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Activating People

– Physical activity in the general population
and referral schemes among primary health
care patients in a Swedish county

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To my family and friends
all of you wherever you are!



"Life is like a box of chocolates... you never know what you're gonna get."
Forrest Gump

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ABSTRACT

In this thesis the need for physical activity interventions is investigated in a general adult population, the characteristics of physical activity referral (PAR) scheme recipients and referral practitioners, and the effectiveness of PAR in a routine primary health-care (PHC) setting in the county of Östergötland, Sweden. The thesis consists of four papers: three papers are based on a quantitative, uncontrolled prospective PAR study and one paper is based on a population survey in the county of Östergötland, Sweden.

In 2006, only one in four of the adult population, aged 18–84 years, in Östergötland was considered sufficiently active to meet the Swedish national public health recommendations, stated as “30 minutes of moderate physical activity a day”. More than one-third (37%) reported that they had no intentions to change their physical activity levels, while 36% had thought about change, and 27% were determined to change. Although the individuals felt a large responsibility for their own physical activity, they also believed that this responsibility is partly shared by health-care providers. Among those who wanted to increase their physical activity level, almost one in seven of the total population and one in four among those reporting poor general health, with a BMI over 30 and those who were inactive reported that they wanted support to bring about this change. More than half of them wanted this support from their health-care provider.

During 2004 and 2005, a total of 6300 patients received PARs as part of the Östergötland PAR scheme. Two-thirds of the patients were female and half of the patients were 45–64 years old. The PAR scheme reached a relatively high proportion of physically inactive people. PAR-related statistics, including the numbers of referrals made at individual PHC centres and by different professional categories, showed large differences in prescribing activities, both by patient categories, and by prescribing professionals, indicating great potential for further improvements of this scheme in the future.

Half of the patients (51%) who received PARs were recommended home-based activities, such as walking. Patient follow-up showed that an increase in self-reported physical activity level was achieved by 52% of the patients at the 12-month follow-up. The proportion of inactive patients decreased from 33% at baseline to 20% at 12 months. The proportion of patients who were physically active on a regular basis increased from 22% at baseline to 32% at 12 months. Neither patient age, diagnosis/PAR reason nor the profession of the prescriber were associated with differences in effectiveness. Low activity levels at baseline and home-based activities were significantly associated with increased physical activity at 12 months. Half of the patients (50%) achieved adherence to PARs at the 12-month follow-up, with adherence assessed by simply asking the patients about their adherence to prescribed activity. Patients’ activity levels at baseline (being at least somewhat physically active) and being issued home-based activities were significantly associated with higher adherence at 12 months.

LIST OF PAPERS

This thesis is based on the following papers, which are referred to in the text by their Roman numerals.

- I. **Leijon ME**, Stark Ekman D, Nilsen P, Ekberg K, Walter L, Ståhle A, Bendtsen P. Is there a demand for physical activity interventions from health-care providers? Findings from a population survey. Submitted to *Scandinavian Journal of Public Health*, December 2008.
- II. **Leijon ME**, Bendtsen P, Nilsen P, Ekberg K, Ståhle A. Physical activity referrals in Swedish primary health care – prescriber and patient characteristics, reasons for prescriptions, and prescribed activities. *BMC Health Services Research* 2008. 8:201.
- III. **Leijon ME**, Bendtsen P, Nilsen P, Festin K, Ståhle A. Does a physical activity referral scheme improve the physical activity among routine primary health care patients? *Scandinavian Journal of Medicine & Science in Sports*. 2008. Accepted.
- IV. **Leijon ME**, Bendtsen P, Ståhle A, Ekberg K, Festin K, Nilsen P. Factors associated with self-reported adherence to prescribed physical activity in routine primary health care. Submitted to *International Journal of Behavioural Nutrition and Physical Activity*, October 2008.

1. INTRODUCTION

Health-related behaviours such as physical activity, diet, alcohol and tobacco use, have been consistently reported to contribute substantially to adult health status [1, 2]. Health-comprising behaviours and risks such as sedentary lifestyle, unhealthy diet, overweight, risky drinking and smoking are among the leading causes of mortality and morbidity in individuals, imposing a significant burden on the health-care system worldwide [1, 3, 4]. There is consistent evidence that many of these behaviours and risks occur in combination and tend to cluster both in individuals and populations [3, 4].

Health risks due to increased rates of physical inactivity among children and adults have become a major public health issue in many countries. Approximately 60% of the adult populations in the world today do not reach the recommended level of physical activity [1]. WHO has stated that promotion of physical activity is an important public health objective, which benefits from a population-based approach involving multiple sectors and disciplines [1, 2]. From a public health point of view, it is important to target the most inactive groups in society, as a small increase in the activity level among sedentary populations has a greater potential to influence public health than efforts aimed at increasing activity levels in those who are already active [5, 6].

A growing body of evidence-based preventive strategies is available to reduce the preventable burden of disease [7, 8]. One important setting in which to use these strategies is the health-care system [9]. Interventions to address unhealthy lifestyle have been seen to be among the most effective strategies available for health-care practitioners [3]. Over the past decade, practitioners in primary health-care (PHC) settings in many countries have promoted increased physical activity or exercise through written prescriptions or schemes [10–16]. In Sweden, these schemes are commonly referred to as physical activity referral (PAR) schemes. They were more broadly introduced in 2001 by the National Institute of Public Health in a national campaign called “Sweden on the Move” [16].

Research has demonstrated that the use of these written prescriptions can be effective under controlled conditions [13, 14, 17–19], and that both general

practitioners and patients have found physical activity prescriptions to be acceptable and feasible [14, 20]. However, there is a “translation gap” between the evidence concerning these interventions and what is currently achieved in practice. This translation gap describes the difficulties in translating intervention efficacy into effectiveness by implementing effective clinical and community-level services into routine practice [7, 8, 21].

This thesis provides new knowledge and insight on PAR schemes in routine care by health-care providers in primary health care in a Swedish county. The research is based on a population-oriented approach to physical activity, providing an investigation into a large-scale, multi-year programme-driven approach that targeted a broad spectrum of individuals in the community and not just those with the highest risk. Research on physical activity has been conducted from many perspectives, from investigating the physiological effects of increased physical activity to the relation between physical activity and health, as well as more large-scale population-based intervention programmes. The main focus in this thesis is on studying physical activity from a public health perspective – what can be done at the population level to increase the physical activity levels in the population and thereby improve public health?

The overall aim of this thesis was to investigate the need for physical activity interventions in a general adult population, the characteristics of physical activity referral (PAR) scheme recipients and referral practitioners, and the effectiveness of PAR in a routine primary health-care (PHC) setting in the County of Östergötland, Sweden.

2. BACKGROUND

2.1 The epidemiology of physical activity

2.1.1 Physical activity definition

Physical activity, exercise and related terms have been defined somewhat inconsistently over the last decade [22–24]. It is therefore important to distinguish between a numbers of related terms which have different meaning. **Physical activity** is defined as *“any bodily movement produced by the contraction of skeletal muscle that increases energy expenditure above a basal level”* [23]. Physical activity can be categorised in various ways, including type, intensity, and purpose. With regard to classification by “purpose,” physical activity is frequently categorised by the context in which it is performed [23]. Commonly used activity classification categories include occupational, leisure-time or recreational, household, self-care, and transportation or commuting activities [23–26].

Health enhancing physical activity (HEPA) is a term used particularly among the European health promotion community, and is defined as *“any form of physical activity that benefits health and functional capacity without undue harm or risk”* [27, 28]. Another term encountered in the literature is **leisure-time physical activity** [23, 29, 30], which has been defined as activities performed by a person that are not required as essential activities of daily living and are performed at the discretion of the person. These activities include sports participation, exercise conditioning or training, and recreational activities such as going for a walk, dancing, and gardening. The term **lifestyle activities** describes the activities that a person carries out in the course of daily life that can contribute to sizeable energy expenditure, e.g., taking the stairs instead of using the elevator, walking to do errands instead of driving, getting off one bus stop earlier, or parking further away than usual to walk to a destination [23].

The terms **exercise** and physical activity are often used interchangeably. However, exercise is a subcategory of physical activity and has been defined as “*planned, structured, and repetitive and purposive in the sense that the improvement or maintenance of one or more components of physical fitness is the objective*”, and in some studies sports participation or “exercise training” is assessed and analysed separately from other leisure-time activities [23].

Physical activity is sometimes defined synonymously with **fitness**. However, the two categories differ as physical activity is a behaviour and fitness is “*a set of attributes that people have or achieve that relates to the ability to perform physical activity*”. The fitness concept includes aerobic capacity, strength, flexibility, speed and power [29]. Physical fitness has been defined in a variety of ways. See for example the WHO’s definition, where **fitness** is defined as “*the ability to perform muscular work satisfactorily*” [23].

2.1.2 The assessment of physical activity

There is no internationally agreed definition or measure of physical activity [1]. Measuring physical activity is very difficult, and the “accurate” assessment of individual activity levels remains a controversial and difficult area [29]. For measurement or assessment at the population level, feasibility must be balanced with measurement accuracy [28]. An individual’s physical activity level is a complex, dynamic process that encompasses various phases of activity participation during life.

Physical activity can be measured or assessed in terms of energy consumption or behaviour. The components of activity which contribute to health status are activity intensity, duration and frequency [31]. Most of our weekly consumption of energy is the result of physical activity that is not related to sport. Instead, it is due to the everyday physical activities such as walking or cycling to work, using the stairs instead of the elevator, working in the garden, the physical demands of the workplace or playing with the children. For non-athletes, such activities are the largest component of total energy consumption in a week [26]. Physically active lifestyles result in improvements to aerobic capacity and body strength. Other physical functions and measurements, such as weight, waist measurement, body composition, blood pressure and blood fat, may also be improved. The same improvement from physical activities

applies to mental health, where both depression and anxiety conditions can be reduced by physical activity [32].

Besides these effects, the actual activity can be measured or assessed by different methods or instruments. Three types of physical activity assessment methods are currently available in clinical settings: direct measurement methods using calorimetry (e.g. doubly labelled water), objective methods measuring physical effort (e.g. pedometers and accelerometers) and subjective methods that are dependent on individual recall, including questionnaires and activity diaries. The more sophisticated methods (other than subjective) are more time and labour consuming and thereby costly, and are in many cases considered to have lower feasibility for large-scale studies. Subjective measurement methods are inexpensive and more easily applicable to large populations. However, subjective methods rely on subjective interpretation of the questions and the perception of physical activity behaviour from the participant [25, 31].

The concept of adherence has been defined by the World Health Organization (WHO) as “the extent to which a person’s behaviour, taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider” [33]. The literature describing adherence has focused mostly on medication adherence. In comparison with the multiple factors involved in adherence to regular physical activity, the factors contributing to adherence to medication are probably less complex. However, researchers are starting to gain useful knowledge about adherence as a contributing factor in health-promoting or disease-preventing lifestyle changes [33]. Few studies have examined adherence as a primary outcome variable of health interventions [34]. There is no universally agreed standard for assessment of adherence in general and no validated self-reporting question exists to measure adherence to physical activity interventions [33]. It has been suggested that adherence to PAR should be evaluated by simply asking the patient about adherence to the prescription, which is a pragmatic and realistic approach from a routine practice perspective [35].

Multiple studies have shown that self-reporting tools for assessment of physical activity are accurate and reliable when compared to objective quantification by activity monitoring or directly measured energy expenditure [36, 37]. As with all self-reported information, there is always a risk of recall or social desirability bias when using self-reported physical activity as an

outcome measure [10]. Such biases should be kept in mind when interpreting the results of studies using self-reported information.

2.1.3 Health aspects

Today there is convincing evidence that physical activity gives health benefits. A sedentary lifestyle increases the risk for premature morbidity and mortality, while a physically active life promotes both physical and mental health, increases quality of life and well-being and functional independence in the elderly. The World Health Organization (WHO) has estimated that physical inactivity is one of the 10 leading causes of death in developed countries leading to 1.9 million deaths worldwide per year [1]. Physical inactivity is considered to be the 5th leading mortality risk factor in Europe. It is the 4th leading risk factor for burden of disease in women and the 7th in men [38]. In Sweden physical inactivity is the 5th leading risk factor for burden of disease for women and the 6th for men. Life expectancy, in lost years, among 25-year-olds is 5.3 years longer for a physically active man compared to a physically inactive man of the same age. The corresponding number for females is 5.1 years [39]. The increased inactivity is partially due to changed patterns of transport, which have resulted in less physical activity for many populations. Other factors include more sedentary occupations, and for many, more free time spent in sedentary activities over the last few decades [29].

According to the World Health Report in 2002 [1], physical inactivity is responsible for the following proportions of some of the most common diseases in developed countries: for example ischaemic heart disease, 22% of cases for women, and 23% for men; colon cancer, 17% of cases; diabetes mellitus cases, 15%; stroke, 13% in women and 12% in men; and breast cancer, 11%.

Research on the health benefits of physical activity has expanded widely to include a variety of outcomes [34], including promotion of self-esteem and positive body image [23, 24, 32, 40]. Physical activity also promotes health by improved fitness, balance and coordination control, and strength in the muscles and connective tissue [23, 24, 32, 40, 41].

Physical activity is associated with improvements in outcomes for many common conditions. Below is a brief summary of conditions related to

inadequate physical activity and, therefore, may have negative health consequences, and where a higher level of physical activity can improve health [23, 24, 32, 34, 41];

- Cardiovascular disease in the form of coronary artery disease, stroke and peripheral arterial disease, is the largest group of inactivity related diseases that can be lethal.
- Type 2 diabetes, hypertension, osteoporosis, overweight and obesity may be directly related to inadequate physical activity.
- Some types of cancer, such as cancer of the colon, breast, prostate, uterus and lung may be related to physical inactivity.
- Other conditions where a higher level of physical activity has positive health effects are: osteoarthritis, asthma, cystic fibrosis, dementia, depression, some heart rhythm disorders, COPD, certain blood lipid disorders, certain gastrointestinal diseases, MS, kidney disease, Parkinson's disease, rheumatoid arthritis, long-standing back problems, spinal cord injury, schizophrenia, some pain disorders, stress, dizziness and balance disorders, and anxiety.

The risks for future adverse health consequences include, in addition to premature death, loss of health-related life years, long-term illness, disability in the form of reduced physical performance, the effect on the heart, arteries, lungs, muscles, joints, balance, bone density and quality of life loss [32].

2.1.4 Recommendations for physical activity

The most commonly used physical activity recommendations in Sweden and in many other countries state that adults should accumulate at least 30 minutes of moderately intense physical activity, such as brisk walks, at least 5 days a week [23, 24, 32, 40]. This recommendation is part of a larger set of health recommendations in Sweden, including increased intake of fruit and vegetables, maintenance of normal weight, avoidance of hazardous alcohol use and the use of tobacco, all aimed at increasing health and quality of life.

Today's guidelines for physical activity represent a conceptual shift from an exercise–fitness paradigm to a physical activity–health paradigm [42]. Until the 1990s physical activity recommendations were generally focused on cardio-respiratory endurance and specified sustained periods of vigorous

physical activity lasting at least 20 minutes 3 or more days a week. However, over the last decade it has been recognised that lower levels of physical activity are also beneficial provided that they are carried out frequently and regularly [24].

This adjusted recommendation recognises that physical activity both at moderate and high intensity levels provides positive health effects. The duration should be longer at moderate intensity compared to higher intensity. This emphasis on intensity to obtain health benefits is different from the recommendations for training to increase physical capacity. This includes aspects such as fitness and strength, which is based on the dose–response relationship between exercise intensity, duration or frequency and on other measures of fitness, such as maximum oxygen uptake or the measure of strength. To improve fitness or strength, higher intensity must be achieved in order to obtain optimal effects. Physical capacity training thus requires an intensity level that is higher than the ‘moderate’ levels needed for health improvements [32].

The updated recommendations from the American College of Sports Medicine and the American Heart Association in 2007 include both moderate- and vigorous-intensity activities. The recommendation also emphasises the importance of muscular strength and endurance [43]:

“To promote and maintain health, all healthy adults aged 18 to 65 yr need moderate-intensity aerobic (endurance) physical activity for a minimum of 30 min on five days each week or vigorous-intensity aerobic physical activity for a minimum of 20 min on three days each week. Moderate-intensity aerobic activity, which is generally equivalent to a brisk walk and noticeably accelerates the heart rate, can be accumulated toward the 30-min minimum by performing bouts each lasting 10 or more minutes. Vigorous-intensity activity is exemplified by jogging, and causes rapid breathing and a substantial increase in heart rate. In addition, every adult should perform activities that maintain or increase muscular strength and endurance a minimum of two days each week. Because of the dose-response relation between physical activity and health, persons who wish to further improve their personal fitness, reduce their risk for chronic diseases and disabilities or prevent unhealthy weight gain may benefit by exceeding the minimum recommended amounts of physical activity”.

2.1.5 Prevalence of physical activity in the population

Due to the difficulties in measuring physical activity there is no clear picture about the physical activity level in the population. The Eurobarometer study is a regularly administered survey that assesses health status in adult populations in the EU. According to the survey, about 23% of the adult population in Sweden is sufficiently active for health, compared to 29% of adults in the EU. Swedish males were 1.6 times more active at the recommended levels than Swedish females [44]. A population-based health survey conducted in the County of Östergötland, Sweden, 1999, also found that 23% of the adult population (18–74) were categorised as regularly active [45], although the study method and questionnaire differed from the Eurobarometer studies.

In Sweden, as in many other countries, there are differences in activity levels between different groups in society. There is a clear socio-economic gradient related to being sedentary, where non-management workers are more sedentary than lower officials, who in turn are more sedentary than senior officials. Sedentary levels are higher among those with lower education levels than those with more education. Overall, income levels are associated with physical activity levels, with those adults at the lower end of the income scale in Sweden less likely to achieve recommended activity levels, compared to those at the higher end. Activity levels are also associated with immigrant status in Sweden, with those adults born outside the Nordic region more likely to be sedentary, compared to adults born in Sweden [4, 26].

Walking is the most popular physical activity among the Swedish population, according to a national survey in 2003 [26, 46]. Half of the population participated in walking at least once a month, while approximately one out of five adults participated in weight and circuit training, running/jogging or group gymnastics/work-out at least once a month.

The factors influencing a person's physical activity level are often classified into individual, interpersonal, and environmental. Factors unique to an individual include demographic, cognitive, attitudinal (e.g. self-efficacy), and behavioural (e.g. skills) characteristics. Examples of interpersonal factors are encouragement by family, friends, and health-care professionals. Environmental factors that affect adherence include culture, physical

surroundings, and issues of costs and access. Exercise self-efficacy, i.e. an individual's belief in his/her capability, is found to be the strongest and most consistent psychological predictor of exercise behaviour [47].

A Danish study describing motivations and barriers to physical activity on a population level found that self-perceived health status is the strongest explanatory variable for physical activity levels. The second strongest explanatory variable was physical activity levels among friends and relatives [48]. Other reasons for choosing to participate in physical activities have also been identified in adult populations, and include improved appearance, enjoyment of the activity itself, social interaction, stress relief, challenge, skill development, achievement and personal satisfaction. Individuals who engage in regular exercise report more support for this activity from people in their home and work environments [47].

2.2 Physical activity promotion

2.2.1 Approaches to physical activity promotion

A broad consensus has emerged in recent years in relation to the desirability of promoting physical activity/exercise through the development of active lifestyles [30]. Support for increased physical activity is noted in numerous policy documents in Sweden [49, 50] and elsewhere [2, 23, 30, 51].

There are various institutional approaches to direct physical activity promotion including informational, behavioural and social, environmental and policy approaches. Understanding of the factors related to increased physical activity, and knowledge about effective interventions for increasing physical activity have improved in recent years. In a review by Kahn [52], the evidence of effective interventions, in terms of changes in physical activity behaviour and aerobic capacity are summarised. Sufficient evidence according to the review was found among two informational interventions ("point-of-decision" prompts to encourage stair use and community-wide campaigns), three behavioural and social interventions (school-based physical education, social support in community settings, and individually-adapted health behaviour change) and one environmental and policy intervention (creation of

or enhanced access to places for physical activity combined with informational outreach activities). The Kahn review concluded that there was insufficient evidence to support the following approaches: classroom-based health education focused on information provision, and family-based social support (because of inconsistent findings); mass media campaigns and college-based health education and physical education (because of an insufficient number of studies); and classroom-based health education focused on reducing television viewing and video game playing (because of insufficient evidence of a corresponding increase in physical activity).

2.2.2 Health-care setting

The health-care system has been identified as an important setting for health promotion and disease prevention. In the main strategies, WHO's Ottawa Charter called for a move to "reorient health services" [9]. Recognising the importance of PHC in motivating adult health behaviour, Sweden's National Public Health Committee has identified PHC as a key component in multi-faceted community-oriented approaches to promote healthier lifestyles. The Committee's recommendation, in the year 2000, was for PHC to support positive health development both for individuals and groups and to provide a foundation for local public health initiatives [49]. According to the committee, important roles of the health services as a health promoter were to:

"initiate and support health promotion and disease prevention measures on the individual and group level and develop methods to ensure that preventive efforts are naturally integrated into the "care chain"', and to; "provide support for individuals and groups who are particularly vulnerable to disease or ill-health, i.e. those who run a greater risk of contracting a disease or to whom psycho-social resources are not so readily available" [49].

The National Public Health Committee also points out the potential advantages of health promotion in the health-care system. Promotion efforts can be delivered on an interpersonal level via normal contacts with patients, and on the institutional level via the influence that the health-care system plays in long-term health development in society, because of its professional knowledge.

The health-care system, especially PHC, has a strategic position in promoting population health, and by broadening the base of medical care to address behavioural risk factors, including physical inactivity, PHC providers could potentially prevent a considerable amount of mortality, morbidity and help prevent disabilities before serious health problems develop [36]. PHC providers are in a natural position to share information about interventions aiming to improve overall health status within the population, particularly with those with existing health problems [53, 54]. Moreover, patients perceive physicians as highly credible sources of medical information. This credibility extends to accepting physician-delivered prescriptions addressing physical activity [53, 55] or other preventive health activities. Many patients not only seek lifestyle advice from their health-care providers but also anticipate that discussing and addressing such issues will be part of their medical care, and patients who receive support for health behaviour changes are more satisfied with their PHC consultations than patients who are not offered this type of information [56, 57].

Health-care providers working in PHC settings are geographically distributed across the nation and have broad access to the adult population [53, 58]. In Sweden, approximately 70% of the adult population consult health-care providers at PHC centres each year [59]. An increasing number of Swedish PHCs also strive to go beyond basic health care, to provide patients with education, counselling, and support programmes to bring about long-term improvements to health, such as increased fitness, better nutrition, or smoking cessation [60]. In many countries, PHC practitioners have implemented community-based schemes to improve activity levels, often referred to as exercise prescriptions or physical activity referral schemes [10–12, 16, 42, 61–64].

2.2.3 Physical activity referral schemes

In the medical world, it is traditional to prescribe the evidence-based treatment known to be the most effective and entailing the fewest side effects or risks. The evidence suggests that in selected cases exercise therapy is just as effective as medical treatment – and in special situations more effective – or adds to the effect. The clinical use of physical activity referrals does not represent a paradigm change – it is rather that the accumulated knowledge on the benefits of physical activity is now so extensive that referrals for increased

activity levels must be implemented in order to practice good medicine [41]. In addition, most long-term therapies for adult health problems combine medication with simultaneous instructions on health habits and lifestyle changes such as diet, physical activity and smoking cessation. Adherence to such lifestyle changes is often as important to optimal treatment outcome as adherence to medication. Furthermore, by encouraging lifestyle changes, health promotion and disease prevention interventions can have a far-reaching impact in enhancing multiple health outcomes beyond the specific condition being treated [33].

Written prescriptions of physical activity, in Sweden commonly referred to as physical activity referral (PAR) schemes, have gained interest in many countries during the last decade [10, 11, 13, 15, 16, 18, 61, 63]. These interventions have been found acceptable and feasible both to general practitioners and patients [14, 20].

Many of these interventions include brief face-to-face communication about the importance of physical activity along with written “prescriptions” for physical activity. Earlier literature refers quite often to exercise referrals. The references to exercise schemes were mainly noted in the UK [63], where the term “exercise referral schemes” has been defined as:

“an intervention where there is a referral by an appropriate professional to a service where there is a formalised process of assessment to that persons need: the development of a tailored physical activity programme to meet that need; and monitoring of the individual’s progress.” [18].

As may be noted in the definition above, research on PARs must take into account the ambiguous vocabulary surrounding this approach. The terms “exercise” and “physical activity” are often used interchangeably in different intervention models and schemes. This broader definition makes it difficult to separate different methods or concepts from each other, or get a clear picture of the effect of different interventions. In the UK, it has been suggested recently, that exercise referral schemes should be renamed as “physical activity referral schemes” (PARS), underlining the shift towards promoting physical activity undertaken in the course of daily activities rather than “exercise” only [42].

In current clinical practice, the activity prescriptions or referrals that are normally issued call for patients to engage in either structured facility-based activities (for example, attending gyms or group activities) or some kind of self-administrated community-based activity (such as walking in various forms). The facility-based intervention concepts generally require a facility representative to contact the patient, usually by phone, and arrange for the first appointment to the facility-based activity. After a defined period of training, the effects are evaluated and a report is send to the prescribing health professional [42].

2.2.4 The evidence base for physical activity promotion in health-care settings

Decisions about policy and practice in the public sector are increasingly driven by consideration of the best available evidence [51]. There is increasing demand and focus on demonstrating effectiveness for work funded by public agencies. Performance measurements within the public sector are now required to be more outcome-oriented, and there is strong pressure to make policy making and practice more rational and “evidence-based” [65].

The evaluation of physical activity interventions in health-care settings is still a relatively young research field, and the literature shows mixed results on the effectiveness of different types of health care-based interventions [13, 14, 17–19]. In Sweden, the Swedish Council on Technology Assessment in Health Care (SBU; Statens Beredning för Medicinsk utvärdering) reviewed the literature concerning the effectiveness of various methods to promoting physical activity and concluded that advice and counselling to patients in everyday clinical practice increase physical activity by 12–50% for at least 6 months after counselling sessions. Moreover, counselling of physical activity supplemented by written prescription, diaries, pedometers, information brochures, etc. increases physical activity by another 15–50% [19]. A Cochrane review [17] found that professional advice and guidance with continued support can encourage people aged 16 years and older to become more physically active. In 2005, Morgan found that exercise-referral schemes appeared to increase physical activity levels in certain populations, namely: individuals who are not sedentary but already slightly active; older adults; and those who are overweight but not obese [13]. In 2006, Sörensen et al., reviewing the effect of exercise prescriptions, concluded that physical activity

was significantly increased for patients participating in six of the 12 studies included [14].

The review-based recommendations from the US Preventive Services Task Force (USPSTF) in 2002 concluded that there was still insufficient evidence for or against behavioural counselling in primary care settings at that time. This conclusion was based on the lack of “good” quality studies, contradictory results among studies, and major methodological problems regarding studies [66].

The literature thus far is sparse concerning the effects of advice about different types of activity, including everyday activities vs. exercise and self-supervised programs vs. organised exercise, and about the relative value of different activities like walking, jogging or running [13, 17–19]. There is also a lack of research describing the characteristics of prescription recipients, activities and the reasons for participation in such schemes [11, 63, 67].

In addition, little is known about the long-term (12 months or more) effects of physical activity interventions, including prescriptions, in health-care settings [13, 14]. Information is also lacking about the most effective way for practitioners to incorporate the use of such prescriptions in routine clinical practice [68].

2.2.5 Statements advocating physical activity referrals

Taking into account the mixed findings to date, clinical support for PARs is strong. A position statement by the American College of Preventive Medicine (ACPM) in 2005 finds that these physical activity interventions are effective [69]. They conclude that effective interventions can be as brief as 2–4 minutes, though longer sessions may be used depending on practice characteristics and patient needs. Based on recent reviews, ACPM also identified several important clinical factors that impact on PHC-based physical activity interventions, including:

- quality and content of provider training;
- appropriate assessment of individual patients;
- length of the counselling session and provider time limitations;

- content of the counselling session including the number of risk behaviours discussed;
- use of a behavioural change model approach;
- method of advice delivery;
- inclusion of a follow-up plan;
- tailoring advice to certain subgroups based on sociodemographic variables or readiness for change.

Furthermore, the ACPM points out that the most successful interventions used a variety of health-care team members to deliver different aspects of the counselling; included a tailored stage of change, written exercise prescription; provided physicians with interactive training sessions; and used an office support system with clinical practice guidelines, provider reminders, and patient follow-up through a variety of communication channels.

Other professional organisations supporting PAR use in clinical settings include the American Academy of Family Physicians, the American Academy of Pediatrics, the American College of Obstetrics and Gynecology, the American College of Sports Medicine and the American Heart Association [69]. The Swedish Council on Technology Assessment in Health Care (SBU) has issued a document that can also be seen as a recommendation or statement as their conclusions call for PHC to adopt best practices in Sweden [19]. This recommendation gives a clear “mandate” to integrate physical activity promotion in every day practice. In addition, the Swedish Medical Society (Läkarsällskapet) encourages the use of physical activity promotion, based on the current evidence linking health outcomes and physical activity. The Society writes of its support for the national recommendations for “30 minutes per day” of physical activity for adults, by stating that *“every clinical doctor should give their patients advice about physical activity, tailored to health status and individual lifestyle”* [32].

2.3 Translating research into practice

2.3.1 Phases of research and evaluation in physical activity promotion

Research and evaluation to support the development of different health promotion and disease prevention interventions takes many forms. Different phases of this development have been identified and described in different models [70–72]. These models typically start with a phase focusing on basic prevalence studies and move along to conducting intervention studies. These interventions can either be research or program driven. The program driven interventions are not researcher-initiated, but are program or policy driven in contrast to the more traditional interventions developed and designed by researchers [71].

One of these models is the Nutbeam “six-stage development model for the evaluation of health promotion programmes” [72]. The model indicates six possible stages of research which combine to develop and evaluate a health promotion intervention, including problem definition, solution generation, innovation testing, intervention demonstration, intervention dissemination and programme management. As presented in figure 1, the first stage includes basic epidemiological research; the second stage draws upon more social and behavioural research; the following stages are related to different kinds of intervention and thereby different forms of intervention-related research.

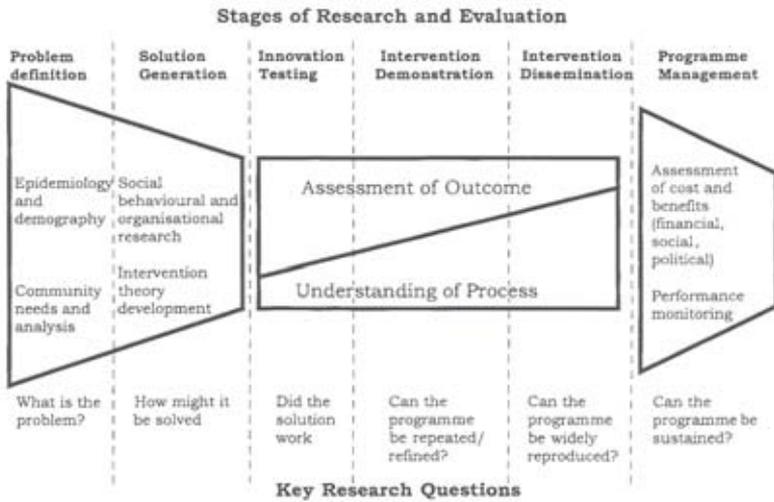


Figure 1. The Nutbeam six-stage development model for the evaluation of health promotion programmes [72].

2.3.2 From research to practice

Considerable progress has been made in developing methods that help in understanding the complex relationship between health promotion activities and health outcomes. Appropriate research designs should take into account this complexity as the multiple factors involved are not easily predicted, controlled and measured by conventional means [72].

Intervention testing is an important phase in Nutbeam's model and other models describing the progression of research and accompanying evaluations. This involves developing an evidence base for the efficacy and/or effectiveness of an intervention. The efficacy of an intervention is defined as its effect under "ideal conditions", while the effectiveness of an intervention is defined as its effect under normal conditions in field settings [73]. Thus far, PAR schemes have mostly been studied in terms of efficacy, employing randomised controlled trial study designs and researcher-assisted study protocols [13]. The evidence in such settings mainly supports the efficacy of PARs, not including aspects of how such interventions translate when integrated into routine practice, i.e. the effectiveness of PARs [7]. To date, few studies have been conducted in routine PHC settings [7, 11], and there seems to be a gap

between efficacy and effectiveness in the field of promoting physical activity, in the meeting between patients and practitioners in a health-care setting [7].

Establishing efficacy is usually an important first stage before widespread dissemination and implementation occur [71, 72, 74]. Randomised controlled trials (RCTs) are essential for evaluating the efficacy of clinical interventions, where the causal chain is relatively short and simple and where results may be safely extrapolated to other settings. However, the causal chains in public health interventions are sometimes more complex, making RCT results subject to effect modification when implemented in different populations [73].

Observational methods are essential for understanding the effectiveness of many aspects of health care. When comparing the results from observational studies in relation to previously presented RCTs, the results can be valued despite the lack of control groups. These comparisons can give us valuable information to help estimate the “real effect” of interventions [74]. Both the internal and external validity of findings from RCTs can be enhanced by data from observational studies [73].

According to Black [74] there is a false conflict between those who advocate RCTs in all situations and those who believe observational data provide sufficient evidence, based on the belief that they represent an alternative rather than a set of complementary approaches. The heavy emphasis on RCTs, according to this opposing school of thought, leads to an overemphasis of simple interventions, undermining the obvious role of broader complex interventions, involving community-based programmes to improve public health. RCTs may overlook the importance of the social and physical environment as health contributors. Another criticism of RCTs is that the enhanced internal validity accomplished in RCTs is often gained at the expense of external validity since the study conditions tend to be far removed from routine practice [33].

Moreover, RCT study settings are nearly impossible to recreate in real-life clinical settings, where a GP, who may know his or her patient very well, gives carefully individualised advice and intervention instructions to the patient and agrees to clinical follow-up [75]. The neutral stance assumed from clinicians in RCTs will surely be missing from most clinicians’ practices, particularly in smaller clinics. From the broader health promotion perspective supported by people working for large health services systems, including

those concerned with policy and strategic planning, RCTs have to be considered to be only “the tip of the iceberg” of what is required to build a sound evidence base. This base has to account for the full range of evaluation needs from the perspectives of all different stakeholder groups [65].

The gap between knowledge on efficacy and effectiveness is not unique to interventions delivered in the health-care setting. Ogilvie et al. [76] reviewed the health benefits of regular walking in a general adult population, and concluded that the evidence at best demonstrates efficacy and not effectiveness. The authors again point out the need for effectiveness studies, which are far more useful from a systems perspective where the aim is to improve population health.

2.3.3 Generalisability of intervention study results

Another highly relevant concept related to evaluation of health interventions is that of external validity, i.e. how can results be generalised to different contexts such as settings, countries, and health-care systems? The majority of physical activity promotion studies in health-care settings have so far been undertaken in English-speaking countries, primarily the US and UK, followed by New Zealand and Australia. As health-care systems differ between countries, results are neither necessarily applicable nor easily translated between countries and health-care systems [77]. In UK-based reviews, results from US-based studies are sometimes excluded for these reasons. The interchangeable use of the terms “exercise” and “physical activity” in many studies also complicates translation of the findings [42].

Many studies are characterised by a great deal of heterogeneity in patient populations, interventions and outcome measures [10, 13, 14, 17, 77]. Some study findings are difficult to reproduce in a routine service setting; for example studies where the method of recruiting participants was via media advertising or telephone surveys [13]. Other studies may be based on patients recruited from only one or two health-care practices, which also it makes difficult to generalise findings to other contexts [10].

2.3.4 Implementation in daily practice

Despite promising findings related to physical activity and exercise interventions in PHC, there are often a number of obstacles when translating research findings into routine practice. Implementation meets resistance in everyday practice because busy clinicians often lack the time or skills to promote these interventions, or may experience low self-efficacy in conducting behavioural screenings [11, 54, 78, 79]. Interventions that in many health fields have been found to be successful in efficacy studies have proved to be impractical to implement in applied settings. This gap between research and real life can be attributed to multiple factors, including competing interests, lack of infrastructure and limited resources [7, 20, 80, 81].

The effects of physical activity interventions promoted in health-care settings are often evaluated in terms of self-reported physical activity levels, energy expenditure, quality of life, or the presence or absence of risk factors such as high blood pressure. Many trials have measured physical activity by using instruments that are scored using a complicated scale that does not easily convert to use by clinicians and patients. These studies thus have limited clinical usefulness [36]. Furthermore, studies showing successful outcomes generally used relatively intensive interventions in selected trial participants who have established diseases, and it is not clear whether these interventions are feasible for more widespread implementation in more representative populations or in small practices with limited infrastructure [82]. There clearly is a strong need for simpler and more pragmatic approaches that translate research findings into feasible clinical practices, and allow for easier measurement of physical activity levels by researchers, clinicians, and patients.

2.4 Physical activity promotion in Sweden

2.4.1 Approaches to increase physical activity

Numerous approaches have been taken at national and regional levels in Sweden to influence adults to change health-related behaviours. The National

Institute of Public Health was commissioned by the Government in 1999 to plan for a physical activity campaign in collaboration with a number of government agencies and organisations. The “Sweden on the Move” campaign in 2001 was the start of a national long-term strategy, aiming to promote increased physical activity in the population. The message was based on the principle of 30 minutes of daily physical activity is important for health and well-being. The aims and objectives of the campaign were based on the Ottawa charter from 1986, including their five main strategies: strengthen community action; develop personal skills; reorient health services; create supportive environments; build healthy public policies [26, 83, 84].

The “Sweden on the Move” strategy included two parallel approaches. One involved the encouragement and creation of opportunities for local and regional initiatives, and the other supported initiatives in four important settings: workplaces; pre-school and school; leisure-time settings; and health-care settings. These efforts included increased knowledge and knowledge dissemination, education, method development, research and evaluation [26, 83].

In April 2003 the Swedish parliament adopted a new national health policy aiming “to create social conditions to ensure good health, on equal terms, for the entire population”. This overall aim was supported by 11 objectives, addressing the main determinants related to public health. The objectives included one specific domain regarding “increased physical activity” and another objective that stressed the importance of achieving “a more health promoting health service” [50].

2.4.2 Physical activity referral schemes in Sweden

In Sweden, the PAR concept was more broadly introduced in the national “Sweden on the Move” campaign in 2001 [26, 83]. Swedish PAR campaigns were initially local and regional initiatives based on local networks and PHC professionals’ own interests. PARs were launched on a national level with support from an evidence-based handbook “FYSS” (Physical Activity in Prevention and Treatment of Diseases) to increase practitioners’ knowledge about the effects of physical activity in health promotion and disease prevention.

In Sweden PARs normally consist of activities that are home-based or self-monitored, such as walking, and facility-based activities organised by different physical activity organisations in the community [16, 83]. Generally, the Swedish PARs are broader in construction than for example PARS or ERS (exercise referral schemes) in the UK. While the UK-based schemes traditionally focus solely on facility-based exercise prescriptions issued by physicians [42], the Swedish PAR schemes include a range of health-care professionals issuing PARs that refer patients to both facility-based and home-based activities. The Swedish PAR concept has similarities with broader models such as “green-prescriptions” concept in New Zealand, which includes both home-based physical activities and activities provided by the local sport foundation [10]. Although PARs do differ somewhat by region, the common key feature of the broader physical activity referrals used in Sweden can be summarised as - written physical activity prescription issued by a health-care provider, delivered in a formalised process based on the patient’s needs, to some form of locally adapted services or activities.

As a result of the “Sweden on the Move” campaign a pilot study for a PAR project was initiated in ten PHC centres and three occupational health services (OHS) clinics in five Swedish counties, during 2001 and 2002. The aim of this first study was to develop and describe the working method and structure of Physical Activity on Prescription (the Swedish acronym being FaR) and the organised enhancement of physical activity in order to promote health and prevent disease. The results of the study have been presented both in the grey literature [83] and as scientific publications [16, 35].

Among the major findings in the pilot study was the need for a well-defined organisational structure and good relations between health-care units and the physical activity organisations. This factor was considered essential to successful implementation. The study identified a number of supporting factors and barriers to PAR programmes, including the importance of having; a coordinator who works within the organisation and also has the support of the management; a visible structure, both within the actual organisation, as well as among stakeholders outside the clinic; and a community-based network to facilitate supervision and support. Major barriers to the effective implementation of a PAR programme included lack of time; staff turnover; too many projects running at the same time; and insufficient communication both within the actual organisation and among stakeholders [83].

The experiences gathered in this pilot study helped to develop the following guidelines on how to implement Physical Activity on Prescription, which were published by The National Institute of Public Health [83]:

- Adapt physical activity on prescription to existing local conditions; collaborate with other units and organisations by forming a community-based network.
- Appoint a coordinator responsible for the process both within the relevant organisation as well as among stakeholders outside the clinic.
- Make sure the project is firmly anchored within the unit.
- Implement education initiatives with all stakeholders to raise awareness and to secure a mutual platform.
- Create a visible structure for communication.
- Make sure contact persons, phone numbers, addresses, project material, price lists are at hand before you start.
- Prescribe physical activity on the basis of FYSS (The evidence-based handbook - Physical Activity in Prevention and Treatment of Diseases).
- Put Physical Activity on Prescription in context and try to make it part of people's everyday routines.
- Encourage staff to be physically active themselves (role models).
- Begin on a small scale and develop outwards.
- Be patient – behavioural change takes time.

2.4.3 Diffusion of the prescription innovation in Sweden

A national survey from 2005 [60] showed that almost half (48%) of the PHC centres in Sweden had some kind of routine or program related to physical activity (the corresponding figure for smoking was 64%). In these PHC centres, 71% had clear referral procedures, 96% gave oral advice about physical activity, 69% used written physical activity prescriptions and 35% used a specific "anamnesis" method. Another national survey conducted in the same year concerning clinical practice concluded that health-care professionals have great confidence in the benefit of physical activity and generally regard physical activity promotion as an integral part of their duties [19]. Still, the overall conclusion is that physical activity promotion is an underdeveloped field, mainly because of the great variance within various health-care segments [19].

The increased use of PARs and also motivational interviewing caused some debate in Sweden during 2005. This debate was based on a report questioning the widespread use of these two methods, as the report's authors stated that there was not enough evidence of either of these methods. The authors argued that new methods can be used despite the absence of evidence, but only if a method evaluation is done in parallel [85]. This debate is not unique for Sweden, and has taken place in other countries (e.g. in the UK). The National Institute for Health and Clinical Excellence (NICE) has recommended a halt to the further use of PARs other than in controlled research for the time being [18, 63].

The relatively successful diffusion of PARs and other new clinical practices can be explained by "diffusion of innovation" theories, based on the idea that innovations spread and get adopted at different rates. Some never spread at all [86]. Greenhalgh et al. [86] conducted a landmark systematic literature review concerning "Diffusion of Innovations in Health Service Organisations", based on extensive research by the sociologist, Rogers. The Greenhalgh review described six main attributes that influence the adoption of innovations. First, the most important and consistent attribute determining adoption is "relative advantage" (i.e. whether the potential adopter can see any advantage over existing practice). Other attributes promoting adoption of innovation include "compatibility", "complexity", "trialability", "observability" and "reinvention".

2.4.4 Physical activity referral schemes in Östergötland

The first lifestyle and exercise on prescription concept in the county of Östergötland was developed in the late 1980s. However, widespread and systematic use of PARs in the county began many years later, as PARs were nationally introduced in the "Sweden on the Move" campaign in 2001. The first national PAR study included three PHC settings and one OHS setting in Östergötland County, and was the beginning of a formally organised PAR network in Östergötland [16, 83].

Each local PAR network or PHC centre in the county established collaborations with eligible local public health and sports organisations that

were active in the field of health-enhancing physical activity. PAR coordinators or contact persons were appointed both at the PHC centres and participating physical activity organisations [83, 87]. Patient information packages were assembled for use by the members of the regional PAR network containing educational materials describing the health benefits of physical activity, along with waiting room posters for PHC centres, and referral forms for participating PHC personnel.

The prescription procedure used in the county's programmes was intended to be patient-centred and take into consideration the patient's current activity level, activity history, capacity, motivation, and interests. Patients eligible to receive PARs from participating PHC centres were those whom staff believed would benefit from increased physical activity, due to sedentary lifestyles and/or diagnoses indicating that increased physical activity could be beneficial, e.g. high blood pressure, diabetes, and musculoskeletal disorders. Participating patients were provided with written prescriptions and copies of PARs were kept in the patients' medical records. The patient was also provided with a written PAR. If the activity prescribed was facility-based (e.g. group gymnastics, aerobics, water aerobics, weight and circuit training.), a copy of the PAR was also sent to the PAR coordinator in the relevant physical activity organisation, who then contacted the patient by telephone or letter. The patients paid the normal participation fees to the facilities they attended. The physical activity organisation also made a phone call after 5 weeks to verify if the patient had attended the suggested group activity. The purpose of the phone call was threefold: (1) to guide and motivate potential drop-out patients to participate in other activities; (2) to give other patients/participants the opportunity to attend instead of drop-out patients; (3) and to gather information about drop-outs for feedback to the PHC centres. Patients who were prescribed home-based activities, such as walking, did not receive this phone call.

2.4.5 Dissemination of referral schemes in Östergötland

At the end of 2003, 80% of the PHC units in the region worked with PARs to some extent, meaning that they had at a minimum established a supportive community structure to help the patients to gain access to the facility-based activities prescribed by the PHC practitioner [87].

In 2004 and 2005, a previously existing economic incentive to promote improved health-care quality in PHC (e.g. telephone lines for non-urgent health advice, systematic asthma care) was targeted to include incentives to health-care providers using PARs. Experiences with this patient-oriented approach resulted in the County Council's introduction of incentives to support PAR work in general, to stimulate prescription activity, and to compensate for the extra amount of work required to collect and assemble prescription data [87].

The incentives, which primarily involved additional operating funds to participating PHC centres, were performance-based. The incentive also required that participating PHC centres designate coordinators responsible for collecting baseline and follow-up statistics about PARs in each PHC centre. This incentive scheme included support for the 37 community owned PHC units in the county, and was based on three budget categories:

1. Structure (10%), including an exercise on prescription coordinator and collaboration with a least one organisation outside PHC.
2. Volume (2004; 60%, 2005; 50%), including a goal of 50–100 prescriptions a year according to the size of the PHC unit (small PHC, 50 prescriptions; medium PHC, 75 prescriptions; large PHC, 100 prescriptions).
3. Follow-up (2004; 30%, 2005 40%), meaning that 80% of the patients should have been followed up after 3–4 months and at 12 months (only in 2005 and based on prescriptions from 2004).

The criteria for the economic incentives were all based on previous PAR experience in Östergötland, along with the guidelines from the national pilot study. The levels used were supported at management level in primary care and were accepted by PHC representatives [87].

3. AIM

The overall aim of this thesis was to investigate the need for physical activity interventions in a general adult population, the characteristics of physical activity referral (PAR) scheme recipients and referral practitioners, and the effectiveness of PAR in a routine primary health-care setting in the County of Östergötland, Sweden.

The specific aims were:

- to investigate the self-reported physical activity levels in the population, individuals' intentions to change physical activity levels and self-perceived need for support, and their opinions concerning the responsibilities of both the individuals and the health-care providers to promote physical activity.
- to describe and analyse the characteristics of the PAR recipients and referral practitioners, and to analyse PARs in relation to PHC registries.
- to assess the effectiveness of PARs in terms of the changes in self-reported physical activity level in relation to various patient characteristics and the profession of the practitioner.
- to evaluate self-reported adherence to PARs and to analyse the different characteristics associated with adherence.

4. MATERIALS AND METHODS

This section describes the materials, i.e. study objects, and the methods used in the two studies and four papers included in this thesis. The chapter starts by presenting the details of the contexts in which the studies were conducted, followed by a description of the data collection, research methods (i.e. the tools used to gather data), and the statistical methods used in the first study, which is a population survey (paper I). The materials and methods used in the subsequent three papers (II, III and IV), which describe various aspects of a PAR programme in Östergötland County, are presented together and include the prescription procedure, data collection at baseline and follow-up, and statistical analyses of the data collected during this study phase.

4.1 Study setting and context

The studies in this thesis were conducted in Östergötland County, Sweden. This county, with 416 000 inhabitants, is the fourth largest county in Sweden and includes two larger cities (>120,000 inhabitants) and 11 smaller, more rural municipalities. At the time of the PAR studies described in this document, the County Council administered three hospitals and 42 PHC centres. Five PHC centres were privately owned during the study period, while the other 38 PHC centres and the hospitals were public. However, differences in administration between private PHC centres and public PHC centres are minimal in the county, as both types of centres are commissioned by the same Health Authority.

All PHC centres in Östergötland County have a specified catchment area and/or a subscribed population. PHC staff usually includes different health-care professionals, i.e. physicians, nurses, physiotherapists, occupational therapist, dieticians, and behavioural scientists (for example psychologists and mental health counsellors). The number of staff in the PHC centres in Östergötland County ranged from 10 to 80, with the number of physicians ranging from 2 to 12 and nurses from 8 to 35 (as of January 2005).

In Östergötland a Public Health Policy programme was adopted by the County Council in 2001 [88]. Additionally, the action plan “A More Health-promoting Health Service”, was adopted by the County Council in 2003, to further develop and clarify the County Council’s continued efforts to create a more “health-promoting health service” [89]. This included efforts to support equitable health development in the population by contributing more knowledge about disease and health determinants, the distribution of these determinants and how they can be influenced by health-care providers and other public health professionals. Furthermore, these programmes also clarified the importance of active participation by county authorities and PHC centres in efforts at local, regional and national levels influencing the determinants of disease and ill-health. Both these regional documents were influenced by the national public health policies [50] and previous work associated with them [49].

The studies presented were conducted and built upon the context of these policies and efforts, as managed by the County Council’s Public Health Department, according to its ordinary commission by the Health Authorities in Östergötland County. This can therefore be considered as a program-driven intervention, which in contrast to research-driven interventions, is built on program and policy rather than being initiated by researchers [71]. The data collection methods used to gather information were not intended to be used in rigorous scientific investigations, as the results first and foremost were planned to be used in local programme assessment. As the data collection used for all four studies in this document was part of the ordinary health-care routine data gathering, ethical approval for data collection and analysis was not required according to Swedish law.

4.2 Population survey (paper I)

4.2.1 Study description

The first paper in this thesis is based on a comprehensive population survey conducted with adult respondents aged 18–84 years living in Östergötland County in 2006. Recurrent population surveys are conducted in the county, and are used to monitor health and prevalence of risk factors in the general

adult population, with the aim of increasing understanding of the needs for health promoting efforts in the county's population.

The paper investigated the self-reported physical activity levels of the adult population and assessed individuals' intentions to change their physical activity levels and their self-perceived need for support. The paper also investigated their opinions concerning the responsibilities of both the individuals and the health-care providers to promote physical activity. Analyses were conducted in relation to seven background variables: sex, age, education, economy, general health, body mass index - BMI (kg/m^2) (<25 normal weight; 25-29,9 overweight; >30 obese) and physical activity level.

4.2.2 Data collection (paper I)

A postal questionnaire was sent to a sample of 13 440 individuals in Östergötland in March 2006. The target population (315 587 individuals) was the adult population, aged 18–84 years, living in the county. The questionnaire and the survey were designed by the County Council's Public Health Department and the sample was administrated by Statistics Sweden.

The questionnaire consisted of 20 pages. Along with questions about personal and socioeconomic characteristics, the survey included a wide range of questions to identify determinants of health in the adult population, including self-perceived needs for lifestyle changes, coping strategies and perceived support concerning lifestyle and lifestyle changes.

The overall response rate was 54% ($n=7238$). More females (59%) responded to the survey than did males (49%) and responses were not equally distributed between the four age groups. The highest response rate (69%) was found in the oldest age group (65–84 years). The youngest age group (18–29 years) had the lowest response rate (40%). Item non-response rates varied from 1 to 13%. About 8% of the respondents filled in multiple items when asked which health related behaviour was most important to change right now, although they were asked to identify only one item. Multiple responses were excluded from the analysis.

The survey questions used in paper I are presented in table 1. Physical activity was assessed by two questions: one regarding physical activity in everyday

life and one regarding exercise during the last 12 months. Responses from the two questions were categorised using a four-level physical activity index: inactive, somewhat active, moderately active and active at the public health recommendation level (table 2).

Table 1. Variables used from the population survey in Östergötland 2006

Variables	Questions	Response items
Physical activity	Q1: Physical activity in daily life (walking, cycling to work, etc.) over the last 12 months?	A. None B. A few times/week C. Several times/week D. Every day/almost every day
Physical activity	Q2: Exercise over the last 12 months, beyond physical activity in daily life?	A. Hardly anything B. Light activity at least once a week C. Moderate activity at least once a week D. Vigorous activity on a regular basis
Intention to change. This set of questions included nutrition, physical activity, weight, alcohol consumption and tobacco use	Have you considered changing any health-related behaviour by increasing your physical activity?	1. "No, I have no intention to change" 2. "Yes, I have thought about change but not just now" 3. "Yes, I am determined to change right now"
Most important to change	If you intend to change one health-related behaviour which is the most important to change "right now"	1. Healthier eating 2. Increase physical activity 3. Lose weight 4. Quit tobacco use 5. Lower alcohol consumption 6. I don't want to change any of these habits
Support to change (based on the previous question)	Would you like support and help to make these changes? If yes, which support systems or care providers would be most helpful in effecting change?	Yes or no 1. Primary health care 2. Hospital 3. Dentist 4. Occupational health service 5. Pharmacy 6. Internet 7. Other; free text fill-in line
Responsibility. This set of questions included nutrition, physical activity, alcohol consumption and tobacco use	1. How much responsibility do you think you have yourself to lead a healthy lifestyle regarding physical activity? 2. How much responsibility do you think the health-care providers have when it comes to trying to promote physical activity, when patients visit the clinic? 3. How much responsibility do you think the health-care providers have when it comes to trying to promote physical activity in the general population?	1. Very much 2. Somewhat 3. Not much 4. Very little 5. Don't know

Table 2. Physical activity index used in the population survey in Östergötland 2006.

Physical activity index levels are based on the following combinations of Question 1 and Question 2 (see table 1). First letter in the combination responds to Q1, second to Q2:

Physical activity level	Response combination
1. Inactive	A-A, B-A
2. Somewhat active	C-A, A-B, B-B, C-B
3. Moderately active	D-A, D-B, A-C, B-C, C-C
4. Public Health recommendation level	D-C, A-D, B-D, C-D, D-D

The survey included a series of questions addressing health-related behaviour including questions about nutrition, physical activity, alcohol consumption, tobacco use and weight. Participants were asked if they had considered changing any health-related behaviour, which health risk behaviour they considered to be the most important to change “right now”, and whether or not they wanted/needed support to make changes to the identified health-related behaviour. If respondents answered that they would like support to change health risk behaviours, they were asked to identify which support systems or care providers would be most helpful in effecting change. Response items included: primary health care, hospital, occupational health service, dentist, pharmacy (dentist and pharmacologist were options primarily associated with the smoking question), Internet and a free text fill-in response alternative.

Respondents were also asked questions regarding their opinions about personal responsibility for conducting a physically activity lifestyle. They were asked to provide responses to statements about the health-care providers’ responsibility in promoting a physically active lifestyle when patients visit the clinic, and the health-care provider’s responsibility in promoting a physically active lifestyle in the general population.

We combined a number of survey responses into larger categories. For example, responses measuring “support sources for change” were recombined into a dichotomous variable, consisting of “Health care” and “Others”. The definition of “Health care” consisted of primary health care, hospital, occupational health service and pharmacy; the “Others” category consisted of two responses: Internet and free text options not related to health-care service.

Items asking respondents to agree with statements regarding responsibility for promoting physical activity in the adult populations included the response alternatives: very much, somewhat, not much, very little. These alternatives are presented as a dichotomous variable; “Great” (including those who responded very much and somewhat) and “Little” (including those responding not much and very little). The self-reported economy question included five response alternatives including “Neither good nor poor”. The options “Very good” and “Rather good” are presented as “Good”. “Very poor” and “Rather poor” are presented as “Poor”. To measure general health status, we used one fill-in-the-blank question: “In general, would you say your health is?” Responses were dichotomised as: “Good” (comprised of those responding with “Excellent”, “Very good” and “good”) or “Poor” (response alternatives “Fair” and “Poor”).

4.2.3 Data analysis (paper I)

The survey was stratified by gender, age and municipalities resulting in 104 strata, with simple random sampling within each stratum. All statistical analyses were adjusted for non-responses [90]. The final weights that were used in the analyses were calibrated at Statistics Sweden according to the following factors: country of birth, civil status, level of education and occupation. To determine categorical differences between groups Pearson’s chi-squared tests were performed. A *p*-value below 0.05 was regarded as significant. All statistics were calculated using SPSS (release 15.0) for Windows.

4.3 Physical activity referral study (papers II–IV)

4.3.1 Study description

Data generated by clinician and patient participation in PAR programmes, presented in papers II, III and IV, include measures related to prescribed physical activity issued in routine PHC. These three papers are based on the same baseline data collection. Analyses were mainly conducted in relation to

six background variables: sex, age, physical activity level at baseline, referred activity type, referral practitioner, PAR reason. Paper **II** also included a set of registry data from the PHC visit statistics.

4.3.2 Data collection (papers II–IV)

These papers feature analyses of information collected in 37 (in 2004) and 38 (in 2005) of the 42 PHC centres operating within the county. Of the five centres that did not participate in 2004, two public PHC centres did not work with PARs at the time and three private PHC centres declined to participate due to lack of time. In 2005, one of the two public non-participating PHC centres initiated a PAR scheme, and was included in this study. The results in paper **IV** are based solely on the population issued PARs in 2004 and patients aged 18 years or older.

In the registry data used in paper **II**, the study population was divided into five age groups 0–17, 18–29, 30–44, 45–64 and 65 years and older as these age groups were normally used in reports and registry data in Östergötland County. These registry data show that the PHC centres in Östergötland County (all 42) were visited by 234 250 unique individuals in 2004 and by 239 847 unique individuals in 2005. More females (55%) than males visited the PHC centres during the study period. With regard to age, 19% of the PHC visitors were 0–17 years, 12% were 18–29 years, 17% were 30–44 years, 26% were 45–64 years, and 26% were 65 years or older. More than half (56%) of the patients were seen by physicians; 34% were seen by nurses during 2004 and 2005.

Baseline data collection

Baseline data for each patient were collected from the PAR prescription forms. All prescriptions forms were registered in a Microsoft Excel-based spreadsheet by the PAR coordinator in each unit, which was then sent to the principle investigator three times a year for ongoing analysis.

The prescription form used to collect the baseline data included patient data such as age, sex, address, telephone number, and information about the prescriber's profession. Patients were asked to state the number of days in the previous week (7-day recall) where they had participated in "at least a total of

30 minutes of physical activity that made you warm, e.g. brisk walking, gardening, heavy housework, cycling and/or swimming". This question was based on the current Swedish physical activity recommendation (FYSS 2003). Physical activity in the previous week ("7-day recall") and physical activity in a normal week ("normal week") were assessed. The 7-day recall question was used as the primary outcome measure, and the "normal week" question was used in some analyses as a complement. Patients' self-reported physical activity was classified into four groups: (1) regularly active/meet the public health recommendation (those who reported 5–7 days of 30 minutes of moderately intense physical activity); (2) moderately active (3–4 days); (3) somewhat active (1–2 days); and (4) inactive (0 days).

Reasons for receiving physical activity on prescription were registered on the form by selecting one or more of seven pre-defined options including sedentary lifestyle, or pre-existing diseases including known risk factors related to lack of physical activity (musculoskeletal disorders, overweight (body mass index >25)), diabetes, high blood pressure, high blood cholesterol, and mental ill-health. The category also included a free-text line to justify the PAR prescription. Free-text responses were categorised and re-coded into new categories. However, the numbers in each category were small, and included e.g. asthma and chronic pulmonary disease, and are presented in the tables as "other reasons". The prescription form also included data concerning the prescribed physical activity. This was also registered on the form by selecting one or more of seven pre-defined options including walking, Nordic walking, running, swimming, water aerobic, group gymnastics, weight and circuit training, and a free-text line for "other reasons".

In papers **III** and **IV**, patients issued PARs for more than one reason were categorised as a "combination of reasons/diagnosis", and activities were summed up to be either lifestyle activities (free-living or home-based activities such as walking) or structured facility-based activities provided by a local physical activity organisation. Some patients were issued both lifestyle activities and structured activities; these cases were classified as a combination category.

Follow-up data collection (paper III)

In paper **III**, 37 (in 2004) and 38 (in 2005) of the 42 PHCs in the region participated in the follow-up (figure 2). Of the five units that did not

participate in 2004, two public PHC centres did not work with PARs and three private PHC units declined to participate due to lack of time. In 2005, an additional public PHC unit initiated its PAR work and was included in the study. A 3-month follow-up was conducted by 36 units in 2004 and by 37 in 2005, and a 12-month follow-up was conducted among patients issued physical activity on prescription in 2004 by 27 of the 37 units that included patients in 2004. The main reasons for non-participation in follow-ups were lack of time or shortage of staff.

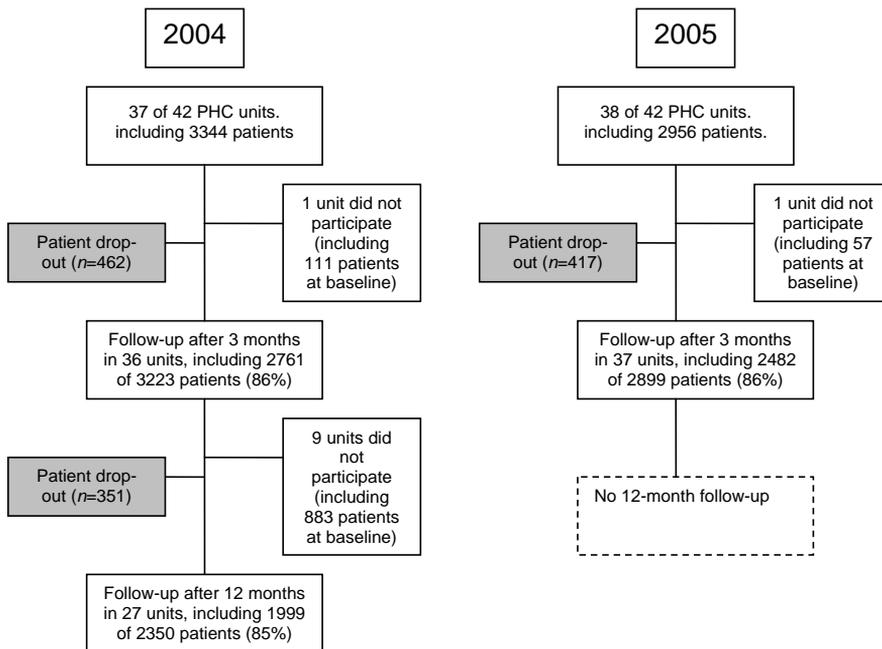


Figure 2. Data collection flow chart including PHC units and patient drop-out.

PAR effectiveness was defined as a change in self-reported physical activity level between baseline and follow-ups, as assessed by the same question as used at baseline. To make the follow-up procedure easier for the primary health-care units' PAR coordinators, three options were used to collect the data: telephone interview, postal questionnaire, and/or during the patient's normal return visit. At the 3-month follow-up, 73% of the patients were contacted by telephone, 17% by postal questionnaire, and 10% answered the follow-up questions during a return visit. The 12-month follow-up showed a

similar pattern with 68% contacted by telephone, 21% by postal questionnaire, and 11% during a return visit.

Follow-up data collection (paper IV)

In paper IV, a 3-month follow-up on patients issued PARs was conducted in 36 PHC centres and a 12-month follow-up was conducted in 27 PHC centres. The main reasons for non-participation in follow-ups in PHC centres were lack of time or shortage of staff.

Patients' self-reported adherence to the prescribed activity was assessed by asking the patient the question "have you adhered to your physical activity prescription?" The respondent selected one of three alternatives: (1) "I adhered to the prescription"; (2) "I'm active but in another activity than the prescribed activity"; (3) "I do not follow my prescription". Results are presented as (1) adhered, (2) partly adhered and (3) non-adhered. Follow-ups also included the same physical activity question, and patients were asked to state their current physical activity.

Three different methods were used to collect the questionnaire data: telephone interview, postal questionnaire, and/or questionnaire provided during the patient's normal return visit. At the 3-month follow-up, 74% of the patients were contacted by telephone, 14% by postal questionnaire, and 12% answered the follow-up questions during a return visit. The 12-month follow-up showed a similar pattern with 68% contacted by telephone, 21% by postal questionnaire, and 11% during a return visit.

4.3.4 Data analyses (papers II–IV)

In paper II, the health-care providers' reasons for PARs are presented as proportions of all patients receiving PARs. A PAR rate was calculated from the number of PARs issued in PHC during one year divided by the number of unique individuals who visited the 42 PHC centres in the region each year. A practitioner-specific PAR rate was calculated from the number of PARs issued by different types of health-care providers during one year and presented as the total number of PARs divided by the number of unique individuals that visited each health-care provider category during one year.

Health-care providers' reasons for PARs are presented in this study as a proportion of all patients receiving PARs.

In paper **III**, logistic regression analyses were applied to identify possible associations between an individual's self-reported increase in physical activity (not including patients already categorised as regularly active) from baseline to follow-up, and his/her sex, age, activity level at baseline, referred activity type, referral practitioner, and reason for being issued physical activity. Separate analyses were done for the 3- and 12-month follow-ups.

In paper **IV**, logistic regression analyses were applied to identify possible associations between self-reported adherence, and sex, age, activity level at baseline, referred activity type, referral practitioner, and reason for prescription of physical activity. Separate analyses were done for the 3- and 12-month follow-ups. As the aim of the study was to analyse adherence, patients reporting part adherence were excluded from these analyses, e.g. the outcome measure was adhered vs. not adhered. The correlation coefficient between adherence and change in activity level was calculated with Spearman's rho.

In all papers statistical significance was set at $p < 0.05$, the confidence intervals were 95% and the statistical software SPSS (release 14.0 in paper **II**, release 15.0 in paper **III** and **IV**) was used for all analyses.

5. MAIN RESULTS

This section presents the results of the four papers, starting with the population survey (paper I), followed by the results from papers II, III and IV, which investigate different outcomes of the PAR study in Östergötland County

5.1 Population survey (paper I)

According to the population survey, 25% of the adult population in Östergötland during 2006 were categorised as physically active according to the national public health recommendations, and 11% were categorised as inactive (table 3). There were differences between sexes, as more males reported physical activity at the public health recommendation level than females. The largest group of females was categorised in the “moderately active” group, resulting in lower numbers of females than males in both the inactive and somewhat active group. Overall, higher activity levels were associated with younger age groups, higher education levels, higher income levels, better self-reported general health status, and lower BMI.

Table 3. Physical activity levels in the adult population (18–84 years) of Östergötland in 2006

	<i>n</i>	Physical activity level				<i>p</i> -value
		Inactive (%)	Somewhat active (%)	Moderately active (%)	Public health recommendation level (%)	
Total	6966	11	27	38	25	
Sex						0.01
Females	3802	10	25	40	24	
Males	3164	11	29	35	25	
Age groups (years)						0.00
18–29	1294	9	16	34	41	
30–44	1589	10	27	36	27	
45–64	1948	10	31	39	21	
65–84	2135	14	33	40	12	
Female age groups (years)						0.00
18–29	783	8	17	37	38	
30–44	918	9	24	43	24	
45–64	1048	8	26	42	24	
65–84	1053	17	35	37	12	

	Physical activity level				Public health recommendation level (%)	p-value
	Inactive	Somewhat active	Moderately active			
	n	(%)	(%)	(%)		
Male age groups (years)						0.00
18–29	511	10	14	32	44	
30–44	671	11	29	30	30	
45–64	900	11	35	37	17	
65–84	1082	11	31	44	13	
Education						0.00
Compulsory school	2059	16	34	38	13	
Upper secondary school	3293	10	26	37	27	
Post-secondary school	1446	6	21	38	35	
Self-reported economy						0.00
Good	3865	9	26	39	27	
Neither good nor poor	2042	12	28	36	24	
Poor	908	15	30	36	19	
General health						0.00
Good	5456	8	24	39	29	
Poor	1456	20	36	33	11	
Body mass index (BMI) (kg/m ²)						0.00
<25	3400	8	22	38	32	
25.0–29.9	2373	11	32	38	20	
>30	877	20	36	33	11	

At the time of the survey, about 37% (table 4) of the adult population in Östergötland stated that they had no intentions to change their physical activity level, 36% had thought about change, but “not just now”, and 27% were determined to change “right now”. It is notable that a majority of those categorised as belonging to the two least active groups (inactive or somewhat active) stated that they were considering increasing their activity level, just “not right now”.

Table 4. Intention to change physical activity level in the adult population (18–84 years) of Östergötland in 2006

	Have you considered increasing your physical activity?				p-value
		“No, I have no intention to change”	“Yes, I have thought about change but not just now”	“Yes, I am determined to change right now”	
	n	(%)	(%)	(%)	
Total	6569	37	36	27	
Sex					0.00
Females	3552	35	36	29	
Males	3017	39	37	24	
Age groups (years)					0.00
18–29	1289	24	38	38	
30–44	1580	24	41	34	
45–64	1883	41	37	21	
65–84	1817	64	25	11	

	Have you considered increasing your physical activity?				p-value
	n	"No, I have no intention to change" (%)	"Yes, I have thought about change but not just now" (%)	"Yes, I am determined to change right now" (%)	
Female age groups (years)					0.00
18–29	778	20	36	43	
30–44	917	23	39	38	
45–64	1008	39	37	24	
65–84	849	59	28	13	
Male age groups (years)					0.00
18–29	511	28	40	33	
30–44	663	26	44	31	
45–64	875	43	37	20	
65–84	968	69	22	9	
Education					0.00
Compulsory school	1782	50	33	17	
Upper secondary school	3215	34	38	29	
Post-secondary school	1422	32	37	31	
Self-reported economy					0.00
Good	3667	40	34	26	
Neither good nor poor	1908	36	39	25	
Poor	861	30	40	31	
General health					0.00
Good	5243	36	36	28	
Poor	1284	40	40	21	
Body mass index (BMI) (kg/m ²)					0.00
<25	3270	42	34	24	
25–29.9	2229	34	38	28	
>30	796	23	44	33	
Activity level					0.00
Inactive	625	27	54	19	
Somewhat active	1699	26	47	27	
Moderately active	2530	39	34	27	
Public health recommendation level	1543	49	22	29	

Participants were asked to rank the health-related behaviour they considered to be the most important to change “right now”. Physical activity was the leading item on this list, with 28% of all participants choosing this item.

Among the other health-related behaviours listed as the most important to change “right now”, 24% answered to lose weight, 16% considered healthier eating, and 2% lowering alcohol consumption. Tobacco use, presented here as cigarette smoking and use of snuff, were considered to be the most important to change among 33% of the smokers, and snuff among 9% of the snuff users. Among all respondents, cigarette smoking was considered to be the most important behaviour to change among 5% and snuff use among 1%.

Those ranking physical activity as the most important health behaviour change needed “right now” tended to belong to younger age groups and have higher education levels. Among those ranking physical activity to be the most important behaviour to change, 15% answered that they wanted or needed support to make this change. Factors associated with the need for higher support included female sex, inactivity, obesity, poor health, and lower self-reported income levels. Half of the respondents identified health-care providers as a primary source of support with the greatest number referring to help from PHC personnel as most important. Responses citing PHC as a primary source of support were associated with older age (especially females) and those describing themselves as inactive.

Participants agreed, almost universally (93–99%), that an individual’s own responsibility to conduct physical activity is high. However, three out of four (76%) thought that health-care providers also had a great responsibility to promote patients’ physical activity levels. This finding was associated with respondents who reported higher education levels, higher income levels, better general health, and higher activity levels. Approximately 47% of respondents also thought that health-care providers had high responsibility to promote physical activity in the general population. Factors associated with agreement on this statement included older age, higher income levels, and poor general health.

5.2 Physical activity referral study (papers II–IV)

During the two-year period, a total of 6300 patients received PARs (3344 in 2004 and 2956 in 2005), amounting to about 1.5% of the total population of the county. The average number of PARs per PHC centre was 90 prescriptions in 2004 (with a range of 42–182 prescriptions) and 78 prescriptions per PHC centre in 2005 (with a range of 20–154 prescriptions). There were substantial seasonal variations in PARs, with the highest number of prescriptions issued from February to April and the lowest numbers during July.

5.2.1 Prescription characteristics and PAR rates (paper II)

Paper II demonstrates that two-thirds of the patients receiving PARs were female and the average age of PAR patients was about 54 years. The youngest patient was 12 years old and the oldest was 96 years old.

PAR rate

Table 5 describes the sex and age distribution of PAR patients in participating PHC centres in Östergötland County in 2004 and 2005, and presents PAR rates during the study period; i.e. the number of prescriptions issued per year in relation to the number of unique individuals who visited PHC during one year. Females had higher total PAR rates than males, with an average of 1.6% compared to 1.0% for men during this two-year period. Patients between 45 and 64 years of age had the highest PAR rate, with an average of 2.5% of the visits (by unique individuals) in 2004 and 2005.

Table 5. Physical activity referral rates in relation to sex and age

	2004		2005		TOTAL	
	Number (%)	PAR rate	Number (%)	PAR rate	Number (%)	PAR rate
Sex						
Female	2218 (66.3)	1.7	1972 (66.7)	1.5	4190 (66.5)	1.6
Male	1125 (33.6)	1.1	983 (33.3)	0.9	2108 (33.5)	1.0
Age group						
0–17	13 (0.4)	0.03	19 (0.6)	0.04	32 (0.5)	0.04
18–29	160 (4.8)	0.5	183 (6.2)	0.6	343 (5.4)	0.6
30–44	716 (21.4)	1.8	556 (18.8)	1.4	1272 (20.2)	1.6
45–64	1683 (50.3)	2.7	1449 (49.1)	2.3	3132 (49.7)	2.5
65+	771 (23.1)	1.3	747 (25.3)	1.2	1518 (24.1)	1.2
Total	3344	1.4	2956	1.2	6300	1.3

Note: The PAR rates are the number of PARs issued in PHC during one year divided by the number of unique individuals that visited PHC in one year.

Profession PAR rate

Patient records showed marked variations in activity levels among patients issued PARs. When asked to recall physical activity in the immediate past

seven days and over a 'normal' week, the proportion of inactive recipients, i.e. those who reported no activity, was 33% and 27% respectively. Another large proportion (29% for a 7-day recall and 30% for a 'normal' week) reported only 1–2 days a week on which their physical activity lasted at least 30 minutes. Only a quarter of patients stated that they were already regularly active, reporting 5–7 days on which physical activity lasted for at least 30 minutes (22% (7-day recall) and 24% (normal week) respectively).

The specific health professions of practitioners who issued PARs in 2004 and 2005 are shown in table 6. Overall, nearly two-thirds of the prescriptions were issued by physicians (35% of all PARs issued) and nurses (30%). However, the profession-specific PAR rate shows that physiotherapists and behavioural scientists produced the highest relative number of prescriptions, i.e. the number of prescriptions issued in relation to the number of unique individuals that visited each professional category. The results for 2004 and 2005 were similar, although physiotherapists prescribed PARs at somewhat higher rates and physicians at slightly lower rates in 2005 compared to 2004.

Table 6. Physical activity referral rates by referring health practitioners

	NUMBER OF PRESCRIPTIONS (%)		PROFESSIONAL PAR RATE (%)	
	2004	2005	2004	2005
Physician	1238 (38.1)	904 (31.5)	0.6	0.5
Nurse	1022 (31.4)	814 (28.4)	0.9	0.7
Physiotherapist	504 (15.5)	610 (21.3)	14.6	22.1
Occupational therapist	53 (1.6)	31 (1.1)	0.6	0.7
Dietician	129 (4.0)	168 (5.9)	3.9	4.6
Behavioural scientist	62 (1.9)	36 (1.3)	10.5	15.6
Other	245 (7.5)	303 (10.5)	1.3	1.3
Total	3253 (100)	2866 (100)	–	–

Note: The profession PAR rate is a ratio expressing the number of PARs issued by different professional categories in one year divided by the number of unique individuals that visit each category group each year.

There was considerable variation in the proportion of PARs issued by practitioners from specific professional categories when viewed by individual PHC centres. In some centres, only 4% of the prescriptions were issued by physicians, while in one particular centre, physicians issued all of the prescriptions. The proportion of PARs issued by nurses ranged from 0% to 93%; the proportion of PARs issued by physiotherapists ranged from 0% to 66%.

Reasons for PARs

The most common reasons for issuing PARs included musculoskeletal disorders (39.1%) and overweight (35.4%), followed by high blood pressure (23.3%) and diabetes (23.2%) (Table 7). Females who received PARs had higher proportions of referrals related to musculoskeletal disorders than males. Prescriptions for males were more likely to cite diabetes and high blood pressure as motivators for PARs.

Table 7. Reasons for physical activity referral*

	SEX		AGE GROUP					PROFESSION		TOTAL
	Female (n=4190) (%)	Male (n=2108) (%)	0–17 (n=32) (%)	18–29 (n=343) (%)	30–44 (n=1272) (%)	45–64 (n=3132) (%)	65+ (n=1518) (%)	Physician (n=2142) (%)	Other (n=3977) (%)	n=6300 (%)
Sedentary	14.6	13.9	21.9	22.7	17.1	13.0	12.8	17.7	12.9	14.4
Musculoskeletal	44.6	28.8	43.8	40.5	46.0	37.8	35.7	37.2	40.4	39.1
Overweight	35.2	35.7	37.5	42.9	38.5	36.2	29.2	39.4	33.8	35.4
Diabetes	18.3	32.9	6.3	1.7	7.5	26.2	35.2	17.0	27.2	23.2
High blood pressure	20.4	28.9	0	1.7	10.1	27.9	30.2	25.3	22.7	23.3
Cholesterol	8.0	10.2	0	0.3	2.5	10.6	12.2	9.8	8.5	8.7
Mental health	10.1	7.4	3.1	23.0	16.2	8.1	2.4	14.1	6.9	9.2
Other reasons	9.4	8.0	15.6	9.0	7.4	8.4	11.1	10.1	8.3	8.9

Notes: *The total sums exceed 100%.

Prescriptions due to high blood pressure, high blood cholesterol and diabetes were positively associated with older age. The number of patients issued prescriptions due to multiple health reasons increased with the age of the patients. Free text describing other reasons for prescribing physical fitness activities consisted primarily of asthma and chronic pulmonary disease ($n=63$).

‘Mental ill-health’ as a reason for PAR was most common among those aged 18–44. The number of patients who were issued PARs due to mental ill-health grew during the study period from 7.8% ($n=262$) in 2004 to 10.7% ($n=317$) in 2005. Mental ill-health as justification for PARs increased for females as the study period progressed, increasing from 8.5% ($n=188$) in 2004 to 12% ($n=236$) in 2005.

‘Being sedentary’ as a primary reason or in combination with other reasons for PARs, was a prescribing justification used most commonly for patients in younger age groups. ‘Being sedentary’ was more frequently issued as a

justification for PARs by physicians than all the other professional groups combined. Physicians also more frequently issued PARs to patients with overweight and mental health problems compared to other practitioners. The other practitioner categories to a larger extent justified PARs to patients due to musculoskeletal disorders and diabetes.

Prescribed type of physical activity

Table 8 describes the various types of activities that were prescribed for the recipients. Half of the patients (50.8%) were prescribed a lifestyle or home-based activity such as walking, which was the most common activity prescription for both sexes and for all age groups. Structured group-based activities, including water aerobics, group gymnastics and Nordic walking in groups, were more commonly prescribed for females than for males. Gymnastics and weight and circuit training were more commonly prescribed for younger patients.

Table 8. Prescribed type of physical activity for referred patients*

	SEX		AGE GROUP					PROFESSION		TOTAL
	Female (n=4190) (%)	Male (n=2108) (%)	0–17 (n=32) (%)	18–29 (n=343) (%)	30–44 (n=1272) (%)	45–64 (n=3132) (%)	65+ (n=1518) (%)	Physician (n=2142) (%)	Other (n=3977) (%)	n=6300 (%)
Walking	46.7	58.9	37.5	37.9	42.8	52.6	57	51.5	50.8	50.8
Nordic walking**	11.6	6.2	0	4.1	7.2	10.8	11.3	12.7	8.3	9.8
Running	0.7	1.5	6.3	1.7	1.8	0.8	0.2	1.7	0.6	1.0
Swimming	3.6	5.1	12.5	7.3	5.4	4.1	2.2	5.2	3.6	4.1
Water aerobics	31.0	12.9	6.3	19.2	22.7	25.5	27.1	21.2	26.5	24.9
Group gymnastics	14.8	9.6	9.4	20.4	17.2	11.9	10.4	17.9	12.5	13.1
Weight and circuit	17.3	21.4	40.6	33.5	26.7	17.6	10.6	17.6	19.8	18.7
Other activity	26.4	29.6	31.3	29.7	30.1	27.4	24.8	27.8	25.8	27.5

Notes: *The total sums exceed 100%. **Nordic walking, also known as ski walking, pole walking or fitness walking, involves walking with modified ski poles.

5.2.2 Activity level at 3 and 12 months (paper III)

The study population in paper III consisted of 6300 patients: two-thirds of the patients were female and the average age of PAR patients was about 54 years. The youngest patient was 12 years old and the oldest was 96 years old. The research in this study was aimed at identifying factors associated with short term (3 months) and long term (12 months) activity rates, after initial prescriptions had been issued.

One PHC centre did not participate, leaving 6122 patients available for the 3-month follow-up. The 12-month follow-up involved only patients included in 2004; 2350 patients were available at follow-up.

There were no statistically significant differences between patients at baseline and the patients in the 3-month follow-up regarding any of the background characteristics. However, patients at the 12-month follow-up differed from baseline, by being less active at baseline (37% inactive and 19% regularly active vs. 33% and 22% at baseline) ($p<0.001$), more commonly prescribed facility-based activities (45% vs. 41% at baseline) ($p<0.001$), more frequently issued prescription by physicians (41% vs. 35% at baseline) ($p<0.001$), more often had sedentary lifestyle as a reason for PARs, and less often received PARs due to musculoskeletal problems (6% and 19% vs. 3% and 22% at baseline) ($p<0.001$).

The response rate was 86% (5243/6122) at the 3-month follow-up and 85% (1999/2350) at the 12-month follow-up.

Increased physical activity

Half the patients reported increased physical activity both at 3 months (49%) and at 12 months (52%). As shown in figure 3, the proportion of inactive patients decreased from 33% at baseline to 17% at 3 months and 20% at 12 months. The proportion of patients who were physically active on a regular basis increased from 22% at baseline to 33% at 3 months and 32% at 12 months.

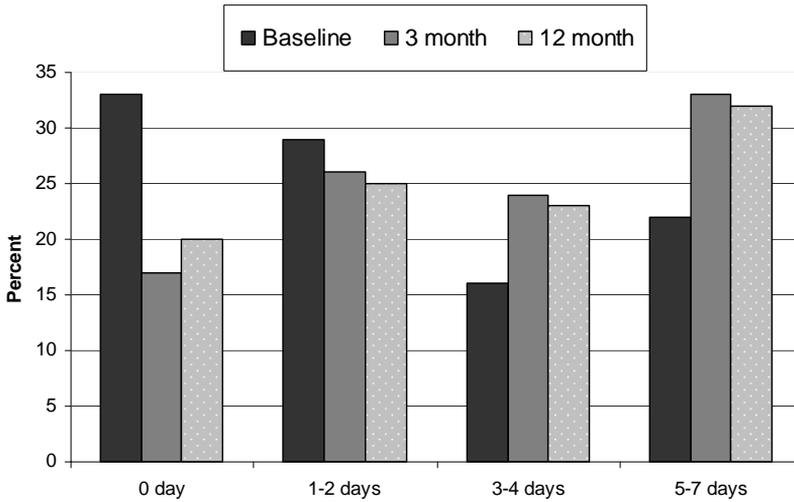


Figure 3. Physical activity level as percent at baseline ($n=5477$), 3 months ($n=4705$) and 12 months ($n=1808$).

Table 9 shows the patients’ changes in activity level after 3 and 12 months in relation to their activity levels at baseline. Nearly one-third (29%) of the patients in the follow-up studies who had reported zero days of 30 minutes activity a week (7-day recall) at baseline were still inactive at the 3-month follow-up. However, 30% increased their physical activity to 1–2 days a week, and 19% increased to 3–4 days a week; almost one in four (22%) reached the level of regular physical activity.

Table 9. Change in patient-reported physical activity level from baseline to 3 and 12 months follow-up

	Activity level at 3-month follow-up					Activity level at 12-month follow-up				
	<i>n</i>	0 days (%)	1–2 days (%)	3–4 days (%)	5–7 days (%)	<i>n</i>	0 days (%)	1–2 days (%)	3–4 days (%)	5–7 days (%)
Activity level at baseline (7-day recall)	4282					1652				
0 days	1393	29	30	19	22	598	29	28	22	21
1–2 days	1220	14	37	27	22	497	16	29	29	26
3–4 days	717	9	21	36	34	240	14	25	28	33
5–7 days	952	8	11	19	62	317	10	15	16	59
Activity level at baseline (normal week)	4322					1652				
0 days	1398	22	29	23	26	500	25	29	24	22
1–2 days	1231	6	34	35	25	490	11	29	34	26
3–4 days	719	3	14	43	40	312	8	22	37	33
5–7 days	974	4	9	15	71	352	7	9	17	67

A similar pattern was found for the physical activity question presenting a normal week at the 12-month follow-up. Fewer patients reported inactivity and more were regularly active when referring to physical activity in a normal week compared to their report of physical activity in the last 7 days.

Predictors of increased physical activity

Neither the patient's sex, age, referral reason nor the profession of the prescriber were significantly associated with increased physical activity. Two factors, patient's physical activity level at baseline, i.e. being inactive, and the type of physical activity issued, i.e. being issued lifestyle or home-based activities, were the only factors that were significantly associated with increased physical activity in the final multiple regression model (see table 10).

Table 10. Odds ratio for the multiple logistic regression model of increase in physical activity at 3 months ($n=3679$) and 12 months ($n=1468$)

	3-months			12-months		
	<i>p</i> -value	Odds ratio	95% CI	<i>p</i> -value	Odds ratio	95% CI
Activity level at baseline (7-day recall)	<0.001			<0.001		
0 days		4.58	2.86–7.35		3.97	2.89–5.46
1–2 days		1.49	0.96–2.31		2.52	1.83–3.46
3–4 days		1.00			1.00	
Activity type	<0.001			0.015		
Lifestyle activity		1.07	0.87–1.32		0.97	0.69–1.38
Facility-based activity		0.66	0.54–0.82		0.70	0.50–0.98
Combination of home-based and facility-based activity		1.00			1.00	

5.2.3 Adherence at 3 and 12 months (paper IV)

The study population in paper IV consisted of 3300 patients. The mean age of those included in this study was 54 years (SD 14.2). Two out of three were females. The youngest patient was 18 years old and the oldest was 96 years old.

Due to non-participating PHC centres, 2753 patients were available for the 3-month follow-up. Nine PHC centres did not participate in the 12-month follow-up, leaving 1992 patients available for this follow-up. The patient characteristics did not differ significantly between those at baseline ($n=3300$) and those participating in the 3-month follow-up ($n=2753$) or 12-month follow-

up ($n=1992$) for age, sex, activity level at baseline, referred activity type, referral practitioner or reasons for prescription.

The external patient drop-out was very low and resulted in a follow-up rate of 98% (2704 of 2753) at the 3-month follow-up and 99% (1965 of 1992) at the 12-month follow-up. Only patients who responded to the question on adherence were included in the analyses, leaving 2612 patients for the 3-month follow-up and 1907 patients at the 12-month follow-up. The internal drop-out rate ranged from 0% (age) to 11% (activity level at baseline) for the questions analysed.

Adherence

The average adherence rate to PARs was 56% at 3 months and 50% at 12 months. There were no statistically significant differences between females and males in adherence at 3 or 12 months ($p=0.467$ and $p=0.812$, respectively). Eighteen percent partly adhered to the prescription at the 3-month follow-up, and 21% partly adhered at the 12-month follow-up.

Predictors of adherence

In the descriptive analyses, higher adherence to PARs was associated with increased age, higher activity level at baseline, home-based activities, prescriptions issued by professional groups other than physicians, and among patients issued PARs due to diabetes, high blood pressure and "other PAR reasons".

In the multiple logistic regression models, higher adherence was associated with higher activity level at baseline, and to prescriptions including lifestyle or home-based activities, both at 3- and 12-months (table 11).

Table 11. Adherence, multiple logistic regression analysis: odds ratio for adherence to physical activity prescriptions in routine primary health care at 3 months ($n=1860$) and 12 months ($n=1320$)

	3 months			12 months		
	<i>p</i> -value	Odds ratio	95% CI	<i>p</i> -value	Odds ratio	95% CI
Activity level at baseline (7-day recall)	<0.001			<0.001		
0 days		1.00			1.00	
1–2 days		1.83	1.42–2.35		1.75	1.33–2.310
3–4 days		3.92	2.67–5.77		2.69	1.84–3.92
5–7 days		2.14	1.60–2.87		3.38	2.36–4.84
Activity type	<0.001			<0.001		
Home-based activity		1.88	1.15–3.07		1.06	0.75–1.50
Facility-based activity		0.49	0.32–0.76		0.47	0.33–0.66
Combination of home-based and facility-based activity		1.00			1.00	

5.2.4 Correlation between adherence and change in physical activity levels

In paper III effectiveness of PARs was presented in terms of increased physical activity by those receiving prescriptions and in paper IV as self-reported adherence by those receiving prescriptions.

The relation between adherence and activity levels is presented in table 12 (table not presented in the papers), and shows that 61% of those who reported adherence to PARs at 12 months also increased their physical activity as assessed by the 7-day recall question. Moreover, it can be seen that 61% of those who partly adhered and 28% of those reporting not adhering to PARs also increased their physical activity at the 12-month follow-up. Similar patterns were seen with the 7-day recall question and the normal week question.

A significant correlation was found between changes in activity level (main outcomes in paper III) from baseline to follow-up (categorised as increased, no change, or decreased) and the adherence assessments (main outcome in paper IV). The correlation coefficient was 0.21 according to the 7-day recall question ($p<0.001$) and 0.22 according to the normal week question ($p<0.001$) at the 3-month follow-up. The corresponding figures for the 12-month follow-up were 0.22 ($p<0.001$) and 0.25 ($p<0.001$), respectively.

Table 12. Relation between self-reported adherence and change in activity level

	3-month follow-up			12-month follow-up		
	Adhered	Partly adhered	Non-adhered	Adhered	Partly adhered	Non-adhered
Activity level (7-day recall)	<i>n</i> =2499	<i>n</i> =624	<i>n</i> =1115	<i>n</i> =824	<i>n</i> =349	<i>n</i> =456
Increased	57	57	26	61	61	28
No change	24	25	45	18	21	41
Decreased	19	18	29	21	18	31
	100	100	100	100	100	100
Activity level (normal week)	<i>n</i> =2527	<i>n</i> =627	<i>n</i> =1133	<i>n</i> =829	<i>n</i> =351	<i>n</i> =454
Increased	60	62	30	63	63	31
No change	26	24	43	22	21	36
Decreased	14	14	27	15	16	33
	100	100	100	100	100	100

6. GENERAL DISCUSSION

6.1 Discussion framework

This thesis has investigated the need for physical activity interventions in a general adult population, the characteristics of physical activity referral (PAR) recipients and referral practitioners, and the effectiveness of PARs in a routine primary health-care setting in the County of Östergötland, Sweden.

The sequence of the four papers presented, and the general discussion in this thesis is structured according to the Nutbeam “six-stage development model for evaluation of health promotion programmes” [72] including:

1. problem definition
2. solution generation
3. innovation testing
4. intervention demonstration
5. intervention dissemination
6. programme management

The first stage in the Nutbeam model, defined as “problem definition”, presents the results from the population survey in order to strengthen insight into the importance of physical activity promotion in general and more specifically, to present the particular demand for interventions in the health-care setting. This type of information is valuable in order to achieve the next stage in the Nutbeam model, solution generation. At this stage PARs are only one possible intervention among others that can be considered during a solution generation phase. The PAR study (presented in papers II–IV) introduces and tests an “innovation”, the physical activity referrals, which have been found to be feasible to practitioners and effective under study conditions. The innovation testing and intervention demonstration phases, corresponding to stages 3 and 4, were based on a PAR model adapted to fit into ordinary work in PHC settings. This PAR intervention was delivered during routine practice. The follow-ups were planned, conducted and

evaluated as part of the ordinary work within health-care settings, by the County Council's Public Health Department, according to its ordinary commission by the Health Authorities in Östergötland County.

In this thesis, the PAR is defined to be both a health promotion and disease prevention intervention. The presentation employs the term health promotion (analogous to Nutbeam) in this general discussion, without making any significant difference between the "health promotion" and "disease prevention" aspects of PARs. While much of the discussion here is based and structured on the Nutbeam model, this section of the thesis also makes some deviations in content from the original stages in the model.

6.1.1 Problem definition: is there a demand for physical activity interventions from health-care providers?

The main findings in paper I point out a considerable need for physical activity interventions in Östergötland. The study found that just 25% of the population in Östergötland were categorised as having a physical activity level that meets the national public health recommendations. This is almost consistent with findings from other studies, including the Eurobarometer study from 2002, which includes the European Union countries, and a previous population survey in the county of Östergötland from 1999. Both of these latter studies reported that 23% of the respondents in the study area had reached recommended physical activity levels [44, 45].

There are some differences between the findings from these earlier studies and the one described in this document. The results presented in paper I found only small differences between sexes, while the Eurobarometer study found that Swedish males were 1.6 times more active at the recommended levels than Swedish females [44]. The highest proportion of inactive individuals in our study were found among those belonging to the older age groups, and among those reporting the lowest education levels, poorer self-rated economy levels, poorer health status and among those with higher body mass index (BMI). In Östergötland there have been some small changes in activity levels in the population, comparing the population survey conducted in 1999 with this one from 2006. The proportion of those categorised as "regularly physically" active has increased in the total survey population in the ensuing

years, but the proportional changes are different for different gender and age groups. In the two oldest groups, women increased their activity level the most, while both men and women in the youngest age group show a decrease in physical activity levels. On the other hand, the proportion of inactive men aged 30–44 years has fallen. There are no clear changes for other variables [91].

Still, there is no clear picture concerning physical activity levels in the Swedish population, mainly due to lack of consensus as to what instrument to use to measure these levels. Many instruments used to measure physical activity at the regional or County Council levels lack evidence of a scientific basis and are seldom validity-tested. Given the lack of a common measurement approach, it is difficult to do comparisons within different regions in Sweden and to follow changes over time.

Who wants to increase their physical activity level?

According to the research published here, physical activity is the leading behaviour that the respondents want to change “right now”. Respondents prioritised increasing physical activity before changes in other areas such as decreased weight, healthier eating, quitting tobacco use or lowering alcohol consumption. One explanation for the high desire to increase physical activity levels among respondents might be that the proportions not sufficiently active are relatively high in the general adult population, and therefore include a considerable number of the population. Another possible explanation is that the majority feel that it will be easier to add a positive behaviour than to break existing negative health behaviours. Another factor may be that awareness of the importance of being physically active and awareness of the recommended level, must nowadays, be considered to be relatively high.

Almost one out of seven of those who considered physical activity to be the most important health-related behaviour to change also reported that they would welcome active targeted support to help them to increase their physical activity level. Extrapolated out to the general population, this segment corresponds to approximately 12 000 adults in the county. Of those who might be assumed to be in greatest need of increased activity (i.e. respondents reporting poor general health, BMI >30 and inactivity) more than one-quarter called for support to increase their physical activity level. This high-risk group especially called for support from health-care providers. It is important to remember that these figures, concerning help or not, only include those who

considered physical activity to be the most important change to make right now. Targeted support from health-care providers to achieve increased physical activity could also be demanded by those prioritising weight loss or change in other health-related behaviours.

Who is responsible for an individual's activity level?

Although most respondents stated that they held strong personal responsibility for ensuring that they were physically active, a large majority among all sub-groups also felt that health-care providers held responsibility for supporting patients in order to increase physically active behaviours. Differences were seen in terms of demand for health-care provider support, however. Those respondents with the highest intentions to change activity levels (i.e. those stating they were determined to change) were found especially among the younger age groups, but these younger respondents were also less likely to identify health-care providers as a source of support. Highest confidence in health-care providers (i.e. in seeking support from health-care providers and identifying health-care providers as an important support setting for increased physical activity) was seen among the elderly and among those reporting poor general health, high BMI and/or low activity levels. This seems natural, as different groups find information in different ways and from different sources. Younger people to a larger extent use new technologies to communicate and to find information, while older people rely on more traditional sources of information. This variety of information-seeking behaviours highlights a demand for even broader interventions focussing on multiple sources of information and support tailored towards different groups [42, 92].

This study's findings indicate that health care-based physical activity referrals issued by health-care providers are likely to be welcomed by older patients and those in most need of increased activity levels. Those in the younger age groups and those reporting good health and higher activity levels might find support for behavioural changes elsewhere. These findings are interesting both for the practice implications for health-care providers, and from a broader public health point of view, since it is important to increase physical activity levels in the most inactive groups in society. It is also important to improve public health, to seek interventions that will be effective for disadvantaged groups at particularly high risk. Interventions will then serve to reduce health disparities in the population rather than increase them [93], as

currently, many physical activity interventions appear to reach primarily those in good health who are already active [94].

A targeted use of interventions such as PARs can help the least active patients in a number of ways: by outlining specific steps to take, ensuring that physical activity levels are at appropriate levels for such patients, taking age, gender, current activity level, activity history, motivation, and health conditions into consideration. Other, much larger groups of patients who will benefit from PARs include those adults who are engaged in physical activity, but at inadequate levels. Many people are unaware that their physical activity levels are inadequate and are therefore less motivated to increase existing levels [95, 96]. Most adults who have adopted a physically active lifestyle may already be in agreement that their efforts are beneficial to their health, but, along with not knowing that their current levels are not adequate, they may also lack information and motivation on how to increase their activity levels.

The health-care provider's role in physical activity promotion includes outreach to these high risk individuals. However, health-care providers also need to be aware of the people who want to increase their physical activity but do not necessarily think of asking for special support from their health-care providers. Health-care providers can also expand their roles by educating and encouraging patients who are not aware of their insufficient activity levels and those are in the pre-contemplation stage for changing their physical activity levels without creating guilt or bad conscience. This also touches some of the ethical aspects included in delivering lifestyle advice. Is it reasonable to interfere with peoples' lives? Some might argue that patients might be offended, based on a belief that these issues are too personal and beyond the remit of health-care providers. Previous research [56, 57] and the results presented in the population survey show that these issues are demanded by the patients rather than something that they feel offended by. This task also lies in the remit of the health-care provider as commissioned by health-care authorities. Still some patients can feel offended, and this must be taken into consideration, which again highlights the demand for individualised patient-centred advice and counselling; people's preferences differ and different external factors also impact differently.

6.1.2 Solution generation: the Östergötland PAR model

Stages 1 and 2 (problem definition and solution generation) in the Nutbeam model call for a description of a population's characteristics, health problems, and need for some kind of intervention, and then require definition of possible methods to meet these factors. These components form the basic building blocks for planning health promotion interventions.

It is important to remember that PAR schemes are only one intervention among others within and outside health-care settings, considering all possible physical activity interventions in society. But PAR is a good example of combining an important health behaviour, such as increased physical activity, and efforts aiming to achieve correlated changes at the organisational level, for example the specific public health policy domain regarding "a more health promoting health service". In this case, PAR is relevant both as a method to increase the physical activity level among individuals, and as a method to help health-care providers reorient health services.

A considerable strength in the PAR model in Östergötland is that it includes acknowledgements of this dual benefit approach. The PAR model has been developed in collaboration between different actors in public governance and organisation in society over a longer period of time. In Sweden, PAR schemes normally prescribe activities that are home-based or self-monitored, such as walking, and facility-based activities organised by different physical activity organisations in the community. The foundation of PAR work in Sweden is for this method to be part of the routine practice of various health-care professionals. This Swedish model includes what has recently been promoted in the UK by some researchers [15, 42], against the criticism of the more narrow construction of the exercise prescription model used in the UK, which traditionally focuses solely on time-limited (normally 12 weeks) facility-based exercise prescriptions issued by physicians [7, 15, 42]. According to these researchers, these more proscriptive schemes need to be broadened to involve diversification away from just facility-based models, at least in part. More emphasis on self-directed activities could overcome several potential barriers simultaneously (transport problems, not wanting to attend formal exercise programmes alone, cost of attendance, inconvenient times of sessions, dislike of gym environment, and so on) [15].

To provide a broader perspective of the effectiveness of a PAR-type intervention, it is important to consider the wider population effect, i.e. the proportion of the total sedentary or insufficiently-active population referred for physical activities. Attention must also be paid to factors associated with the proportion of the referred population who then actually undertake activities at the appropriate level [11]. The PAR intervention in Östergötland was delivered in approximately 90% of the PHC centres in the county, and reached 1.5% of the total population over a two-year period, including 6300 patients. Study data show that 1.3% of patients visited PHCs. However, as also found by others in similar studies, although a programme reach of more than 6000 is admirable, it must be said that the programme failed to reach most of the inactive adults in the study area [11].

6.1.3 Innovation testing: PAR characteristics

The third stage in the Nutbeam model includes testing of a new innovation and ideally moving through a hierarchy of study designs [72]. As PAR innovations have been found to be effective in randomised trials and acceptable to both practitioners and patients, some of these initial questions have already been answered. However, as there seems to be a gap between efficacy and effectiveness in the field of promoting physical activity [7], it is important to evaluate the “actual PAR model”, as the translation of previous findings in other settings is difficult for many reasons [10, 13, 14, 77]. Moreover, the effect of these interventions are still somewhat under question, and there are arguments to only use them if evaluation is done in parallel with the implementation [18, 63, 85]. This simultaneous evaluation was done in Östergötland, in order to more clearly identify the effects of the programme.

Who were targeted for PARs?

The PAR study (papers II, III, IV) demonstrates that the PAR intervention reached a relatively high proportion of physically inactive people, visiting local PHC centres for other health reasons. Only one out of seven had “sedentary” listed as a reason for receiving a prescription. The main reasons for receiving prescriptions included musculoskeletal disorders, overweight, high blood pressure, and diabetes. All these reasons are relevant to PARs according to their relation to health effects, according to the present evidence [23, 32, 41].

By comparison, the study population in the PAR study was on average less active than the general population presented in the survey study. From that perspective, the referrals appeared to provide a good method for health-care practitioners to stress the importance of physical activity amongst community members least likely to engage in such activities.

While many of the PARs were based on patients' poor physical health, a relatively high number of referrals were issued due to poor mental health, particularly to adults in the 18–44 years age category. Heightened media interest in mental ill-health in Sweden and an increased awareness of the association between mental health and physical activity may partially explain the high numbers of PARs for mental health reasons. Providers' justifications for assigning patients to exercise due to poor mental health were vague; the category was simply defined as such, mental ill-health. With such a broad definition, it is likely that many prescribing health professionals could justify including a patient in this category.

It is also noted that many patients who already stated they were active received PARs. In these cases, it may have been that a change from one activity to another was advised, due to muscle strains or other physical problems. It is also possible that activity changes were suggested in order to increase the total amount of exertion expended by the patients. To a great degree, the reasons for justifying PARs and the resultant prescribed activities were associated with the age distribution of the patients. Accordingly, conditions including high blood pressure, high blood cholesterol, and diabetes were positively associated with older patient ages and there was a positive relationship between age and patients who were categorised as having multiple reasons justifying PARs.

Who issued PARs?

Most of the available research concerning PARs is limited to written prescriptions issued primarily by physicians [63]. The study described here highlights the use of PARs by different health-care practitioners in clinical settings. The importance of involving allied health professionals in PHC-based PAR schemes has been demonstrated in previous research [7, 69, 97]. Different approaches by the various health-care practitioners almost certainly influenced both the number of prescriptions and the distribution of reasons for

referring patients to physical activities in Östergötland County. Physicians and nurses issued the majority of the prescriptions in this study. However, physiotherapists and behavioural scientists issued the highest number of PARs in relation to the number of unique individuals who visited each professional category. Still, physicians issued the greatest number of referrals, and also the highest proportion of PARs to inactive patients. This underscores the critical role of physicians in the PAR approach to achieve increased levels of physical activity in the community. According to PHC registers, 90% of the visits in PHC are to a doctor or nurse.

As discussed previously there is some criticism of the more narrow construction of the exercise prescription model used in the UK. This criticism also notes that, in order to achieve maximum effectiveness, the intervention delivery must also be adopted by non-physician members of the primary care team [42]. PARs in Östergötland are also issued by allied health professionals. PAR issuance rates by individual PHC centres and PAR issuance rates per health professional category show differences in prescribing activities, both by patient categories and by prescribing professionals. Thus, there is great potential for benchmarking and further development in the prescription efforts, regarding issuance trends by various health-care professionals. As the PAR programme is fairly new in Östergötland, analysis of the general PAR rate and profession-specific PAR rates can be used by individual PHC centres in order to identify areas for improvement and modify goal setting.

Which is the most common PAR activity?

Walking is the most common physical activity in the population [46], and unsurprisingly, walking was also the most commonly recommended activity for PAR recipients. Half of the patients in this study were issued lifestyle or home-based activities, and walking was the most frequently prescribed activity for both sexes and in all age categories. This finding is consistent with recent physical activity guidelines, which has resulted in walking becoming something of a gold standard for low-intensity physical activity [98, 99]. Numerous studies have demonstrated that walking is a feasible activity for sedentary individuals and a valuable activity for health enhancement [24, 32, 40, 41, 100].

The other patients were issued prescriptions for a facility-based activity or a combination of both home-based and facility-based activities. Younger

patients, aged 44 years and under, were usually prescribed more physically strenuous activities such as group gymnastics and weight and circuit training; activities such as walking, Nordic walking, and water aerobics were more common among the older age categories. Females to a much larger extent than males were prescribed group-based activities such as water aerobics and group gymnastics. These activity differences may be a result of the prescribers' expectations about gender and age preferences for the range of different activities listed in the prescription form. One can only hope that these prescriptions were patient-centred and took into consideration the patient's current activity level, activity history, capacity, motivation, and interests. One also hopes that care was taken to prescribe an activity that the patient ended up enjoying, as enjoyment of a particular activity has been found to be important for the long-term effectiveness of the intervention [101].

6.1.4 Intervention demonstration: is PAR effective?

In this study, the fourth stage in the Nutbeam model concerning intervention demonstration is closely related to the previous stage of testing the innovation in a real-life setting. This discussion on intervention demonstration in the context of the real-life programme includes the effectiveness (not efficacy) of the PAR intervention and a number of predictors were found to explain this effectiveness. This intervention demonstration discussion does not include any discussion about process outcomes (included in the Nutbeam model) as this was not a research goal of the studies presented here.

The two papers presenting patient follow-up at 3 and 12 months show encouraging results based on patients' self-reported adherence to PARs and to self-reported increased physical activity levels. The results in paper **III** show that the PARs were effective in increasing the self-reported physical activity level both in the short-term (3 months) and the long-term (12 months), as approximately half of the patients reported increased physical activity levels at both follow-ups. The increased physical activity levels attained in this observational study are largely comparable to the results achieved in intervention groups in randomised controlled trials (RCT) based on similar concepts. Improvements in the proportion of patients reaching a certain level of physical activity seen in such studies vary between 15 and 25%, compared to approximately 5–15% in control groups [10, 12].

The overall adherence to PARs described in paper IV shows that slightly more than half of the patients adhered to the prescription at 3 months and that half of the patients adhered to PARs at 12 months. These results are comparable to a previous Swedish PAR study, which reported 53% adherence at 6-month follow-up [16], and with medication adherence in the long-term treatment of chronic illness, which averages 50% in developed countries [33].

Which factors are associated with the effectiveness of PARs?

The large number of patients included in our study made it possible to conduct subgroup analyses in order to gain improved understanding of the variables crucial to achieving increased physical activity. The results in papers III and IV demonstrate that the effectiveness of PAR is not related to differences between sexes, age groups, prescription issued by different referral practitioners or due to certain PAR reasons/diagnoses. Such findings are important, as few other studies to date have had sufficient numbers of participants to allow for such detailed analysis [10, 18].

Using univariate logistic analyses, it was found that age was related to higher adherence to PAR activities 12 months after issuance. This is consistent with findings in previous studies [42, 63], which have also found that patients with certain referral conditions (e.g. myocardial infarction) demonstrate much higher (even doubled) adherence rates than other referral conditions (e.g. mental illness). It has to be noted that these results are based on descriptive analyses only. Higher adherence rates were also associated with age and certain prescribers' reasons for issuing PARs through descriptive and univariate analyses. In the multiple regression model, age and PAR reason were no longer significant, indicating that other factors are more important when predicting adherence.

Differences were found in the descriptive and univariate analyses, indicating lower adherence rates in prescriptions issued by physicians. But multiple logistic regression analyses found that there were only two variables, activity level at baseline and activity type (i.e. lifestyle/home-based activities versus facility-based activities), that showed significant differences in adherence or increased physical activity, i.e. predicting adherence or increased physical activity.

This study failed to show any significant differences in prescription pattern by the different health-care professionals. Two recently published reviews indicate that this may be the norm. The review by NICE [18] concluded “There is insufficient evidence to make clear inferences about the impact of the job title/position of the deliverer of the intervention”, while a Swedish SBU review [19] put this question on the future research list as it was unclear “To what extent is the effectiveness of advice/counselling affected by whether it is provided by a doctor or by another healthcare professional, such as a district nurse or physiotherapist”. Whether differences can truly be found between different prescribers, based on different health-care professions, seems unclear. At this point there is no evidence to draw any conclusions on this matter.

Activity level at baseline

In the adherence study (paper IV) those patients who reported being at least somewhat physically active before they were enrolled in PAR activities also reported higher adherence to PAR programmes over time than those categorised as inactive at baseline. However, the results in paper III present a different result: those who self-reported as least active at baseline were those achieving the largest increase in activity levels at follow-ups. The two outcome assessments, adherence versus increase in activity levels, allow for different ways to investigate the effectiveness of PAR interventions. In published reports, however, measurements regarding changes or increase in physical activity level are more commonly used than self-reported adherence to programme guidelines. The justification for adherence as an indicator of programme compliance is based on the assumption that there is a need for simpler and more pragmatic measurement methods to use in daily practice. The concept of adherence is more closely related to the prescription itself, while the activity level assessment is focused on the effect of the prescription.

There are definitely advantages and disadvantage when using either of these assessments to evaluate PARs, and both have considerable shortcomings. When using increased physical activity to assess effectiveness (paper III), the largest increases were found among those who were least active at baseline, indicating that the intervention was effective in increasing physical activity in those who had the most to gain from improvement (i.e. those being inactive). Obviously, those least active at baseline have the greatest potential to increase their activity level, and some of the changes observed in the patients’ physical

activity levels could be due to natural causes, as many people move between being sedentary and being active at different times in their life [47]. The large increase among those least active may also be due to a regression to the mean effect or even a measurement effect [102].

In the paper using self-reported adherence (paper **IV**), being physically inactive at baseline was associated with lower adherence. In this research adherence was assessed by using a very simple question, whether a patient adhered to the prescribed activity or not. As no gold standard for a self-reporting measure of adherence exists [33, 35], we used a question that was pragmatic and simple to use in clinical practice, even though this question has not been scientifically validated. Using this method there is a more obvious risk of recall or social desirability bias based on the construct of the question and the context of a health-care provider asking it within a follow-up. Despite these drawbacks, experienced health-care professionals have expressed that they believe that patients generally report adherence truthfully and to the best of their ability.

The findings in the adherence paper (paper **IV**) are consistent with previous research, including a review from 2004 which concluded that exercise referral schemes appear to increase physical activity levels in those who are not sedentary but already slightly active [13]. It would seem that those who are at least slightly active have established a habit of engaging in physical activity, even though the habit may be relatively weak, whereas those who are inactive experience more difficulties in translating motivation and behavioural intentions into actual behaviour change. This suggests that this kind of prescription may not be a sufficiently effective intervention to encourage sedentary patients to initiate a new behaviour. Instead, some form of longer personal counselling or the use of some type of motivational technique may be required for many who are physically inactive in order to achieve the desired behavioural changes.

The similarities and differences reflected in the results using two outcome assessments, adherence and activity levels, presented in papers **III** and **IV**, are mainly due to these differences. Based on the results presented, these assessments can be seen as two complementary approaches, even though there is a need for more in depth research about their relation and content.

Activity type

In both papers **III** and **IV**, there were significant differences related to the referred activity type (i.e. lifestyle/home-based activities versus facility-based activities) with referral preferences for lifestyle/home-based activities.

In the paper using increased physical activity to assess effectiveness (paper **III**) the largest increases in physical activity level were found among those who were issued lifestyle activities. The odds ratio indicates that 41% more of the patients issued lifestyle activities actually increased their activity, compared to those issued facility-based activities. On the other hand, different activities fit different people, and amongst the facility-based population, there was a 44% increase in activities in this group over time. Paper **IV** re-established the trend for lifestyle activities as a preferred approach, as again home-based activities were associated with higher adherence to PAR recommendations, compared to facility-based activities.

Although there is insufficient evidence to conclude which types of physical activity are most effective in increasing physical activity levels [19], it is likely that relatively simple home-based activities can more easily become habit than more complex behaviours. Activities like walking, jogging or cycling can easily be incorporated into routine daily life, whereas facility-based activities typically require more intentional effort and planning [103], not to mention personal resources from participants. Differences in adherence between activity types can also be attributed to different preferences and personal characteristics of the participants [34]. Facility-based activities usually require higher intensity activity than home-based activities such as walking.

Research findings are somewhat inconsistent concerning the relationship between adherence to recommended activity levels and the frequency and intensity of the issued activity [13, 19, 34]. Studies from the US have suggested that home-based activities increase levels of moderate physical activity, while facility-based activities might achieve greater improvement in levels of vigorous activity [13]. These characteristics and relationships are not yet well understood. It is clearly not a question of “either–or” but rather “both–and”, in the sense that home-based and facility-based activities should be viewed as complementary approaches in the promotion of physical activity. Those who are just beginning an activity program may benefit most from some features of facility-based activities, such as individualised instruction and support. Home-

based activities, on the other hand, clearly offer increased flexibility, which may be essential for individuals with time or transportation limitations [34].

People in modern societies spend the great majority of their time either at work, in transit, or performing household chores. It has been suggested [29] that encouraging lifestyle activity within these settings may be more effective. Lifestyle activities may be more likely responses to intervention and are more susceptible to environmental factors. Walking and stair-climbing, for example, could be undertaken easily by most people every day, and may be particularly amenable to environmental reinforcement.

6.1.5 Intervention dissemination: how to go from research to routine care?

The studies presented in this thesis have generated information that meets the four initial stages in the Nutbeam model. But this general discussion also includes information describing how physical activity interventions fulfil the final two stages in the model, intervention dissemination and programme management, even though these aspects are not included in the presented papers.

The fifth stage in the Nutbeam model, “intervention dissemination”, identifies successful ways for widespread adoption of an intervention among different programmes. As discussed previously, physical activity referral schemes are gaining support in many countries, including Sweden. Nevertheless, health care-based physical activity interventions have been considered an underdeveloped field in Sweden, mainly because of the great variance in delivery of such interventions within various health-care segments [19]. There are many obstacles that currently limit an even more widespread adoption of PARs in Sweden.

The usage or implementation of complicated methods or measurements related to preventive work in everyday practice may be one of the reasons for the translation gap, i.e. the failure in translating effective clinical and community-level services into routine practice. One of these is the gap between efficacy and effectiveness that exists in the field of promoting physical activity in health-care settings. Few studies have been conducted about physical activity promotion in routine PHC settings [7, 11]. The

available research often lacks aspects of how these interventions translate when integrated into routine practice [7]; many successful studies described in the literature have used relatively intensive interventions with selected trial participants who have established diseases. Such circumstances make it unclear whether the studied interventions are feasible for more widespread implementation in more representative populations or in small practices with limited infrastructure [82]. Another problem translating current research into everyday practice is that many trials have used screening instruments that are scored on a scale that does not easily convert to a counselling message, resulting in restricted clinical usefulness [36]. The overall research findings, while quite positive about PARs in general, may not provide sufficient evidence to justify the wide-scale implementation in the minds of many health-care authorities. Many obstacles remain when translating research findings into routine practice.

The first obstacle is the gap that exists due to the personal characteristics of the providers. Some providers feel that there is a lack of time, that they lack the skills, and and/or that they experience low self-efficacy in conducting behavioural screenings for patient populations [11, 54, 78, 79]. Second, a translation gap exists due to contextual or organisational issues as these interventions have been found impractical to implement due to competing interests, lack of infrastructure and limited resources [7, 20, 80, 81]. There clearly is a strong need for simpler and more pragmatic approaches, when trying to translate research findings into feasible clinical practices. Improvements could include, among other things, easier measurement of physical activity levels for use by researchers and practitioners.

Another possible solution to reducing some of the translation gap is to find easier ways of evaluating PARs, and by that reducing the gap between a study's context and real-world practice. The use of adherence to assess the effectiveness of PARs is one attempt to make it easier. The use of an "attendance" or "uptake" measurement for the issued activity is another. Attendance refers to attendance at the initial consultation or first training session, and is used for its simplicity and because it can be monitored objectively avoiding the use of self-reported outcomes. This measure has been used in several RCT studies. But this method has already been questioned, as it has been found to have a surprisingly low quality [15]. The idea behind simply asking the patient about adherence to the prescription is that this is a

pragmatic and realistic approach from a routine practice perspective [35]. However, the validity of the measure has yet to be tested.

This particular assessment method was described and used in paper **IV**, and as expected, there was a correlation between adherence and increased physical activity level (main outcome in paper **III**). Three out of five of those adhering to PARs (61%) also increased their self-reported physical activity levels (according to the 7-day recall question) between baseline and 12-month follow-up. To the best of our knowledge, the association between adherence and changes in physical activity level has not been examined in previous research. Increased long-term physical activity levels due to interventions cannot be achieved without a certain degree of adherence. It is therefore suggested that adherence can be assessed as a proxy for changes in physical activity level and that patients' adherence is just as important to assess as the actual physical activity level.

Another possible solution to lowering the more contextual translation gaps, especially those related to lack of infrastructure and lack of time, is the behaviour change principles known as the 5As (assess, advise, agree, assist, arrange). The 5A approach provides a structure that is effective for helping patients to achieve change across a range of topics in clinical care, including health behaviours [54]. These principles also apply at the clinical level for designing activities to support behaviour change [21], and provide a framework for action in clinical care and health-care system design [81]. The use of a structure like the 5As might strengthen the future dissemination of PARs in the health-care system.

An additional solution to bridge the translation gap is the use of information technology for screening patients and providing advice, giving health-care providers the opportunity to use their limited time with those in need of more personal support [80, 104]. Health-care providers certainly play an important role in the dissemination of physical activity interventions, and the health-care system is an important setting. In such settings, patients have access to multiple health-care disciplines, and can benefit from health-care providers' professional knowledge and natural authority regarding health issues. An emphasis on provider–patient partnerships to promote physical activity can lead to “spill over effects” in other settings when putting physical activity on the public health agenda.

What is the strength of the prescription innovation?

Although the use of PARs in Sweden is beginning to grow, the wisdom of widespread diffusion throughout the national health system has been questioned, due to lack of evidence to prove its effectiveness [85]. Although the method of using written prescriptions for physical activity promotion has been found acceptable and feasible both to general practitioners and patients [14, 20], the explanation for this diffusion is not fully understood.

The adoption of interventions depends on multiple factors, including timing. Within the health-care system, some interventions get adopted quickly, while others do not get adopted at all or to a very low extent [86]. The six main attributes of the “Diffusion of innovations in Health Service organisations”, listed by Greenhalgh [86] can to some extent explain the factors related to dissemination of PARs in Östergötland County, and why, in this setting, PAR was positively received among health-care providers.

The first and most important attribute, according to Greenhalgh, in determining adoption is the “relative advantage” of the innovation (i.e. whether the potential adopter can see any advantage in adopting a new approach over existing practice). Given the widespread diffusion of information about health behaviour, there is overwhelming evidence to convince practitioners about the importance of lifestyle issues such as increased physical activity. There is a demand for the health-care provider to be more “health-promoting”, and this health orientation, which is demanded by the health authorities, is nowadays more visible in the providers’ commission. Another factor resulting in advantages accruing to PAR diffusion could be financial. Treatment costs for lifestyle-related conditions are increasing at an exponential rate. The PAR intervention is a face-to-face intervention that is non-invasive, takes little time to issue, and emphasises to the patient the seriousness of the need to increase physical activity.

The PAR approach appears to be easily incorporated into providers’ ordinary routines (compatibility) making it simple to use (i.e. low complexity). The expected users of PARs in Östergötland participated in the development of the PAR model, including the actual prescription form, etc. (trialability). These efforts were conducted with simultaneous evaluation, giving each PHC centre regular feedback concerning the programme results (observability). As it continues to be used in the county, the PAR model is evolving, and there are

constantly opportunities to make adjustments (reinvention) in the model to improve its fit in the actual organisation structure and make adjustments for different external conditions (e.g. patient journal systems).

6.1.6 Programme management

The final stage (stage 6) in the Nutbeam model “programme management” is directed towards supporting programme management. In recent years there have been many national initiatives supporting the dissemination of PARs in Sweden. The “Sweden on the Move” campaign in 2001 emphasised the importance of physical activity and created an administrative foundation for the dissemination of PARs, as the campaign called for increasing the common knowledge about physical activity through knowledge dissemination, education, method development, research and evaluation [26, 83, 84]. PARs were launched as part of the “Sweden on the Move” campaign and were supported by the evidence-based handbook “FYSS” (Physical activity in prevention and treatment of diseases) provided by the National Institute of Public Health and YFA (Yrkesföreningar för Fysisk Aktivitet - a section of the Swedish Society of Sports Medicine). The handbook was aimed at increasing knowledge about the health benefits of physical activity in health promotion and disease prevention among practitioners. All these efforts – policy support and practical advice to practitioners – were essential in building the foundation of the Swedish PAR model.

These initiatives were strengthened by a new national health policy in 2003 [50]. At the regional level in Östergötland, the Public Health Policy programme [88] and the action plan “A more health-promoting health service” [89], further developed and clarified the County Council’s continued efforts. The enhanced profile given to health promotion in the county affected the context in which the PAR study was presented; without these initiatives and the economic incentive that supported the data collection for the PAR programme in the county, this study would never have been carried out.

6.2 Methodological considerations

There is a growing body of evidence to support discussion of various PAR approaches. What is unique about the findings presented in this thesis is that

this research provides new information about PAR schemes in routine health centre settings, within a Swedish setting. Overall, the findings presented also provide one of only very few descriptions of PAR programmes that have been implemented in a large population. The 6300 patients in this study allowed for relatively sophisticated analyses to identify factors that predict increased physical activity or adherence in patient groups. As all the data used were gathered in the context of routine visits to health-care centres, this gathering process represents a considerable strength of this study. This routine applicability has been described by researchers as an essential component that must be met if PARs are to be implemented on a broader basis.

Evaluation of interventions in routine care normally presents challenges, and is even more problematic when assessing behavioural change. Health-related behaviours, like physical activity, are considered extremely difficult to measure [13, 28, 29]. Methodological problems often appear in the measurement of physical activity and there seems to be no consensus on how to best approach this issue [13]. Measurement methods differ significantly from study to study and are often inadequately described, leading to major difficulties when it comes to estimating the effect size of various methods of promoting physical activity [19]. This inconsistent measurement methodology is therefore seen as the greatest weakness of studies in this field [13].

Physical activity is, like many other health behaviours (e.g. weight loss and smoking), often cyclical or episodic. People begin an activity; participate for a time, and then stop, only to resume again later. Thus each year many people both begin and stop participating in different activities [47]. Few people are active consistently at the same level each week for an entire year. This makes it difficult to draw conclusions both about the physical activity level in the general population, based on cross sectional studies, and on changes in activity levels among individuals included in a physical activity intervention.

However, patients' self-reported levels of physical activity gathered from simple questionnaires have been shown to be both practical and valid for epidemiological study, compared with more objective measures such as motion sensors, heart rate monitoring, and doubly-labelled water [10]. Using patients' self-reported physical activity levels as a measure before and after an intervention has been considered valid and useful, but can sometimes give misleading information due to the individual's awareness of their own

physical activity behaviour, as some individuals overestimate and some underestimate their physical activity levels [96, 102].

The population survey presented in paper **I**, has a number of limitations, which must be considered when interpreting the results. The indices of physical activity level were derived from two questions about activity in daily life and exercise, resulting in a measurement that has not yet been validated. When this survey was planned there was no simple validated physical activity question available in Sweden, and the index items used had been used in the previous population survey. This was the case for many questions in the population survey, as the whole survey used quite simple questions for practical reasons. Moreover, the overall response rate to this survey was 54%, with considerably lower proportions of respondents in certain groups, lowering the generalisability of the results.

In the PAR study presented in papers **II**, **III**, **IV**, there were also a number of methodological problems that must be considered when interpreting the results. This was an observational study in a real-life setting, which is essential for analysing the effectiveness of methods shown to perform well in randomised control trials [74]. However, because this was an observational study, the lack of a control group makes it difficult to determine the exact or “real” effect of the intervention.

First, there is a possibility of selection bias, as patient recruitment may affect the generalisation of our results. There were no data available about how many patients were asked initially about their willingness to be issued PARs and how many did not give consent to participate. The prescription was issued in collaboration and discussion with practitioners, as is often the case in routine practice [75]. Those patients who were included in the study might not be representative of all patients, as their participation was voluntary. Volunteers might have been more willing to change their activity levels than others.

Furthermore, the PAR study gathered information that is based solely on simple categories like age, gender, current self-reported activity level, referral reason, and the profession of the prescriber. These data provide only the most basic information and the information that is easiest to gather. This study lacks vital background information about the patient’s socioeconomic status (job, education, economy, etc.), ethnicity, BMI, physical activity history or

information about their physical activity self-efficacy. The lack of additional data, particularly about socioeconomic status, may be somewhat evened out due to the large number of participants in the study. Almost every PHC centre in the county participated, and thus patients from different areas in the county were included.

The economic incentives to support PARs in Östergötland may be considered an intervention in itself, as these incentives could have enhanced PAR related efforts and yielded a higher number of prescriptions than would otherwise have been the case. Although studies involving economic incentives have so far showed mixed results on the provision of preventative services [105, 106], it is possible that the incentive schemes did impact on practitioner willingness to issue PARs. As part of the county's incentive scheme, goals were set for the total number of prescriptions to be issued, which may have resulted in PHC centres only trying to attain these stated goals.

Another important consideration is the context of these studies and how that affects the generalisability of the findings. The studies presented in this thesis were conducted and built upon the context and conditions in Östergötland County in the early 2000s. The studies included are based on a program-driven intervention, according to ordinary public health work in the county, as commissioned by the Health Authorities, rather than being research-driven, initiated by researchers for research purposes [71].

The PAR study described in this thesis certainly has weaknesses. However, these limitations should be balanced against the study's strengths. The study included a large number of patients in a routine health-care setting, generating a huge amount of data. This made it possible to do statistically sound subgroup analyses. This must also be considered favourable to the study's external validity, meaning that the results can be generalised to other populations and settings. Assessing study strengths and weaknesses is always a matter of balance as it is difficult to achieve a high degree of both internal and external validity in the same study. The study context described in this document contributed to a highly pragmatic "study design", with an emphasis on feasibility, and the need for simple questions and procedures.

6.3 Future research

The results of the work presented in this thesis provide new insights to support the use of PARs to promote better health in patients visiting health-care providers in PHC settings. The PAR studies here are the result of a large-scale, multi-year initiative that involved not only thousands of physically inactive patients, but also numerous physical activity organisations along with hundreds of health-care providers who collaborated to increase physical activity levels in Östergötland. This research demonstrates the effectiveness of using PARs by health-care providers in routine PHC settings, showing that this intervention can lead to measurable increases in formerly less-active populations. Two factors predicting the effectiveness of PARs were found in this quantitative approach: activity level at baseline and activity type. The results presented in this thesis, and from other studies, underline the complexity of PARs and the difficulties associated with interpreting PAR programme results. Therefore, more research, both qualitative and quantitative, is needed to further increase our knowledge of the factors crucial for successful delivery of a PAR intervention.

From the work of this thesis, some suggested future research topics are:

- Qualitative research, including studies addressing differences between patients who adhere to the prescription and those who do not adhere. Such studies should also address variables such as patient's self-efficacy, activity history, personality, motivation. etc.
- Process-oriented research, increasing our knowledge of the factors that function as barriers and/or facilitators related to the implementation and more widespread dissemination of PARs.
- Research on PAR programmes taking place outside PHC settings, including hospital settings; and studies focusing on special groups or patients with certain diagnoses.
- Interventions to decrease sedentary behaviour, as a complement to programmes that just aim at increases in physical activity. This approach calls for better measurement methods to fully capture all relevant aspects of sedentary behaviour (not just inactivity), as many instruments used today suffer from the "floor effect" or threshold effect (i.e. those who do not achieve a certain amount of activity are categorised as inactive, although they may well be engaged in some activity).

- Standardised and easy to use evaluation methods relevant to PARs, including both subjective and objective measurements. Validity testing of already existing methods and instruments. Better evaluation methods would also increase the generalisability of findings and simplify comparisons between studies.
- Studies including health economy aspects of PARs.
- Research incorporating the use of different information technology-based concepts like screening and self-tests delivered by touch-screen computers or on the Internet as part of clinical screening and practice approaches.
- Studies using broader and interdisciplinary perspectives of public health research, i.e. applying a holistic perspective [30] using ecological models [26, 107] to PAR research. Such approaches highlight the need for complex, multi-level solutions, and aim at understanding the external social, cultural, physical, demographic and economic influences on individuals, rather than relying solely on the individual's own capability, motivation and skills.
- Studies about interventions that are shown to be especially effective in disadvantaged groups. Population surveys have reported that the prevalence of physical inactivity is higher in disadvantaged groups. As factors like ethnicity, income, social class and education are interrelated, there is a need to examine the independent associations between these factors and physical activity to inform about appropriate interventions for high-risk groups.
- Meta-analysis including observational studies.

7. CONCLUSIONS

The findings from the studies presented support a number of conclusions with regard to the aim of this thesis:

- There is a considerable need for increased physical activity in the general population in order to meet the public health recommendations.
- Adults feel great responsibility for their own physical activity; many also believed that this responsibility is shared by health-care practitioners.
- Physical activity is identified by the respondents to be the most important health-related behaviour to change “right now”, as measured in the adult patient population in Östergötland County, Sweden.
- Those assumed to be in the greatest need of increased physical activity were those who to a larger extent called for support to increase their physical activity level, especially from health-care providers.
- The PAR scheme in Östergötland County reached one in 70–80 PHC patients visiting PHC in the study area including a relatively high proportion of physically inactive people.
- Females and middle-aged patients were issued PARs to a larger extent.
- Physicians and nurses issued PARs to the highest numbers of patients, but in relative figures physiotherapists and behavioural scientists issued the highest number of prescriptions to individuals, based on the total number of patients seen.
- The PAR scheme was successful in increasing self-reported physical activity among ordinary patients in the routine PHC setting. Low physical activity level at baseline and being issued home-based activities were associated with higher increases in activity level at follow-ups.
- Prescriptions from ordinary staff in routine PHC yielded adherence in half of the patients in this routine care PAR scheme follow-up. Patients’ activity level at baseline (being at least somewhat physically inactive) and being issued home-based activities were associated with higher adherence at 3- and 12-month follow-ups.
- Primary health care-based physical activity intervention is still relatively new in Sweden, and according to prescription statistics, there are many avenues for growth and improvement in the years to come.

8. SAMMANFATTNING PÅ SVENSKA

I denna avhandling har behovet av ökad fysisk aktivitet undersökts hos den vuxna befolkningen i Östergötland, karakteristika för de patienter som erhållit fysisk aktivitet på recept (FaR) och hos dem som ordinerat FaR, samt effektiviteten av de FaR recept som har ordinerats patienter i den rutinmässiga primärvården i Östergötland under 2004 och 2005. Avhandlingen består av fyra vetenskapliga artiklar, av vilka tre är baserade på de data som insamlats hos de 6300 patienter som ordinerades FaR under 2004 och 2005. Den fjärde artikeln är baserad på en befolkningsenkät som genomfördes av Landstinget i Östergötland år 2006.

Endast var fjärde vuxen i befolkningen (18–84 år), i Östergötland kan, med hänsyn tagen till den nu gällande nationella folkhälsorekommendationen som förordar minst 30 minuter av vardaglig fysisk aktivitet på måttlig intensitetsnivå, anses vara tillräckligt fysiskt aktiva. Mer än en tredjedel (37 %) av den vuxna befolkningen rapporterade att de inte hade några avsikter att förändra sin fysiska aktivitetsnivå, medan 36 % hade funderat på att förändra den och 27 % var fast beslutna att göra en förändring. Även om den enskilda individen känner stort ansvar för sin egen fysiska aktivitet, så anser de flesta också att detta ansvar delvis delas av hälso- och sjukvården. Bland dem som ville öka sin fysiska aktivitetsnivå önskar en av sju i den allmänna befolkningen och en av fyra bland dem med särskilt stort behov av att öka sin aktivitetsnivå (de som rapporterar dålig hälsa, BMI > 30 eller de som är fysiskt inaktiva) stöd för att kunna åstadkomma denna förändring. Mer än hälften av dessa önskar att få detta stöd från hälso- och sjukvården.

Totalt erhöll 6300 patienter FaR i Östergötland under 2004 och 2005, två tredjedelar av dessa var kvinnor och hälften av patienterna återfanns i åldersgruppen 45–64 år. FaR-relaterad statistik, på såväl vårdcentralsnivå som för de olika yrkesgrupperna visar på stora skillnader i förskrivningsmönster i länet, vilket kan vara en indikation på att arbetsformen har utvecklingspotentialer.

Hälften av de patienter (51 %) som erhöll FaR, blev förskrivna en vardagsaktivitet, som exempelvis promenader. Vid 12-månadersuppföljningen hade hälften av patienterna (52%) som erhållit FaR

ökat sin självrapporterade fysiska aktivitetsnivå, och andelen inaktiva patienter i studiepopulationen hade minskat från 33 % vid förskrivningstillfället till 20 %. Andelen patienter som kategoriserades som regelbundet fysiskt aktiva ökade i sin tur från 22 % vid förskrivningstillfället till 32 % vid 12 månadersuppföljningen. Det var inga skillnader i resultat avseende patientens ålder, diagnos/förskrivningsorsak eller förskrivarens yrke vid uppföljningstillfället. Låg aktivitetsnivå vid förskrivningstillfället och aktivitets typ, till förmån för vardags aktiviteter, var de enskilda faktorer som var signifikant associerade med ökad fysisk aktivitet vid 12 månadersuppföljningen. Dessutom visade uppföljningen av patienternas egenrapporterade följsamhet till FaR att 50 % av patienterna följde sin FaR-förskrivning. Patienternas aktivitetsnivå vid förskrivningstillfället (något fysiskt inaktiv – ej inaktiv) och ordination på vardagsaktiviteter var förknippade med en signifikant bättre följsamhet vid 12 månadersuppföljningen.

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The road to becoming a researcher

This thesis has emerged from collaborations with and support from a large number of people. The notion of launching a research career was not an obvious choice for me and when the opportunity arose it was more due to a number of lucky circumstances than me fulfilling any particular ambition or goal. That's why the quote at the beginning of this thesis is so fitting: "Life is like a box of chocolates – you never know what you're gonna get!".

It was a big step for me just to study at the university, as there is no academic tradition in my family at all. I started in Örebro to become a PE teacher, feeling a bit confused and lost, only really enjoying the community-based course that everybody else seemed to hate. This course and the new insights were leading me toward the public health track, supported by one of our lecturers and my first supervisor Ulf Ekelund. The following year I started at the Master of Public Health programme in Linköping.

As a curious student, I really liked to discuss issues and ideas with my fellow students and lecturers. Discussions in the "Measuring health" lecture by Margareta Kristensson were especially important and eye-opening for me. These discussions led to part-time project employment, which started in January 1999, and to a Master's thesis, including measuring health-related quality of life among COPD patients, which was supervised by Margareta and Preben Bendtsen. Thanks to Preben this study also developed into a scientific article. One thing led to another and I ended up at the Centre for Public Health Sciences in Linköping where I stayed for 10 years.

The next lucky circumstance occurred when the Swedish government commissioned a "physical activity year" in 2001, putting physical activity on the agenda. I came in contact with a number of people who became important in both my public health and academic career. There were many, but to mention a few of them: Johan Tranquist, Annika Strandell, Lena Kallings, Peter Lamming, and later also Johan Faskunger at the National Institute for Public Health, and Agneta Ståhle, Eva Jansson, Mai-Lis Hellenius at Karolinska Institutet, and Anna Östbom and Agneta Sunder in the health-care

setting steering group during the campaign year and Mats Börjesson at Sahlgrenska in Gothenburg. I also got to know many who were working in the field of physical activity promotion in different Swedish regions. I became the regional campaign “messenger”, responsible for the regional communication and creation of a regional “Sweden on the Move” network. Östergötland participated in the national pilot study of PARs, putting even more focus on PARs. Later on, and mostly thanks to motivation from Lena Kallings, the initial report on this project was complemented by two scientific papers.

The campaign year in 2001 also resulted in increased PAR activity by the County Council of Östergötland. PARs were incorporated in the previously existing economic incentive system. This would not have been possible without the hard and tireless work of Anna Skogsfors who was later joined by Kerstin Aldstedt at the County Council “ledningstaben”. Without their work to ensure this PAR follow-up, this thesis would definitely not be focused on PARs, if there had been a thesis at all.

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The research phase

The regional PAR incentive evolved into a research project because a number of people supported and guided me into the world of research. These were people with broad experience in research, but also people who were always

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Per Nilsen, my LIR colleague who became a co-author and then my third co-supervisor, with a very sharp eye, always interested in exploring the complexities of the topic at hand and looking for new angles, giving sharp and constructive input to written materials. This input really improved my writing and developed my skills in writing scientific papers.

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Life beyond the thesis

Towards the end of my work on this thesis, yet another opportunity arose which led to dramatic changes in my life. I moved with my family to Skåne in late December 2008 so this thesis is my last contribution to PARs in Östergötland, at least for the time being. This new era is due to another person believing in my ability and competence, Jan Sundquist, head of the new Centre for Primary Health Care research in Malmö. I will continue doing research, hopefully collaborating with some of my colleagues and friends from the past as well as new people in Malmö, which for me is an unexplored and new environment. “Life is like a box of chocolates – you never know what you’re gonna get!”.

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References

1. World Health Organization, *The World Health Report 2002: Reducing risks, promoting healthy life*. WHO: Geneva, 2002.
2. World Health Organization, *Global strategy on diet, physical activity and health*. WHO: Geneva, 2004.
3. Orleans, T.C., *Addressing multiple behavioural health risk in primary care: Broadening the focus of health behaviour change research and practice*. *Am J Prev Med*, 2004. **27**(2S): p. 1–3.
4. The Swedish National Institute of Public Health, *Folkhälsopolitisk rapport 2005 [Public Health Report 2005]*. *Statens folkhälsoinstitut*, 2005:58. Stockholm: Statens folkhälsoinstitut, 2005, 35 p. (in Swedish, summary in English).
5. Rose, G., *Sick individuals and sick populations*. *Int J Epidemiol*, 2001. **30**(3): p. 427–32; discussion p. 433–4.
6. Task Force on Community Preventive Services, *Recommendations to increase physical activity in communities*. *Am J Prev Med*, 2002. **22**(4 Suppl): p. 67–72.
7. Eakin, E.G., et al., *Physical activity promotion in primary care: bridging the gap between research and practice*. *Am J Prev Med*, 2004. **27**(4): p. 297–303.
8. Ockene, J.K., et al., *Integrating evidence-based clinical and community strategies to improve health*. *Am J Prev Med*, 2007. **32**(3): p. 244–52.
9. World Health Organization, *The Ottawa Charter for Health Promotion*. 1986: First International Conference on Health Promotion, Ottawa.
10. Elley, C.R., et al., *Effectiveness of counselling patients on physical activity in general practice: cluster randomised controlled trial*. *BMJ*, 2003. **326**(7393): p. 793.
11. Harrison, R.A., F. McNair, and L. Dugdill, *Access to exercise referral schemes – a population based analysis*. *J Public Health (Oxf)*, 2005. **27**(4): p. 326–30.
12. Harrison, R.A., C. Roberts, and P.J. Elton, *Does primary care referral to an exercise programme increase physical activity one year later? A randomized controlled trial*. *J Public Health (Oxf)*, 2005. **27**(1): p. 25–32.
13. Morgan, O., *Approaches to increase physical activity: reviewing the evidence for exercise-referral schemes*. *Public Health*, 2005. **119**(5): p. 361–70.
14. Sorensen, J.B., T. Skovgaard, and L. Puggaard, *Exercise on prescription in general practice: a systematic review*. *Scand J Prim Health Care*, 2006. **24**(2): p. 69–74.

15. Gidlow, C., et al., *Attendance of exercise referral schemes in the UK: a systematic review*. Health Educ J, 2005. 64(2): p. 168–186 (doi:10.1177/001789690506400208).
16. Kallings, L.V., et al., *Physical activity on prescription in primary health care: a follow-up of physical activity level and quality of life*. Scand J Med Sci Sports, 2008. 18: p. 154–161.
17. Hillsdon, M., C. Foster, and M. Thorogood, *Interventions for promoting physical activity*. Cochrane Database Syst Rev, 2005(1): CD003180.
18. National Institute for Health and Clinical Excellence, *NICE public health intervention guidance – four commonly used methods to increase physical activity: brief intervention in primary care, exercise referral schemes, pedometers and community-based exercise programmes for walking and cycling*. NICE: London, 2006.
19. SBU, *Metoder för att främja fysisk aktivitet : en systematisk litteraturöversikt [Methods of promoting physical activity: a systematic review]*, in *SBU-rapport, 181*. Statens beredning för medicinsk utvärdering (SBU), (The Swedish Council on Technology Assessment in Health Care): Stockholm, 2007. 296 p. (in Swedish).
20. Aittasalo, M., *Physical activity counselling in primary health care*. Scand J Med Sci Sports, 2008. 18(3): p. 261–2.
21. Glasgow, R.E., et al., *Translating what we have learned into practice. Principles and hypotheses for interventions addressing multiple behaviors in primary care*. Am J Prev Med, 2004. 27(2 Suppl): p. 88–101.
22. Caspersen, C.J., K.E. Powell, and G.M. Christenson, *Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research*. Public Health Rep, 1985. 100(2): p. 126–31.
23. Physical Activity Guidelines Advisory Committee, *Physical Activity Guidelines Advisory Committee Report, 2008*. Department of Health and Human Services: Washington, DC, 2008. p. 1–683.
24. US Department of Health and Human Services, *Physical Activity and Health: A report of the Surgeon General*. US Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion: Atlanta, GA, 1996.
25. Vanhees, L., et al., *How to assess physical activity? How to assess physical fitness?* Eur J Cardiovasc Prev Rehabil, 2005. 12(2): p. 102–14.
26. The Swedish National Institute of Public Health, *Fysisk aktivitet och folkhälsa*, L. Schäfer Elinder and J. Faskunger, Editors. 2006.

27. Cavill, N., et al., *An evidence-based approach to physical activity promotion and policy development in Europe: contrasting case studies*. Promot Educ, 2006. **13**(2): p. 104–11.
28. Hagströmer, M., *Assessment of health-enhancing physical activity at population level*. Department of Biosciences and Nutrition Unit for Prevention Nutrition, Karolinska Institutet: Stockholm, 2007.
29. Riddoch, C., Physical activity, in *Key topics in public health – essential briefings on prevention and health promotion*, L. Ewels, Editor. Churchill Livingstone: London, 2005.
30. Thurston, M. and K. Green, *Adherence to exercise in later life: how can exercise on prescription programmes be made more effective?* Health Promot Int, 2004. **19**(3): p. 379–87.
31. Hagströmer, M. and P. Hassmén, *Bedöma och styra fysisk aktivitet, in FYSS -Fysisk aktivitet i sjukdomsprevention och sjukdomsbehandling*, A. Ståhle, Editor. Statens Folkhälsoinstitut: Stockholm, 2008.
32. The Swedish National Institute of Public Health and Yrkesföreningar för fysisk aktivitet, *FYSS 2008 - Fysisk aktivitet i sjukdomsprevention och sjukdomsbehandling [Physical activity in prevention and treatment of diseases]*. Statens folkhälsoinstitut (The Swedish National Institute of Public Health): Östersund, 2008. 613 p. (in Swedish).
33. World Health Organization, *Adherence to long-term therapies: evidence for action*. WHO: Geneva, 2003. p. 1–209.
34. Dominick, K. and M. Morey, Adherence to physical activity, in *Patient treatment adherence: concepts, interventions, and measurement.*, H. Bosworth, Editor. Lawrence Erlbaum and Associates: Mahawah, NJ, 2005.
35. Kallings, L., et al., *Self-reported adherence - a method for evaluating prescribed physical activity in primary health care patients*. J Phys Act Health (in press).
36. Babor, T.F., C.N. Sciamanna, and N.P. Pronk, *Assessing multiple risk behaviors in primary care. Screening issues and related concepts*. Am J Prev Med, 2004. **27**(2 Suppl): p. 42–53.
37. Pronk, N.P., C.J. Peek, and M.G. Goldstein, *Addressing multiple behavioral risk factors in primary care. A synthesis of current knowledge and stakeholder dialogue sessions*. Am J Prev Med, 2004. **27**(2 Suppl): p. 4–17.
38. Ezzati, M. et al., *Mortality and burden of disease attributable to individual risk factors, in Comparative quantification of health risks global and regional burden of disease attributable to selected major risk factors.*, M. Ezzati et al., Editors. World Health Organization: Geneva, 2004. p. 2141–65.

39. Bronnum-Hansen, H., et al., *Impact of selected risk factors on expected lifetime without long-standing, limiting illness in Denmark*. *Prev Med*, 2007. **45**(1): p. 49–53.
40. Department of Health, *At least five a week: evidence on the impact of physical activity and its relation to health*. Report from the Chief Medical Officer, Department of Health, United Kingdom: London, 2004.
41. Pedersen, B.K. and B. Saltin, *Evidence for prescribing exercise as therapy in chronic disease*. *Scand J Med Sci Sports*, 2006. **16 Suppl 1**: p. 3–63.
42. Dugdill, L., R.C. Graham, and F. McNair, *Exercise referral: the public health panacea for physical activity promotion? A critical perspective of exercise referral schemes; their development and evaluation*. *Ergonomics*, 2005. **48**(11–14): p. 1390–410.
43. Haskell, W.L., et al., *Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association*. *Circulation*, 2007. **116**(9): p. 1081–93.
44. Sjöström, M., et al., *Health-enhancing physical activity across European Union countries: the Eurobarometer study*. *J Public Health (Oxf)*, 2006. **14**: p. 291–300.
45. Ekberg, K., H. Noorlind-Braghe, and M. Dastserri, *Östgötens hälsa och miljö*. Folkhälsovetenskapligt Centrum Landstinget i Östergötland: Linköping, 2000 (in Swedish).
46. Riksidrottsförbundet, *Svenskarnas idrottsvanor. En studie av svenska folkets tävlings- och motionsvanor*. RF: Stockholm, 2004 (in Swedish).
47. Sherwood, N.E. and R.W. Jeffery, *The behavioral determinants of exercise: implications for physical activity interventions*. *Annu Rev Nutr*, 2000. **20**: p. 21–44.
48. Sundhetsstyrelsen, *Befolkningens motivation og barrierer for fysisk ativitet [Population's motivation and barriers to physical activity]*. 2003 (in Danish).
49. The National Public Health Committee, *En hälsoinriktad hälso- och sjukvård [Health promoting health care]*. Nationella Folkhälsokommittén: Stockholm, 2000 (in Swedish).
50. The Swedish Government, *Regeringens proposition 2002/03:35 "Mål för folkhälsan" [Government Bill 2002/03:35 – Public health objectives]*. Stockholm, 2002 (in Swedish).
51. Hillsdon, M., et al., *The effectiveness of public health interventions for increasing physical activity among adults: a review of reviews*. Health Development Agency: London, 2004.
52. Kahn, E.B., et al., *The effectiveness of interventions to increase physical activity. A systematic review*. *Am J Prev Med*, 2002. **22**(4 Suppl): p. 73–107.

53. Estabrooks, P.A. and R.E. Glasgow, *Translating effective clinic-based physical activity interventions into practice*. *Am J Prev Med*, 2006. **31**(4 Suppl): p. S45–56.
54. Whitlock, E.P., et al., *Evaluating primary care behavioral counseling interventions: an evidence-based approach*. *Am J Prev Med*, 2002. **22**(4): p. 267–84.
55. The Writing Group for the Activity Counseling Trial Research Group, *Effects of physical activity counseling in primary care: the Activity Counseling Trial: a randomized controlled trial*. *JAMA*, 2001. **286**(6): p. 677–87.
56. Albright, C.L., et al., *Incorporating physical activity advice into primary care: physician-delivered advice within the activity counseling trial*. *Am J Prev Med*, 2000. **18**(3): p. 225–34.
57. Johansson, K., P. Bendtsen, and I. Akerlind, *Advice to patients in Swedish primary care regarding alcohol and other lifestyle habits: how patients report the actions of GPs in relation to their own expectations and satisfaction with the consultation*. *Eur J Public Health*, 2005. **15**(6): p. 615–20.
58. Taylor, A., *The role of primary care in promoting physical activity, in Perspectives on health and exercise*, J. McKenna and C. Riddoch, Editors. Palgrave Macmillan: London, 2003.
59. The National Board of Health and Welfare, *Hälso- och sjukvård – lägesrapport 2003 [Health Care Status Report 2003]*. Socialstyrelsen: Stockholm, 2004 (in Swedish).
60. The National Board of Health and Welfare, *Häsofrämjande hälso- och sjukvård? En kartläggning a hälsofrämjande och sjukdomsförebyggande insatser*. Socialstyrelsen: Stockholm, 2005 (in Swedish).
61. Sorensen, J.B., et al., *Exercise on prescription: a randomized study on the effect of counseling vs counseling and supervised exercise*. *Scand J Med Sci Sports*, 2008. **18**(3): p. 288–97.
62. Aittasalo, M., et al., *From innovation to practice: initiation, implementation and evaluation of a physician-based physical activity promotion programme in Finland*. *Health Promot Int*, 2007. **22**(1): p. 19–27.
63. James, D.V., et al., *Factors associated with physical activity referral uptake and participation*. *J Sports Sci*, 2008. **26**(2): p. 217–24.
64. van Sluijs, E.M., et al., *Feasibility and acceptability of a physical activity promotion programme in general practice*. *Fam Pract*, 2004. **21**(4): p. 429–36.
65. Wimbush, E. and J. Watson, *An evaluation framework for health promotion: Theory, quality and effectiveness*. The Health Education Board for Scotland: London, 2000.

66. US Preventive Services Task Force, *Behavioural counseling in primary care to promote physical activity: recommendations and rationale*. *Ann Intern Med* 2002. **137**(3).
67. Gidlow, C., et al., *Socio-demographic patterning of referral, uptake and attendance in physical activity referral schemes*. *J Public Health (Oxf)*, 2007. **29**(2): p. 107–13.
68. Huang, N., *Motivating patients to move*. *Aust Fam Physician*, 2005. **34**(6): p. 413–7.
69. Jacobson, D.M., et al., *Physical activity counseling in the adult primary care setting: position statement of the American College of Preventive Medicine*. *Am J Prev Med*, 2005. **29**(2): p. 158–62.
70. Eccles, M., et al., *Changing the behavior of healthcare professionals: the use of theory in promoting the uptake of research findings*. *J Clin Epidemiol*, 2005. **58**(2): p. 107–12.
71. Holder, H., et al., *Phases of alcohol problem prevention research*. *Alcohol Clin Exp Res*, 1999. **23**(1): p. 183–94.
72. Nutbeam, D., *Evaluation health promotion – progress, problems and solutions*. *Health Promot Int*, 1998. **13**(1): p. 27–44.
73. Victora, C.G., J.P. Habicht, and J. Bryce, *Evidence-based public health: moving beyond randomized trials*. *Am J Public Health*, 2004. **94**(3): p. 400–5.
74. Black, N., *Why we need observational studies to evaluate the effectiveness of health care*. *BMJ*, 1996. **312**(7040): p. 1215–8.
75. Puska, P., *Commentary: Physical activity promotion in primary care*. *Int J Epidemiol*, 2002. **31**(4): p. 815–7.
76. Ogilvie, D., et al., *Interventions to promote walking: systematic review*. *BMJ*, 2007. **334**(7605): p. 1204.
77. Isaacs, A.J., et al., *Exercise Evaluation Randomised Trial (EXERT): a randomised trial comparing GP referral for leisure centre-based exercise, community-based walking and advice only*. *Health Technol Assess*, 2007. **11**(10): p. 1–165, iii-iv.
78. Aspy, C.B., et al., *Integrating screening and interventions for unhealthy behaviors into primary care practices*. *Am J Prev Med*, 2008. **35**(5 Suppl): p. S373–80.
79. Coups, E.J., A. Gaba, and C.T. Orleans, *Physician screening for multiple behavioral health risk factors*. *Am J Prev Med*, 2004. **27**(2 Suppl): p. 34–41.
80. Curry, S.J., *Toward a public policy agenda for addressing multiple health risk behaviors in primary care*. *Am J Prev Med*, 2004. **27**(2 Suppl): p. 106–8.

81. Stange, K.C., S.H. Woolf, and K. Gjeltema, *One minute for prevention: the power of leveraging to fulfill the promise of health behavior counseling*. Am J Prev Med, 2002. 22(4): p. 320–3.
82. Atkins, D. and C. Clancy, *Multiple risk factors interventions. Are we up to the challenge?* Am J Prev Med, 2004. 27(2 Suppl): p. 102–3.
83. Kallings, L.V., M. Leijon, and Statens folkhälsoinstitut, *Erfarenheter av Fysisk aktivitet på recept - FaR*. Statens folkhälsoinstitut, 2003:53. Statens folkhälsoinstitut: Stockholm, 2003, 99 p. (in Swedish).
84. Strandell, A., et al., *Sätt Sverige i rörelse 2001 – Redovisning och erfarenheter. [Sweden on the move 2001 - description and experiences]*. Swedish National Institute of Public Health: Stockholm, 2002 (in Swedish).
85. Lindberg, M. and Wilhemsson, S, *"Vem bryr sig" Distriktsköterskans förebyggande och hälsofrämjande arbete - ett svårprioriterat uppdrag och en outnyttjad resurs*. FOU-enheten för Närsjukvården, Landstinget i Östergötland, rapport 2005:3. Linköping, 2005 (in Swedish).
86. Greenhalgh, T., et al., *Diffusion of innovations in health service organisations. A systematic review*. BMJ Books, Blackwell Publishing: Oxford, 2005.
87. Leijon, M.E. and M. Jacobson, *Fysisk aktivitet på recept - fungerar det? En utvärdering av Östgötamodellen*. Folkhälsovetenskapligt Centrum, rapport 2006:2. Landstinget i Östergötland: Linköping, 2006.
88. Landstinget i Östergötland, *Using the power of health towards a full life - a summary of Östergötland's Public Health Political Programme 2001–2010*. Linköping. 2001. <http://www.lio.se/upload/6754/Engelskfolder.pdf>
89. Landstinget i Östergötland, *A more health promoting health care system. The County Council of Östergötland's Action Plan 2003–2010 – summary*. Linköping, 2003. http://www.lio.se/upload/33306/Sammanfattning_engelsk.pdf.
90. Särndal, C. and S. Lundström, *Estimation in surveys with nonresponse*. Wiley Series in Survey Methodology, R. Groves, Editor. Chichester: John Wiley & Sons, 2005.
91. Noorlind-Braghe, H. and L. Walter, *Östgötens hälsa 2006*. Folkhälsovetenskapligt Centrum, rapport 2006:8. Landstinget i Östergötland: Linköping, 2006 (in Swedish).
92. Gidlow, C., et al. (2008) *State of the art reviews: Methods of evaluation: issues and implication for physical activity referral schemes*. Am J Lifestyle Med 2(1): p. 46–50 (doi:10.1177/1559827607308733).
93. Kamper-Jorgensen, F., et al., *International panel evaluation of Swedish public health research*, F. Kamper-Jorgensen, Editor. Swedish Council for Working Life and Social Research, Swedish National Institute of Public Health: Stockholm, 2004.

94. Aittasalo, M. and S. Miilunpalo, *Offering physical activity counselling in occupational health care – does it reach the target group?* *Occup Med (Lond)*, 2006. **56**(1): p. 55–8.
95. Ronda, G., P. Van Assema, and J. Brug, *Stages of change, psychological factors and awareness of physical activity levels in The Netherlands*. *Health Promot Int*, 2001. **16**(4): p. 305–14.
96. van Sluijs, E.M., S.J. Griffin, and M.N. van Poppel, *A cross-sectional study of awareness of physical activity: associations with personal, behavioral and psychosocial factors*. *Int J Behav Nutr Phys Act*, 2007. **4**(1): p. 53.
97. Aittasalo, M., et al., *A randomized intervention of physical activity promotion and patient self-monitoring in primary health care*. *Prev Med*, 2006. **42**(1): p. 40–6.
98. Padden, D.L., *The role of the advanced practice nurse in the promotion of exercise and physical activity*. *Top Adv Practice Nurs eJ*, 2002. **2**(1).
99. Warburton, D.E., C.W. Nicol, and S.S. Bredin, *Prescribing exercise as preventive therapy (review)*. *CMAJ*, 2006. **28**(7): p. 961–74.
100. Pate, R.R., et al., *Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine*. *JAMA*, 1995. **273**(5): p. 402–7.
101. Hagberg, L.A., et al., *Importance of enjoyment when promoting physical exercise*. *Scand J Med Sci Sports*, 2008.
102. van Sluijs, E.M., et al., *Physical activity measurements affected participants' behavior in a randomized controlled trial*. *J Clin Epidemiol*, 2006. **59**(4): p. 404–11.
103. Verplanken, B. and H. Aarts, *Habit, attitude, and planned behaviour: is habit an empty construct or an interesting case of goal-directed automaticity?* *Eur Rev Soc Psychol*, 1999. **10**: p. 101–34.
104. Carlford, S., et al., *Computerized lifestyle intervention in routine primary health care: Evaluation of usage on provider and responder levels*. *Patient Educ Couns*, 2008. [Epub ahead of print] (doi:10.1016/j.pec.2008.10.004).
105. Town, R., et al., *Economic incentives and physicians' delivery of preventive care: a systematic review*. *Am J Prev Med*, 2005. **28**(2): p. 234–40.
106. Millett, C., et al., *Impact of a pay-for-performance incentive on support for smoking cessation and on smoking prevalence among people with diabetes*. *CMAJ*, 2007. **176**(12): p. 1705–10.
107. Hillsdon, M., et al., *Advising people to take more exercise is ineffective: a randomized controlled trial of physical activity promotion in primary care*. *Int J Epidemiol*, 2002. **31**(4): p. 808–15.