Physical activity on prescription in accordance with the Swedish model increases physical activity: a systematic review

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ABSTRACT

Objectives This study investigates the effects of the core elements of the Swedish model for physical activity on prescription (PAP) by evaluating studies that compared adults who received PAP with adults who did not receive PAP. All participants were adults identified by a healthcare professional as in need of increased physical activity. Primary outcome was level of physical activity.

Design Systematic review.

Eligibility criteria (1) Published 1999. (2) Systematic review, randomised controlled trial (RCT), non-RCT or case series (for adverse events). (3) ≥12 weeks' follow-up. (4) Performed in the Nordic countries. (5) Presented in English, Swedish, Norwegian or Danish.

Data sources Systematic searches in PubMed, Embase, the Cochrane Library, AMED, CINAHL and SweMed+ in September 2017. Included articles were evaluated using checklists to determine risk of bias.

Results Nine relevant articles were included: seven RCTs, one cohort study and one case series. Primary outcome was reported in seven articles from six studies (five RCTs, one cohort study, 642 participants). Positive results were reported from three of the five RCTs and from the cohort study. No study reported any negative results. Swedish PAP probably results in an increased level of physical activity (GRADE⊕⊕⊕O).

Conclusions Although the number of the reviewed articles was relatively modest, this systematic review shows that PAP in accordance with the Swedish model probably increases the level of physical activity. As a model for exercise prescription, Swedish PAP may be considered as part of regular healthcare to increase physical activity in patients.

What is already known

- Physical inactivity is the fourth leading cause of non-communicable disease worldwide according to the WHO.
- A large part of the population in industrialised countries, including the population in contact with healthcare, is insufficiently physically active.
- Methods to increase the level of physical activity in patients have shown mixed results in previous systematic reviews and therefore new methods are needed.

What are the new findings

- The present systematic review shows that the Swedish physical activity on prescription (PAP) method probably increases the level of physical activity in adult patients who are insufficiently active (GRADE⊕⊕⊕O).
- We suggest that the Swedish PAP model be used in the healthcare setting to increase the level of physical activity and be implemented as part of routine healthcare.

INTRODUCTION

Lack of physical activity (PA) is a major health threat globally as one-third of all adults are estimated to fall short of existing public health guidelines for PA.[1] According to the WHO, inadequate PA is the fourth leading risk factor for non-communicable diseases, accounting for more than 3 million premature deaths in 2004.[2] Inadequate PA accounts for 30% of the ischaemic heart disease burden and 27% of type 2 diabetes burden.[2] Regular PA may both treat and prevent diseases such as cardiovascular disease. PA may also be an effective treatment for diabetes mellitus,[3] overweight/obesity,[4] chronic obstructive pulmonary disease[5] and atherosclerotic cardiovascular disease.[6]

Although global consensus concludes that inadequate PA can cause health problems and that increased PA can improve health, evidence is still lacking with regard to optimal methods for increasing PA for people who would benefit from increased PA. As with other lifestyle interventions such as smoking and alcohol counselling, promoting PA has become part of routine healthcare. Several attempts have been made to implement different types of exercise prescription models in different countries with varying results,[7] and there is evidence that PA interventions may be useful for increasing PA in healthy adults.[8]

A model used in several countries is exercise referral schemes. In these schemes, the patient usually takes part in supervised group exercise at specific exercise centres for a specified period. Several systematic reviews of exercise referral schemes have found that these schemes result in a small to medium increase in PA level.[9 10] Several systematic reviews have also studied key features of exercise prescription that have been successful.

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These features include follow-up,[11] primary care-based intervention[12] and duration of the exercise referral scheme.[7]

Sweden has developed and adopted its own model—physical activity on prescription (PAP). All licensed Swedish healthcare professionals may prescribe PAP.[13] The method has previously been described in detail and consists of three core elements: patient-centred dialogue; individually tailored PA recommendation with written prescription; and follow-up.[14] Swedish PAP has been used for almost 20 years and several scientific studies have evaluated its efficacy, but no systematic review has been performed.

To this end, we performed a systematic review with the aim to evaluate the existing scientific evidence for the efficacy of the Swedish PAP model. Our main objective was to determine whether PAP in accordance with the Swedish PAP model increased PA, compared with no PAP. In addition, we evaluated whether the Swedish PAP model influenced mortality, morbidity, adverse events, physical function and health-related quality of life (HRQoL). Our objective was defined based on participants, intervention, comparison and outcome (PICO):

- *Participants:* Adults identified by a healthcare professional as in need of increased PA.
- *Intervention:* PAP containing the core elements of the Swedish model performed in the Nordic countries. Swedish PAP was defined as including patient-centred dialogue, individually tailored PA recommendation with written prescription and follow-up.
- *Comparison:* No PAP in accordance with the Swedish model, excluding disease/injury-specific rehabilitation.
- *Outcome:* Primary—level of PA. Secondary—mortality, morbidity, adverse events, physical function and HRQoL.

METHODS

The study protocol, consisting of PICO and eligibility criteria for reports, was written before the search was conducted. The systematic review was not registered in any trial registry. This report is based on the work from a health technology assessment (HTA) performed at HTA centrum, Sahlgrenska University Hospital in Gothenburg, Sweden.[15]

ELIGIBILITY CRITERIA

To be included in this systematic review, studies should comply with the PICO and fulfil the following eligibility criteria:

- Publication date: 1999.
- Study type: Systematic review, randomised controlled trial (RCT), non-RCT or case series (for adverse events).
- Study length: At least 12 weeks of follow-up.
- Setting: Nordic countries.
- Language: English, Swedish, Norwegian or Danish. Finnish was not included due to language barriers.

Search and study selection

During September 2017, two authors (TS, ELD) performed systematic searches in PubMed, Embase, the Cochrane Library, AMED, CINAHL, PsycINFO and SveMed+. In addition, these two authors searched the SBU, Folkehelseinstituttet and Sundhedsstyrelsen websites. To identify additional references, reference lists of relevant articles were searched manually. The search strategy for the search in PubMed can be seen in online supplementary box 1. A graphic presentation of the selection process of studies (reports) is presented in figure 1. These two authors (TS, ELD) also conducted literature searches and independently selected the studies, assessed the obtained abstracts and made a first selection of full-text articles for inclusion or exclusion. Any disagreements were resolved through consensus. The remaining articles were sent to all authors and they independently read the articles, and a final decision on inclusion was made via consensus during a meeting of all the authors. The included studies and their designs and patient characteristics are presented in table 1. The excluded studies and the reasons for exclusion are presented in online supplementary table 1. To assess the ongoing scientific activity in the research field and also to estimate the risk for publication bias, we performed a search in ClinicalTrials.gov (12 November 2017) to detect ongoing studies and any unpublished studies.

Data extraction and quality assessment

The included studies, except for the case series, were critically assessed using separate checklists to assess RCTs and cohort studies. These checklists are used in all HTA reports performed at HTA centrum, Sahlgrenska University Hospital, and are modified versions of checklists from the Swedish agency for HTA and assessment of social services (SBU). Study quality issues were grouped into three main categories: directness (including exclusions, recruitment, population and eligibility criteria); study limitations (including blinding, dropouts, compliance, study length, randomisation and outcome reporting); and precision (including sample size, measurements, results reporting and statistical methods). Using the Grading of Recommendations Assessment, Development and Evaluation (GRADE) guidelines, we evaluated each study's quality per category as follows: no serious problems; some problems (but not enough to downgrade); or serious problems.[16] A study's grade could also be a combination of two of the three levels, for example, some to major problems. Data were extracted by at least two authors per outcome.

Data synthesis and analysis

The results and the assessed quality of each article were summarised and assessed per outcome. The summary measures used in each report are presented in tables in the Results section. The certainty of evidence was defined according to the GRADE system.[16]

PATIENT INVOLVEMENT

This research was done without patient involvement. Patients were not invited to comment on the study design and were not consulted to develop patient-relevant outcomes or interpret the results. Patients were not invited to contribute to the writing or editing of this document for readability or accuracy. There are plans to disseminate the results of the research to the relevant patient community. We did not evaluate whether the studies included in the review had any patient involvement.

RESULTS

Figure 1 shows a flow chart of the search and selection process. The literature search identified 1093 articles after removal of duplicates. After reading the abstracts, 1015 articles were excluded. Another 39 articles were excluded by two authors after reading the full articles. The remaining 39 articles were sent to all members of the project group, and nine articles (seven RCTs, one cohort study and one case series) were identified as fulfilling the inclusion criteria and were included in the final assessment (table 1).[17–25] Three articles presented results from the same RCT.[20 22 23] The case series was included to collect information on adverse events.

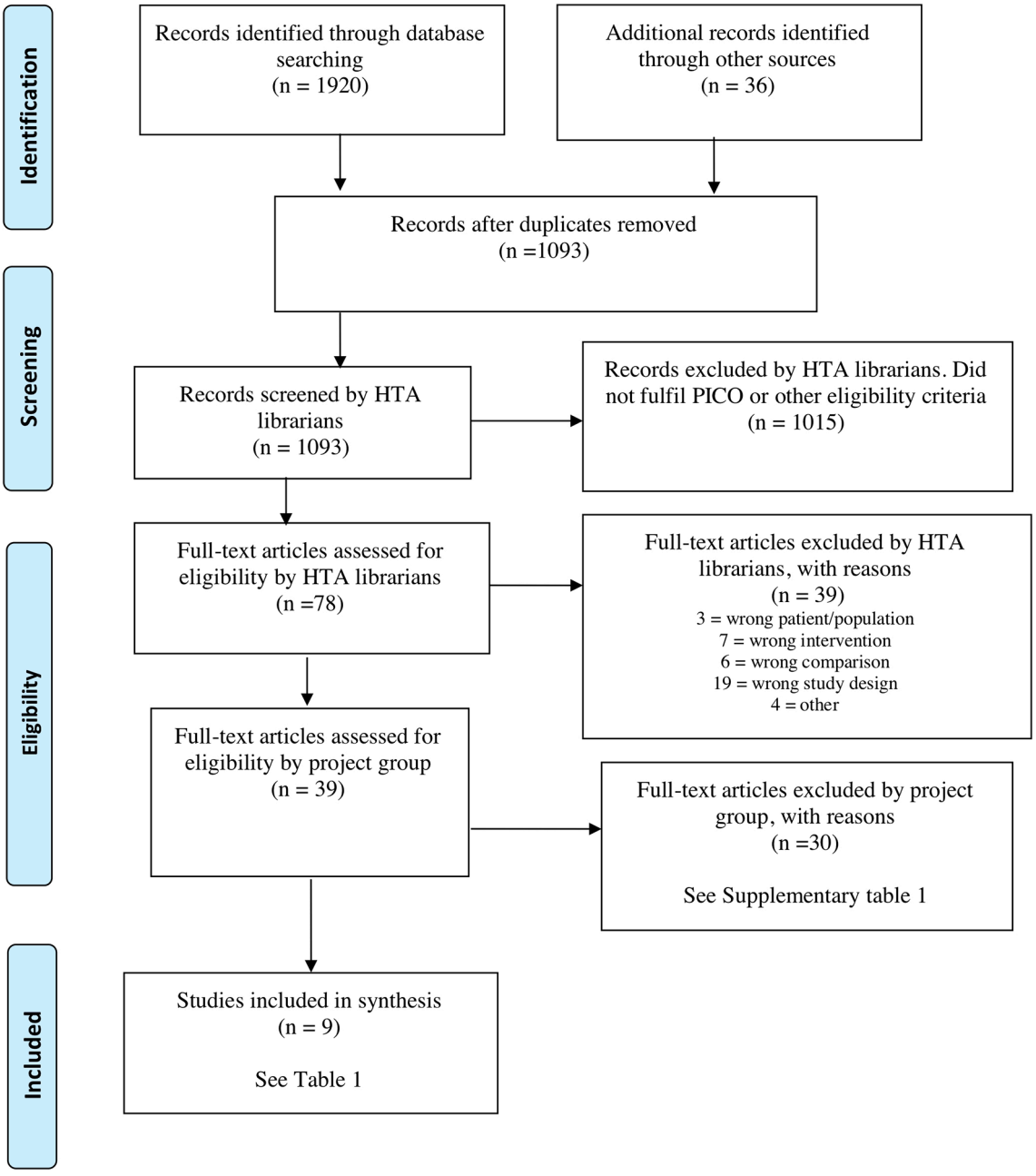

Figure 1 Selection process—flow diagram. HTA, health technology assessment; PICO, participants, intervention, comparison and outcome.

Overall, the controlled studies had no serious problems with directness, some problems with study limitations and some or major problems with precision (table 1). We found five studies in ClinicalTrials.gov that were either in the process of recruiting patients or were completed but not yet published. As these five studies were completed less than 2 years prior to our study, they presented a low risk for publication bias.

PRIMARY OUTCOME

The effect on the level of PA was reported in seven articles that derived from five RCTs and one cohort study for a total of 642 participants.[17–21 23 24] The studies had no serious problems with directness but some problems with study limitations and precision. A majority of studies used different types of self-assessments to measure the level of PA. Results are shown in online supplementary table 2.

Although 12 weeks was the minimal follow-up time, several studies reported follow-up after 6 months and two studies reported follow-up after 18 or 36 months. Because different aspects of level of PA were reported and combined with varying follow-up times, no meta-analysis could be performed. Three out of five RCTs and the cohort study showed statistically significant positive effects on at least one outcome measure for level of PA in favour of Swedish PAP compared with no PAP. No study reported decreased level of PA following Swedish PAP. Aittasalo *et al* reported an increase from 2.3 to 3.5 moderate to vigorous PA (MVPA) sessions per week in the intervention group, which is a 0.9 MVPA session per week more compared with the control group (95% CI 0.2 to 1.5).[17] Kallings *et al* and Sjögren *et al* (same RCT) reported that participants in the intervention group more than doubled their weekly exercise time, an increase of 159 min/week (IQR 0–430), which was a significantly greater

Table 1 List of included studies and their characteristics

Author, year, country	Study design	Study duration (years)	Study groups Intervention versus control	Participants (n)	Mean age (years)	Men (%)	Outcome variables	Primary outcome	Directness	Study limitations	Precision
Aittasalo *et al*,[17] 2006, Finland	RCT	2003 (1 year)	I=PAP C2=Usual care	203	47	24	Frequency total PA (IPAQ) Duration total PA (IPAQ) Frequency MVPA (IPAQ) Duration MVPA (IPAQ)	Change in frequency and/or duration of total PA and MVPA Numbers of issued PAP	+/?	?/–	+/?
Hellgren *et al*,[18] 2016, Sweden	RCT	3 years	I1=PAP+ pedometer+cost-free glucose monitoring I2=I1+supervised group sessions (8 for 12 months)+reminder every 3 months C=Usual care	96	63	42	Development of diabetes HOMA-IR HbA1c Waist circumference Systolic blood pressure Diastolic blood pressure Body weight PA (four-level scale)	Not defined	+	+/?	?/–
Hemmingsson *et al*,[19] 2009, Sweden	RCT	2005–2008 (4 years)	I=PAP focused on cycling and walking+bicycle+pedometer C=Group sessions focused on walking+pedometer	120	48	0	Cycling (measured in I, self-assessed in C) Steps (pedometer) Body weight Waist circumference	Achieve cycling ≥2 km/day	+	+/?	?
Kallings *et al*,[20] 2009, Sweden*	RCT	2005–2007 (3 years)	I=PAP C=Written general information	101	68	43	Frequency MVPA (diary) Duration MVPA (diary) Steps (pedometer) Body weight BMI Waist circumference Total body fat (BIA) Systolic blood pressure Diastolic blood pressure Glucose HbA1c Cholesterol Triglycerides HDL LDL	Reduction in cardiometabolic risk factors and relate to change in PA	+	+/?	?
Morén *et al*,[21] 2016, Sweden	RCT	2010–2014 (4 years)	I=PAP C=Usual care	88	71	47	Duration MVPA (accelerometer) Steps (accelerometer) 6-MWT HRQoL (EQ5D-VAS)	Change in level of PA and physical capacity	+	?	?
Olsson *et al*,[22] 2015, Sweden*	RCT	2005–2007 (3 years)	I=PAP C=Written general information on importance of PA	101	68	43	HRQoL (SF-36)	Level of PA	+	+/?	?
Sjögren *et al*,[23] 2012, Sweden*	RCT	2005–2007 (3 years)	I=PAP C=Written general information	73	68	40	Duration total PA (diary) Steps (pedometer)	Level of PA	+	+/?	?/–
Hendberg *et al*,[24] 2014, Sweden	Cohort	2011–2012 (1 year)	I=PAP+rehabilitation supported by physiotherapist C=Rehabilitation with physiotherapist	34	79	47	PA (Grimby-Frändin)	Confidence in performing daily activities	+	?/–	–
Kallings *et al*,[25] 2008, Sweden	Case series	2001–2003	I=PAP	481	51	25	Adverse events	Level of physical activity	NA	NA	NA

*Results from the same RCT.
+No serious problems.
–Major problems.
?Some problems.
BMI, body mass index; C, control; EQ5D-VAS, EuroQoL-5 dimension visual analogue scale; HbA1c, glycated haemoglobin; HDL, high-density lipoprotein; HOMA-IR, homeostatic model assessment of insulin resistance; HRQoL, health-related quality of life; I, intervention; IPAQ, International Physical Activity Questionnaire; LDL, low-density lipoprotein; MVPA, moderate to vigorous physical activity; NA, not applicable; PA, physical activity; PAP, physical activity on prescription; RCT, randomised controlled trial; SF-36, 36-item Short Form survey; 6-MWT, 6 min walk test.

increase than among participants in the control group (p<0.05 for between-groups analysis). Hemmingsson *et al* reported that 60.8% of participants in the intervention group complied with at least one treatment goal (either cycling ≥2 km/day or walking ≥10 000 steps/day), compared with 41.8% in the control group (OR 2.2, 95% CI 1.3 to 3.8).[19] Hendberg *et al* reported that 9/16 participants in the intervention group showed better outcome for level of PA, compared with their matched controls, while 3/16 showed worse outcome for level of PA, compared with their matched controls (p=0.039 for between-groups analysis).[24] Hellgren *et al* reported a non-significant trend for a slightly higher increase in the level of PA for participants in the intervention group compared with the participants in the control group.[18] Morén *et al* reported no effect on time spent on MVPA per day, but an increase in steps per day in the intervention group with a decrease in the control group both at the 3 and 6-month follow-up. This difference, however, was not significant in the between-groups analysis (+2489 steps/day, 95% CI −285 to 5264, p=0.08).[21]

We conclude that PAP containing the core elements of the Swedish model probably results in an increased level of PA compared with no PAP in adults who have been identified as in need of increased PA by a healthcare professional. There was a moderate certainty of evidence (GRADE ⊕⊕⊕O).

SECONDARY OUTCOMES

Results for secondary outcomes are summarised in the online supplementary table 3.

- No studies reported mortality data.
- HRQoL was studied in two RCTs with no or small intergroup differences.[21 22] Conclusion: PAP containing the core elements of the Swedish model may result in little or no difference for HRQoL (GRADE⊕⊕OO).
- Body weight and waist circumference were studied in three RCTs with no or small intergroup differences.[18–20] Conclusion: PAP containing the core elements of the Swedish model may result in little or no difference regarding body weight and waist circumference (GRADE⊕⊕OO).
- Glucose metabolism was studied in two RCTs and these found no or small intergroup differences.[18 20] Conclusion: PAP containing the core elements of the Swedish model may result in little or no difference in glucose metabolism (GRADE⊕⊕OO).
- Physical function was studied in one RCT using the 6 min walk test (6-MWT).[21] This study had some problems with directness as its participants were limited to patients with transient ischaemic attack. Nonetheless, these patients, who were prescribed PAP containing the core elements of the Swedish model, showed improvement at their 6-month follow-up (+70 vs +31 m, p=0.01). Conclusion: PAP containing the core elements of the Swedish model may increase a patient's 6-MWT distance (GRADE⊕⊕OO).
- Blood pressure was studied in two RCTs, but both had major problems with directness and had no or very small intergroup differences.[18 20] Conclusion: It is uncertain whether blood pressure is affected by PAP containing the core elements of the Swedish model (GRADE ⊕OOO).
- Blood lipids were studied in one RCT with no or small intergroup differences.[20] Conclusion: It is uncertain whether blood lipids are affected by PAP containing the core elements of the Swedish model (GRADE ⊕OOO).
- Adverse events were studied in four RCTs and one case series. Musculoskeletal pain was reported by patients in both groups in one RCT with no intergroup differences. No adverse events were reported in the other studies included.[17 19 21 23 25] Conclusion: PAP containing the core elements of the Swedish model probably results in little or no difference in adverse events compared with no PAP (GRADE⊕⊕⊕O).

DISCUSSION

The main finding of this systematic review was that PAP containing the core elements of the Swedish model increases the level of PA compared with no PAP in adults in need of increased PA. In several of the studies, the increase exceeded the levels that have been shown to be clinically relevant.[26 27] There are not enough studies available to evaluate the direct effects of PAP containing the core elements of the Swedish model on mortality, morbidity or HRQoL.

There are some limitations to this systematic review. One is the relative scarcity of published studies that match our PICO (five RCTs and one cohort study). Another limitation is the fact that a majority of the studies included used different measures for level of PA, often with different follow-up times. The combination of different outcome measures and different follow-up times made it impossible to perform any meta-analysis for our primary outcome measure, the level of PA. Another limitation is that several studies used self-assessments to measure level of PA, with some of these insufficiently sensitive to detect true effects. While all studies included in this systematic review reported results from interventions that contained the core elements of the Swedish PAP model, not all interventions were exactly the same. One intervention included pedometers,[18] one included a provided bike[19] and others only included the core elements of the Swedish PAP model. However, the majority of the studies reported positive effects, and no study reported any negative effects. Finally, this systematic review is unable to analyse the individual effect of each of the three core elements, but this type of analysis is outside the scope of this systematic review.

The strengths of this study include its systematic approach, including the use of the well-validated GRADE system, as well as the inclusion of study participants representing several of the major patient groups suitable for PAP. These strengths suggest that the results are applicable for a majority of patients in need of increased PA. As this systematic review was restricted to studies conducted in Nordic countries, its generalisability within the Nordic countries is possible although its generalisability to other countries is not as strong. We believe that such a restricted setting combined with the examination of a relatively well-defined model for exercise interventions, the Swedish PAP, was necessary to secure the uniformity between the studies with regard to the PAP method. Previous systematic reviews have either examined exercise referral schemes specifically or a combination of several different exercise prescription models with limited results.[7 9–12] A well-performed systematic review of exercise referral schemes, including eight studies with 5190 participants, reported a relatively small increase in participants that reached recommended levels of MVPA assessed by accelerometer.[10]

Although this systematic review included a relatively few studies, the majority of these studies showed significant increases in level of PA. One difference between exercise referral schemes and Swedish PAP is that exercise referral schemes focus more on referring patients to a programme performed outside the healthcare system lasting typically 10–12 weeks, whereas Swedish PAP focuses more on patient-centred long-term lifestyle changes that are individually dosed and followed within the healthcare setting. In our systematic

review, all studies report follow-up of at least 12 weeks, while a majority reported follow-up times of 6 months or more.

Regarding the magnitude of effect, a dose–response association between PA and outcome parameters such as death and cancer has been suggested.[26 27] Wen *et al* concluded that individuals with 15 min of daily exercise had a life expectancy 3 years higher than inactive individuals.[27] Holme and Anderssen found that light-intensity PA 4 hours per week was associated with a 38% reduction in all-cause mortality compared with being sedentary.[26] They also found that for each added hour of PA per week, there was a significant increase in survival. In summary, although there is no formal definition of the minimal important difference in level of PA, an increase of 15 min/day or 1 hour/week is likely to be clinically relevant. In this systematic review, an increase of more than 1 hour of PA per week was achieved in at least two studies.[17 20] In two other studies, a significantly larger number of participants who received Swedish PAP increased their PA levels, assessed as cycling distance and leisure time activity.[19 24] Both these increases corresponded to increases well above 15 min/day, compared with controls, although these increases were not quantified in exact time.

The results of the present systematic review have important clinical implications. We suggest that PAP models containing the core elements of the Swedish PAP model may be considered for implementation in routine healthcare to increase the PA levels of patients in need of increased PA. However, it remains to be elucidated which components of Swedish PAP plausibly are responsible for the positive effects on PA levels. Furthermore, long-term effects and effects on hard-end points need further study. We recommend that future studies focus on using well-validated methods for measuring level of PA and include long-term follow-ups. We also recommend that future studies investigate the individual effect of each core element of the Swedish PAP model.

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