skills training plus two individual coaching sessions with a health psychologist, instructional videos showing how to apply the behaviour change theories in consultations and a handbook providing a structure for the consultations, example sentences and checklists for procedures.	Accelerometers and activity log.	At 6 mths: PAM accelerometer min (average min moderate or vigorous PA per day for 7 consecutive days); PAM accelerometer min with added self-reported cycling, swimming and strengths training min, self-reported PA.	No significant differences at 6 months follow-up between control and intervention groups. Cohen's d at 6 mths for PAM accelerometer min d= 0.17; for PAM accelerometer min plus cycling, swimming and strengths training min d = 0.08; for self-reported PA d= 0.14.

BMI: body mass index; CI: confidence interval; CHAMPS: Community Healthy Activities Model Programme questionnaire; COPD: chronic obstructive pulmonary disease; CVD: cardiovascular disease; kcal/wk: kilocalories per week; MET: metabolic equivalent; MET min: ratio of work MET metabolic rate to resting metabolic rate; MI: Motivational Interviewing; min: minutes; MVPA: moderate to vigorous physical activity; mth: month; OR: odds ratio; PA: physical activity; PACE: Physician-based Assessment and Counselling for Exercise; PC: primary care; PCP: primary care physician; RCT: randomised controlled trial; SD: standard deviation; sig. : significant; wk: week; yr: year.

