Do primary care interventions to promote physical activity work?

A systematic review of the literature

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Summary

Aim: To determine whether interventions undertaken with patients in primary care settings can be effective in increasing their physical activity participation.

Methods: A systematic review of physical activity intervention studies was conducted. Studies included were those undertaken with adult primary care patients which used a randomised controlled trial (RCT) or controlled quasi-experimental design and reported physical activity participation as a primary outcome. The methodological quality of studies was appraised using the criteria developed by the United States Preventive Services Task Force and the potential public health impact of the interventions tested was assessed using the RE-AIM model.

Results: Twenty studies were included in the review. In eight studies physical activity was addressed as part of a multiple risk factor intervention, and these included a total of 17565 subjects. Six of these studies were RCTs but all were given a methodological rating of 'fair'. Twelve studies tested interventions focused solely on physical activity, with 7984 subjects enrolled in total. Eight of these were RCTs, two of which were given a methodological rating of 'good' while the remainder were given a rating of 'fair'. The two multiple risk factor intervention studies which measured short-term effects reported significant outcomes, and four of the seven measuring long-term effects found significant improvements in physical activity. Six of the eight studies testing single risk factor interventions which measured short-term outcomes reported significant improvements in physical activity. Three of the six studies which undertook medium-term follow-up found significant effects while two of the five which undertook long-term follow-up reported significant outcomes.

The small number and diverse nature of the interventions associated with increases in physical activity made it difficult to identify the characteristics of interventions that were associated with a greater likelihood of producing increases in physical activity. Brief and intensive interventions appeared to be equally effective and the greatest effects were achieved when interventions were targeted to the sedentary or insufficiently active.

Appraisal of the public health significance of this literature was undertaken to determine whether these interventions should be recommended to public health policy makers. It was found that most studies used selected samples and that few provided data to enable assessment of the generalisability of study findings, hence the applicability of the findings to the wider population was not known. Furthermore, few interventions have been tested which could be readily implemented in routine primary care settings.

Conclusions: There is evidence of 'fair' quality that interventions conducted with primary care patients which address physical activity alone can achieve improvements in this behaviour. In light of this limited evidence, a reasonable approach for primary care practitioners to adopt is to undertake brief interventions with inactive patients who have health conditions which could be reduced by physical activity participation. Interventions in primary care will not be sufficient to increase physical activity levels in the population and need to be incorporated within multi-faceted, community-wide strategies to address this risk factor.

1. Introduction

1.1 Background

The importance of physical activity for the health of the Australia population was recognised in the Australian Burden of Disease Study, which reported that 7% of years lived with a disability or lost due to premature death in Australia were due to physical inactivity (Mathers et al., 2000). The significance of physical activity stems from its relationship with a number of major causes of disease and injury, including cardiovascular disease, several cancers, mental ill-health, diabetes and injuries in the elderly (USDDHS, 1996; Bauman and Owen, 1999), and the high prevalence of insufficient activity in the population. Indeed, a recent Australia-wide survey found that almost half of the adult population did not spend sufficient time (at least two-and-a-half hours each week) participating in physical activity of at least moderate-intensity (Armstrong et al., 2000). Furthermore, these data revealed that the prevalence of insufficient activity had increased since 1997, particularly among women.

Reflecting the importance of physical activity, National Physical Activity Guidelines for Australians have been developed by the Commonwealth Government (DHAC, 1999). These guidelines draw upon the epidemiological evidence about the amounts of physical activity that are associated with reduced risk of ill-health and recommend that adults "put together at least 30 minutes of moderate-intensity physical activity on most, preferably all, days". Attention has also been paid to the availability of evidence that could guide interventions to increase physical activity participation in the population. A recent review of this evidence *Getting Australia Active: towards better practice for the promotion of physical activity* (Bauman et al., 2002) has reported that while interventions in some settings show promise, the public health investment in this area has been limited and certainly not commensurate with the health significance of physical activity. For this reason, evidence-based reviews are required to guide policy makers in regard to investment in interventions to promote physical activity.

The potential impact of interventions in primary health care services, that is, services that address a full range of personal health needs and are available to all in the community (Donaldson et al., 1996), has been one of the more intensively studied areas of physical activity promotion. The attention given to interventions in these settings is due to a number of factors: the population reach of primary care practitioners, particularly general practitioners (GPs) (NSW Health Department, 1999); the perceived influence that practitioners can have upon patient health beliefs and practices (Booth et al., 1997), and; research which indicates that interventions in primary care settings can be effective in modifying other lifestyle risk factors like smoking (AHCPR, 1996) and alcohol misuse (NHSCRD, 1993).

A range of intervention approaches in primary care settings have been tested, including those where physical activity has been addressed as part of a multiple risk factor strategy and others where there is a focus upon physical activity alone. Interventions tested have been brief and intensive, delivered by medical practitioners, nurses or others, and given to a variety of patient groups. In addition, studies have been carried out to investigate barriers to physical activity promotion that primary health care practitioners face (Bull et al., 1995; McDowell et al., 1997; Abramson et al., 2000). These have identified lack of time, lack of confidence in influencing patient

behaviours and perceived lack of interest among patients as some of the major challenges for promoting the uptake of physical activity promotion in primary care settings.

Another indicator of the interest that has been shown towards physical activity interventions in health care settings is the publication of eight reviews of the research conducted in the field (Ashenden et al., 1997; Eaton and Menard, 1998; Simons-Morton et al., 1998; Riddoch et al., 1998; Eakin et al., 2000; Lawlor and Hanratty, 2001; Petrella and Latanzio, 2002; Eden et al., 2002). While several of these reviews are systematic, the heterogenity of the research has so far precluded a statistical meta-analysis. Nevertheless, it is useful to examine the past reviews of physical activity interventions in health care settings as a means of obtaining an overview of research in this field and of establishing the context for this review.

1.2 Previous reviews of physical activity interventions in health care settings

Appendix 1 shows the studies that have been included in the reviews of physical activity interventions in health care settings that have been conducted so far.

The earliest review identified was that conducted by Ashenden et al. (1997), which addressed interventions in the general practice setting only. Among the six studies that were included, five were RCTs and one was a quasi-experimental study. In five of these physical activity was addressed as part of a multiple risk factor intervention. These authors stated that the impacts upon physical activity shown in the studies were generally positive, but they concluded that this finding could not be validated in light of the small number of studies they examined and their diverse characteristics.

The review of physical activity interventions in medical practices conducted by Eaton and Menard (1998) included eight studies, three of which had been included in the review by Ashenden et al. (1997). Both RCTs and quasi-experimental studies were examined. Five of the eight studies employed multiple risk factor interventions. It was concluded that there is some limited evidence that single risk factor physical activity interventions lead to short-term reductions in this risk factor, but that the lasting health effects of these are unknown.

Simons-Morton et al. (1998) carried out a review of physical activity interventions in health care settings generally, although most of the studies included were conducted in medical practices. Both RCTs and quasi-experimental studies were included in the twelve studies in this review, seven of which had been examined in previous reviews. Four of the twelve studies tested multiple risk factor interventions. The reviewers concluded that changes in physical activity can be initiated in health care settings. They stated that the evidence concerning the long-term effects of these interventions is weaker, but noted that this in not unexpected given that most interventions did not include maintenance strategies.

The review of the effectiveness of physical activity promotion schemes in primary care conducted by Riddoch et al. (1998) included eighteen studies, eight of which had been examined in previous reviews. This review included studies that used pre- and post-test designs without control groups and gave special attention to interventions testing referral to exercise facilities in the United Kingdom. It was concluded that

modest improvements in physical activity are evident across a diverse range of studies. While the evidence that exercise referral schemes can be beneficial was recognised, it was argued that these have limited potential reach because they are perceived as being for people interested in vigorous activities and sports.

In the review of physical activity interventions in primary care by Eakin et al. (2000) both RCTs and quasi-experimental studies were included, but studies involving subjects with cardiovascular disease were excluded. Fifteen studies were examined, 13 of which had been included in previously published reviews and seven of which tested multiple risk factor interventions. Eakin et al. (2000) noted that unifactoral studies appeared to be more frequently effective than those using multiple risk factor approaches, and that brief interventions (3 to 10 minutes in duration) also showed significant effects in most cases. The overall conclusion reached was that brief primary care interventions are effective for achieving moderate, short-term improvements in physical activity. This finding, they stated, appears to hold regardless of the type of health professional who delivered the intervention, be they physicians, nurses or health educators.

Lawlor and Hanratty (2001) undertook a review of physical activity advice interventions delivered in routine primary care consultations. Both RCTs and quasi-experimental studies were included. Eight studies met the inclusion criteria, three of which tested multiple risk factor interventions; all of the studies had been included in previous reviews. These reviewers concluded that physical activity advice delivered in routine care is not effective for promoting sustained increases in physical activity.

Thirteen studies were included in the review of counseling interventions in primary care settings to promote physical activity by Petrella and Latanzio (2002), however, four of these did not provide results about the impact of an intervention upon physical activity participation. All of the nine studies that reported physical activity outcomes had been included in previous reviews. Five of the studies were RCTs and the remainder were quasi-experimental studies. Three tested multiple risk-factor interventions. It was concluded that interventions by family physicians can influence the physical activity participation of patients, particularly when written materials are provided, behaviour change strategies are addressed and training and resources are provided for physicians.

There were eight studies included in the review of clinician counseling to promote physical activity undertaken for the United States Preventive Services Task Force (Eden et al., 2002). Only studies published between 1994 and 2002 that tested counseling interventions by physicians, nurses or other providers of primary care services, were included in this review. Six of the eight included studies had not been reviewed previously, although one of these presented preliminary results only, concerning stage of change for physical activity rather than actual participation levels. Seven of the studies were RCTs and one was quasi-experimental. Multiple risk factor approaches were tested in three of the studies. The conclusion reached here was that the evidence concerning the effectiveness of counseling to promote physical activity in primary care settings is inconclusive

In summary, three of the reviews conducted so far have concluded that there is not clear evidence that physical activity interventions in health care settings are effective

(Ashenden et al., 1997; Lawlor and Hanratty, 2001; Eden et al., 2002), while the remaining five have reached more positive conclusions (Eaton and Menard, 1998; Simons-Morton et al., 1998; Riddoch et al., 1998; Eakin et al., 2000; Petrella and Latanzio, 2002). However, the reviews which recognise the positive effects of these interventions generally state that these effects are of modest size and short-term duration.

1.3 Purpose of the present review

The purpose of the present review is to provide an up-to-date and comprehensive summary of the state of the evidence concerning the effectiveness of physical activity interventions in primary care settings. This will be by means of a systematic review, but not a meta-analysis given that the problem of study heterogenity still prevents this from being undertaken. The need for this review stems from the fact that the recent reviews of this literature (Eden et al., 2002; Petrella and Latanzio, 2002; Lawlor and Hanratty, 2001) have been limited by only including studies published over certain years or by not taking into account some recent and important studies in this field. A limitation of the reviews more generally is that few have recognised that single and multiple risk factor interventions give a different priority to physical activity and warrant examination separately. In addition, little attention has been given to appraising the public health applicability of the studies undertaken.

The objectives of this review are to:

i. identify and review the evidence for the effectiveness of interventions to promote physical activity in primary health care settings;
ii. examine differences in study findings according to intervention intensity (brief vs intensive), delivery context (general practice vs other health care settings), and the characteristics of intervention recipients (e.g., age, chronic disease history etc.), and;
iii. assess the potential public health relevance of physical activity intervention research.

2. Methods

2.1 Study inclusion criteria

Studies meeting the following criteria were included in this review:

i. conducted with adults recruited from primary care settings;
ii. evaluated interventions to increase physical activity;
iii. reported physical activity participation as a primary outcome;
iv. used a RCT or controlled quasi-experimental design, and;
v. published in the English language.

2.2 Literature review

Electronic databases were searched, including MEDLINE and PubMed, for articles published since 1966. The following keywords and search strategy was used: physical activity, physical fitness or exercise, and; health care, primary care, family practice,

medical office, or physician's office, and; health promotion, health education or counseling. In order to identify multiple risk factor intervention studies an additional search was carried out, using a similar strategy to this but substituting in the terms cardiovascular disease or risk factors in place of physical activity, physical fitness or exercise. The reference lists of previous reviews in this field and of the articles collected were examined to identify additional relevant studies. Written contact was made with experts in physical activity research in the United States, Canada and England to request assistance in identifying new or unpublished studies which would be relevant to the review. When potential studies were identified the full text of the articles was obtained and two members of the review team (BS and DM) conferred about whether the study met the inclusion criteria for the review. A total of 27 studies met the inclusion criteria.

2.3 Appraisal criteria

The methodological quality of the studies collected was appraised using the criteria developed by the United States Preventive Services Task Force (Harris et al., 2001). Studies were graded as I if they used a RCT design or II if they used a quasi-experimental design. They then were given a rating of "good", "fair" or "poor" to indicate the extent to which the methods used maintained the internal validity of the study. Studies rated as good met all of the criteria for the study design; those rated as fair did not meet all of the criteria, but had no major flaws which invalidated the results, and; poor studies contained more substantial methodological flaws. Seven of the 27 studies that met the inclusion criteria were rated as poor and therefore were not included in the review. The reasons for assigning poor ratings to these studies are given in Appendix 2.

The potential public health impact of the physical activity interventions was assessed using elements of the RE-AIM model developed by Glasgow et al. (1999). The elements of this model that were used in this assessment addressed the following dimensions of the studies:

- *reach*, the percentage of eligible people recruited to the study and their representativeness of the general population;
- *adoption*, the proportion of potential practitioners or primary care services that were recruited to the study and their representativeness of those professional groups, and;
- *implementation*, whether interventions were undertaken in real world settings and the extent to which they were delivered and adhered to as intended.

3. Results

The results are presented separately for multiple risk factor intervention studies that included a physical activity component and those that focused on the single risk factor of physical activity. In each section a description of the studies is given together with an assessment of their methodological quality, a summary of their results, an examination of the attributes of interventions that appeared to be effective and an appraisal of the public health significance of the findings.

3.1 Multiple risk factor interventions

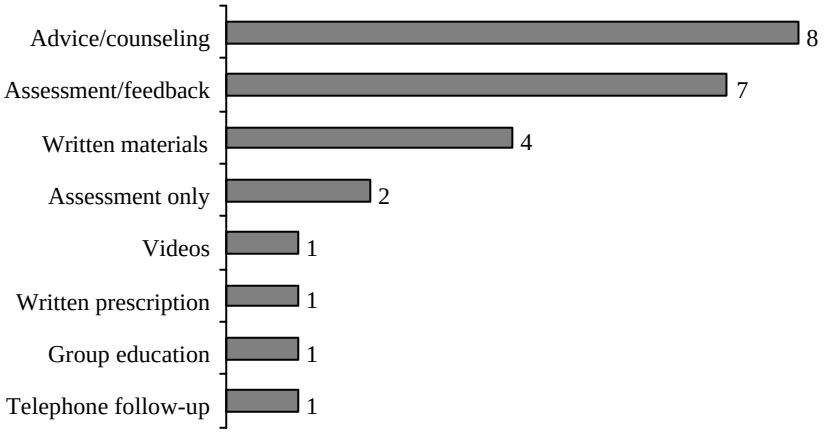
3.1.1 Description of studies

There were eight studies, with a total of 17565 subjects, which tested the effect of multiple risk factor interventions in which physical activity was addressed. Four of the studies were large, with more than 750 subjects, three of which had over 2000 subjects. The remaining four studies were of medium size, with between 250 and 750 subjects. The subjects in most studies (5 out of 8) were adults (18 years and over), while in one they were middle-aged (35-64 years) and in two others they were people aged 65 years and over. In two of the studies only subjects with cardiovascular risk factors were eligible and in another only patients with heart disease were admitted.

In most studies (7) a single multiple risk-factor intervention was compared with a control condition, while in one study three interventions were tested. In total, 10 interventions were tested in these studies.

Figure 3.1.1 shows the number of times that different intervention components have been included in the multiple risk factor interventions that have been tested. The intervention component that has most frequently been tested is verbal advice and counseling, followed by risk factor assessment and feedback, written brochures and booklets, and risk factor assessment without feedback. Videos, a written prescription of risk factor advice, group education sessions and telephone follow-up have each been tested on one occasion.

Figure 3.1.1 Interventions tested in multiple risk factor intervention studies



Four of the interventions tested were conducted in a single session, and the remainder were implemented over one to seven sessions. The number of intervention sessions was not clear in two studies. In the four studies where the duration of interventions was stated, the time spent with subjects ranged from 15 to 90 minutes on each occasion of contact.

In three studies the interventions were delivered by medical practitioners only, in two they were delivered by doctors and practice nurses jointly, while in another two it was nurses only who carried out the interventions. Health visitors delivered the intervention in one study. A theoretical basis for the intervention content was identified in two studies only; in one study this was the Transtheoretical Model and in another it was the Patient Centred Communication Model.

The control condition was not clearly stated in all studies and was often referred to as 'usual care', which may have differed from clinic to clinic. Only two studies specified the treatment given to control subjects; in one study this was brief advice relating to risk factors while in another it was advice supplemented by written information.

In most studies (7 out of 8) long-term follow-up (12 months or more) was undertaken and in three of these subjects were followed up for two years or more. Short-term follow-up (less than 6 months) was carried out in two studies.

3.1.2 Methodological quality of the studies

Six of the studies were RCTs and two were quasi-experimental studies. Cluster RCT designs were used in two of these studies. The use of concealment during randomisation was only stated in two studies, although it was not apparent that randomisation was conducted without concealment in any of the other RCTs.

All of the studies collected data on physical activity by means of self-report, but there was wide variability in the measurement instruments used and the ways that physical activity outcomes were defined. In four of the studies moderate-intensity activities such as walking were measured in addition to vigorous activity, while in two studies only vigorous activity was measured and in the remaining two the type of activity measured was not defined. In most studies (7 out of 8) the instruments used did not have reported reliability or validity.

It was not apparent that any of the studies failed to use intention-to-treat methods in analysis. Both of the two quasi-experimental studies used stratified or multivariate methods in analysis to address the potential for confounding.

The rates of follow-up achieved in the studies were generally good, with five of the seven studies undertaking long-term follow-up achieving rates of 75% or higher. The poorest rate achieved was 59% at a 12-month follow-up.

Overall, all of the six RCTs and two quasi-experimental studies had at least one methodological flaw that caused them to be given a rating of 'fair'.

3.1.3 Findings

At the short-term follow-ups undertaken in two of the studies there were significant intervention-related improvements in the outcomes. In one of these studies (Kelly, 1988), however, the outcome measure was the proportion of subjects reporting a "major change" in at least one risk factor, and the amount of improvement in physical activity was not stated.

Four of the seven studies which undertook long-term follow-up found significant improvements in physical activity. In total, setting aside the intervention reported to lead to a "major change" in at least one risk factor, there were four interventions that were found to lead to increases in physical activity, with one of these associated with both short- and long-term increases in activity.

3.1.4 Attributes of effective interventions

Given that there were only four interventions that were found to lead to increases in physical activity there is a limited basis for drawing conclusions about the attributes of effective interventions.

(i) Intervention intensity

The intensity of the interventions associated with improvements in physical activity varied from a single session of risk factor assessment and advice, to a more detailed assessment plus advice and a second counseling session, to several counseling sessions and telephone reinforcement calls. In one of the studies reporting positive long-term effects the intervention consisted of training and support for GPs to enable risk factor education and advice giving, but the nature of the interventions that GPs subsequently delivered were not described.

(ii) Intervention deliverers

Interventions were delivered by nurses in two of the studies reporting positive changes in physical activity, while in one they were given by health visitor and in another by GPs.

(iii) Characteristics of intervention recipients

The study populations in the studies reporting positive changes in physical activity following intervention differed. These were: patients with angina aged less than 75 years; middle-aged patients (35-64 years); older patients (aged over 65 years), and; adult patients with at least one cardiovascular risk factor.

3.1.5 Public health significance of studies

(i) Reach

Two of the eight studies recruited subjects from a whole population, defined by geographic region in one case and general practice registers of patients in another. In the other studies subjects were recruited from samples of patients, selected from lists of those who attended participating practices or from patients who attended the practices during the study period.

The recruitment rates in the two studies where subjects were recruited from whole populations varied considerably; 37% in one case (Burton et al., 1995) and 80% in the other (Muir et al., 1994). Two studies did not provide sufficient data for calculation of recruitment rates, while in the remaining four studies where subjects were recruited from a sample of the eligible population the rates ranged from 48% to 79%.

The representativeness of subjects was described in two studies and in both of these it was evident that those who participated in the study differed in characteristics to others in the study sites who did not. In the remaining studies where descriptive information about subjects was given but comparisons were not made with the characteristics of the underlying population, there was usually an apparent dominance of certain gender, racial or socioeconomic groups.

(ii) Adoption

The recruitment rates of individual practitioners or health care services to studies were provided in six of the studies. In two of these the recruitment rate was calculated

using all of the eligible practitioners or services in the study region as the denominator, and the rates varied considerably; 3.7% where the denominator was all health centres in Sweden (Lindholm et al., 1995), and 63% where the denominator was physicians who cared for 25 or more Medicare beneficiaries in Baltimore (Burton et al., 1995). In the remaining studies where recruitment rates were given, but the denominator for calculating these did not appear to be all potential practitioners or services in the study region, the rates varied from 18% to 60%.

There was only one study which reported on the representativeness of participating practitioners or services, and here it was stated that participating GPs had higher mean years of practice and were less likely to charge a co-payment to their patients than non-participants (Kerse et al., 1999).

(iii) Implementation
While all of the studies appeared to use health care providers who worked in existing services to implement the interventions, there was only one study in which the interventions were delivered within routine health care consultations. In all other studies the intervention was delivered as a discrete activity which required extra resources or the reallocation of existing resources.

Data on the extent to which interventions were delivered as intended, or complied with by subjects were given in six studies. These showed that the proportions of subjects who received interventions as intended ranged from 32% to 82%. The lowest rates of intervention exposure were reported in the studies where subjects were required to return for a preventive visit after one year (32%) and where interventions were delivered in the context of routine consultations (39%). These indicate the difficulties in effectively delivering interventions that involve multiple contacts with patients or which are delivered in the busy context of routine health care.

3.2 Single risk factor interventions

3.2.1 Description of studies

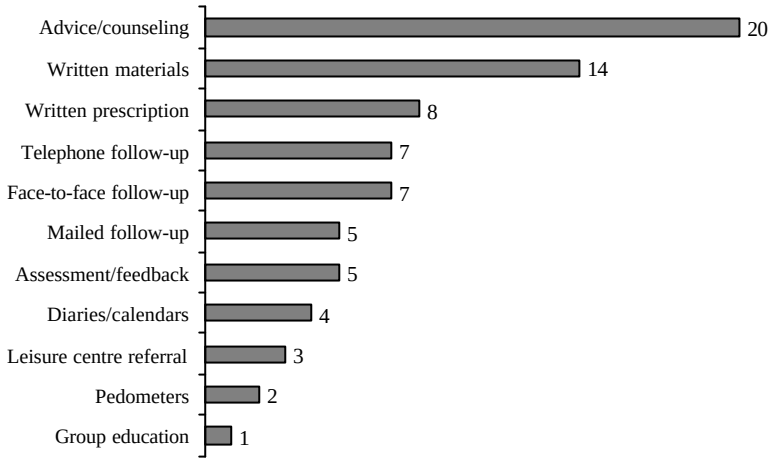
There were 12 studies that tested single risk factor interventions to promote physical activity, with 7984 subjects enrolled in these in total. Five of these had large samples (greater than 750), while six were of medium size (between 250 and 750) and three had smaller samples (less than 250). In seven studies subjects in the middle to older age range (35 years and over) were recruited, in three studies subjects were from the general adult patient population and in one study only older subjects (over 60 years) were recruited. The age criteria for subject selection were not described in one study.

In six of the studies a single intervention was compared with a control condition, while in five studies two levels of intervention were tested and in one there were four levels of intervention tested. In total, 20 interventions were tested in these studies.

Figure 3.2.1 shows the number of times that different intervention components were included in the 20 interventions tested. Verbal advice or counseling for physical activity delivered in a face-to-face contact was the most common intervention modality, followed by written information materials about physical activity. In descending order of frequency the other intervention strategies that were tested were: a written prescription for physical activity; telephone follow-up and reinforcement of

physical activity interventions; face-to-face follow-up and reinforcement of interventions; mailed follow-up and reminders; physical activity assessment and feedback; physical activity diaries or calendars for self-monitoring; referral to a leisure centre with, in many cases, subsidisation of visits; pedometers for self-monitoring, and; group education sessions.

Figure 3.2.1 Interventions tested in single risk factor intervention studies



Eight of the 20 interventions tested were delivered in a single interaction, five entailed two interpersonal contacts and five were delivered in three or more contacts. The number of interpersonal contacts undertaken in two of the interventions could not be defined, because this varied according to the number of visits that patients made to their medical practitioners. One of the interventions tested entailed supervised exercise programs. The approximate duration of interpersonal contact could not be determined in seven of the 20 interventions tested. In five interventions the duration of contact was less than five minutes, in two others it was between 6 and 20 minutes, in two it was between 41 and 60 minutes and in four it was over 60 minutes.

The most common deliverers of physical activity interventions (in 13 of 20 interventions tested) were medical practitioners, and in three of these a health educator was also involved in delivery. Health visitors delivered four of the interventions tested, while two were delivered by a health educator alone and in single instances interventions were delivered by leisure centre staff or an exercise scientist. A theoretical basis was specified for all but two of the interventions tested. Most often (in 14 interventions) the Transtheoretical Model was applied, and in many of these (10) Social Cognitive Theory was also drawn upon. In two interventions Social Cognitive Theory was the only theory that was used, while in one the Health Belief Model was applied.

Control subjects were not reported to be given a physical activity intervention in the majority of studies. In one study the control condition entailed brief advice regarding physical activity delivered by a GP while in another control subjects were given risk factor advice and written information materials from a health visitor following a 75 minute baseline assessment. Control subjects in one study received an extensive physical activity intervention, entailing brief advice from a physician, further advice and written information from a health educator and follow-up by the physician and

health educator at subsequent visits (Writing Group for the Activity Counseling Trial Research Group, 2001).

Eight studies conducted a short-term follow-up of subjects, less than six months after intervention. A medium-term follow-up, of greater than six but less than 12 months was undertaken in six studies, while a long term follow-up of 12 months or more was carried out in five studies. The longest duration of subject follow-up was two years, which was undertaken in one of the studies.

3.2.2 Methodological quality of the studies

Eight of the studies which tested single risk factor interventions to promote physical activity were RCTs and four were quasi-experimental studies. Two of the RCTs used cluster randomisation; one of these randomised at the level of the practitioner and the other at the level of the practice as a whole. Four of the RCTs made it explicit that concealment was used in the randomisation process, but the remainder did not provide information about this.

As in the multiple risk factor studies that addressed physical activity, there was considerable variation in the methods used to measure this behaviour in the single risk factor intervention studies. Seven of the 12 studies provided evidence of the validity and reliability of the physical activity measures. Both moderate- and vigorous-intensity activities were measured in all of the studies.

While not all studies made it explicit that analysis was by intention-to-treat, there was only one study that did not adhere to these methods. In this study a small proportion (5%) of eligible intervention subjects were excluded after allocation to treatment because GPs did not have time, or forgot, to deliver physical activity advice (Bull and Jamrozik, 1998).

In most of the studies the rates of subject follow-up achieved were acceptable. In the two studies in which there were moderate or large losses to follow-up the outcome scores for missing cases were imputed, enabling all subjects to be retained in analysis.

Overall, two of the eight RCTs (Goldstein et al, 1999; Writing Group for the Activity Counseling Trial Research Group, 2001) were given a methodological rating of 'good'. The remaining RCTs and all the four quasi-experimental studies were rated as 'fair'.

3.2.3 Findings

As was the case in the multiple risk factor intervention studies, the studies which addressed physical activity alone used a variety of measures and reported their outcomes in different ways. Six of the eight studies which undertook short-term follow-up reported significant intervention effects. This was found in three of four quasi-experimental studies and three of four RCTs. The one RCT which did not find a significant short-term increase in physical activity was of 'good' methodological quality while the remaining three RCTs reporting significant effects were of 'fair' quality.

Three of the six studies which undertook medium-term subject follow-up, including one of the two quasi-experimental studies and two of the four RCTs, found significant

increases in physical activity following intervention. The one RCT of 'good' methodological quality which undertook medium-term follow-up did not find a significant effect.

Among the five studies which undertook long-term subject follow-up, two reported significant outcomes, although in one of these the intervention effects were only apparent among women (Writing Group for the Activity Counseling Trial Research Group, 2001). This latter trial was the only RCT of 'good' methodological quality that undertook long-term follow-up.

Three of the four studies which reported increases in physical activity among intervention subjects in the short-term and then conducted later follow-up, found non-significant or reduced effects in the medium- or long-term.

3.2.4 Attributes of effective interventions

(i) Intervention intensity

Both brief and more intensive physical activity interventions were associated with short-term increases in physical activity. It was apparent in three studies, however, that the addition of extra intervention components lead to greater effect sizes. For instance, in brief intervention trials it was found that providing physical activity advice verbally and through a written prescription was more effective than verbal advice alone (Swinburn et al., 1998), and that supplementing brief advice and a written prescription with self-help booklets was more effective than advice and a prescription alone (Smith et al., 2000). In a study testing four levels of intervention (Harland et al., 1999) it was found that only the most intensive intervention, which included six counseling sessions and vouchers for attending a leisure centre, achieved significant increases in physical activity.

The findings in studies which undertook medium-term or long-term follow-up did not clearly indicate that brief or more intensive interventions were more effective in increasing physical activity.

(ii) Intervention deliverers

There were no clear indications in the results obtained at short-, medium- or long-term follow-ups that interventions were more effective when they were delivered by particular types of health professionals.

(iii) Patient characteristics

The age group from which subjects were recruited did not appear to be associated with the physical activity results that were obtained. A consistent finding was that significant improvements in physical activity were only achieved among subjects who were sedentary (reporting no activity) or insufficiently active at recruitment. In the two studies in which physical activity outcomes were measured among active and inactive patients combined there were no intervention effects reported.

3.2.5 Public health significance of studies

(i) Reach

In four of the studies, subjects were recruited from the whole populations in the study sites, which in each case was defined as all who were registered with and attended the participating practices. In the remaining studies, subjects were recruited only from

patients who attended for consultations during the study period. Only one of the four studies which recruited subjects from the whole population was able to calculate a recruitment rate in which all eligible patients were included in the denominator, and in this case the rate was 73%. The calculation of accurate recruitment rates was not possible in the three other studies because there were substantial proportions of subjects who did not reply to mailed invitations or screening questionnaires. In the eight studies where subjects were not recruited from whole populations, and where the complete denominator of eligible patients was unknown, the recruitment rates reported ranged from 37-85%.

The extent to which recruited subjects were representative of the underlying population from which they drawn was only examined in one study, and here it was reported that older, male patients were overrepresented in the sample. As in the studies which tested multiple risk factor approaches to physical activity promotion, in many of the single risk factor studies there was a clear dominance of particular demographic groups among the recruited subjects. Women were more strongly represented than men in many studies.

(ii) Adoption
There was only one study where the rate of recruitment of practitioners or health services to participate in the study was reported. The rate of recruitment of GPs to this study was 32%. The extent to which participating practitioners or health services were representative was not examined in any of the studies.

(iii) Implementation
Interventions were delivered by existing staff at the participating sites in seven of the twelve studies, however, there were only three studies where interventions were delivered entirely within routine care. In the remaining five studies interventions were delivered wholly, or in part, by staff who were employed for the purposes of the research study.

Ten of the twelve studies reported on the extent to which interventions were delivered as intended or complied with by patients. In most cases rates of intervention receipt were high; above 75% in five studies where this was expressed as a proportion of the enrolled subjects. In the study that reported intervention exposure in mean minutes, the average duration of the intervention received by subjects was close to that intended. The rates of intervention receipt were lowest in those studies where allocation to the intervention condition took place before subjects had indicated their willingness to attend the sites where these were delivered.

4. Summary and conclusions

This review has examined the effectiveness of physical activity interventions delivered to patients identified in primary health care settings. Because multiple risk factor interventions represent a different approach to those which solely address physical activity, these were reviewed separately.

While six of the eight studies which tested multiple risk factor strategies for promoting physical activity were RCTs, all of these were rated as of ‘fair’ quality.

The most common weakness of the studies was the failure to use physical activity measurements with established validity or reliability. Both of the studies which measured short-term effects reported significant outcomes, although in one of these the amount of change in physical activity was not reported. Four of the seven measuring long-term effects found significant improvements in physical activity. The limited number of multiple risk-factor intervention studies which reported significant improvements in physical activity, together with their fair quality, indicates that the research concerning the effectiveness of these approaches to promoting physical activity is inconclusive.

Most of the studies which tested single risk factor interventions to increase physical activity were RCTs, but only two of these were of 'good' quality. All of the four quasi-experimental studies had methodological weaknesses and were rated as being of 'fair' quality. Six of the eight studies undertaking short-term follow-up reported significant improvements in physical activity, with RCTs and quasi-experimental studies equally likely to report this finding. This is different to other areas of risk factor and disease prevention research, where RCTs typically produce smaller effects than non-randomised trials.

From this review it can be concluded that there is 'fair' evidence that interventions delivered to primary care patients which address physical activity alone can achieve short-term increases in this behaviour. The potential health significance of these intervention effects remains unclear, not just because effects of a short-term nature are reported, but because none of the studies reported significant increases in the proportions of subjects who achieved the levels of physical activity participation recommended by health authorities. The short-term effects in these studies are reported as greater proportions of intervention subjects undertaking any activity or improving their activity, or a relatively higher duration or number of sessions of physical activity. Given the dose-response relationship between physical activity and health improvements (Haskell, 1994), effects of the size reported in these studies may be of some benefit, but it is not clear that this would be sufficient to justify the interventions.

Half of the single risk-factor intervention studies which undertook medium-term follow-up found significant effects while two of the five which undertook long-term follow-up reported significant outcomes. The evidence concerning the medium and long-term effects of these interventions can, therefore, be described as inconclusive. The fact that only five studies have so far undertaken long-term subject follow-up indicates that this is an important area for future investigation.

Both brief and intensive single risk factor interventions appeared to produce short-term increases in physical activity. Some studies indicated that additional intervention components, such as written advice for exercise, booklets, follow-up sessions and leisure centre vouchers, could increase intervention effects. Short-term effects were only found among sedentary or insufficiently active subjects, but there were no other subject characteristics that were associated with greater intervention effects.

Appraisal of the reach, adoption and implementation of the interventions, using the RE-AIM framework, provided a means of assessing the public health significance of the studies. Few studies made comparisons between the characteristics of study

subjects and the populations from which they were drawn, so in most cases it was not possible to determine whether interventions reached a representative group of people. This lack of information is likely to have been due to the difficulties in obtaining information about the characteristics of all patients in primary care populations. Even less information was provided about the representativeness of the practitioners and services who participated in the studies. This, together with the fact that there were few examples of interventions that were implemented in routine service provision, indicated that there has been little consideration given to the potential for the interventions tested in primary health care settings to be disseminated on a wide scale. Hence, there is little data to support the potential effectiveness of these interventions at the population level. Data about the implementation of interventions were frequently not provided, but when given generally indicated that these were delivered as intended, albeit in selective samples of subjects in a limited number of study sites.

The challenge posed by studies which more closely resemble efficacy trials, with volunteer intervention deliverers and subjects, than effectiveness trials undertaken in the "real world" of primary health care, is that conclusions are difficult to draw in regard to the public health significance of this research. In other words, in spite of the reasonable volume of research that has been undertaken concerning physical activity interventions in primary care settings, evidence is still lacking concerning the value of these interventions in improving population health.

5. Recommendations

The evidence that single risk factor interventions can lead to short-term improvements in physical activity provides a limited basis upon which to recommend that these be undertaken in primary care consultations. There are, however, several considerations which need to be taken into account in determining the approach that primary care practitioners should adopt to addressing physical activity. These include: the relevance that this behaviour has to a number of health problems that patients may have; the finding that brief interventions are generally as effective as more intensive interventions, but require only a small input of time by practitioners, and; the fact that primary care practitioners represent only one sector, among a range of others, who must cooperate in any health promotion strategies to address the problem of physical inactivity in the population.

It is recommended that primary health care practitioners make opportunistic use of brief interventions in their routine consultations to advise patients who could benefit from increased physical activity. This includes those with hypertension, overweight or obesity, glucose intolerance, or symptoms of anxiety or depression. Brief advice could also be written down for patients, as a type of physical activity prescription, and supplemented by information handouts and opportunistic follow-up in subsequent consultations. Such an approach could be undertaken as part of routine clinical care and will not require an investment of additional resources by practitioners or services.

This review highlights a number of issues that should be addressed to strengthen the quality and public health relevance of research concerning interventions to address physical activity in primary care settings. Further studies are required to test both single and multiple risk factor interventions delivered in routine care with

representative samples of patients. The representativeness of practitioners and services who are engaged in intervention delivery should be measured. Formative research and pilot studies are required in order to develop intervention approaches that are acceptable and feasible for practitioners and patients to use. There is a need to evaluate interventions using valid and reliable measures of physical activity and to adopt standardised outcome measures, a factor which may create the potential for meta-analysis of future studies in this field. An important outcome variable to be included in future studies is the proportion of subjects who undertake recommended amounts of physical activity after intervention. Research is also required to test the effect of interventions among patients in different age groups and those with various health problems that could be addressed by increased activity. The importance of physical activity requires that ongoing attention be given to the best methods of engaging the health sector in addressing this health behaviour.

Appendix 1. Studies included in reviews of physical activity interventions in health care settings

Table A1. Studies included in reviews of physical activity interventions in health care settings

Study	Design[6]s	Review							
		Ashenden et al. (1997)	Eaton & Menard (1998)	Simons-Morton et al. (1998)	Riddoch et al. (1998)	Eakin et al. (2000)	Lawlor & Hanratty (2001)	Petrella & Latanzio (2002)	Eden et al. (2002)
Reid and Morgan (1979)	RCT			D4		D4			
Campbell et al. (1985)	QE				D4				
Kelly (1988)	QE		D4			D4	D4		
Logsdon et al. (1989)	QE	D4	D4	D4		D4	D4	D4	
Shultz (1993)	RCT			D4					
Gibbins et al. (1993)	QE-uc				D4				
Lewis and Lynch (1993)	RCT	D4	D4	D4	D4	D4	D4	D4	
Cupples and McKnight (1994)	RCT	D4			D4				
Family Heart Study Group (1994)	RCT	D4							
Graham-Clarke and Oldenburgh (1994)	RCT	D4		D4	D4	D4	D4	D4	
ICRF OXCHECK (1994)	RCT	D4	D4	D4	D4	D4			
Vernon (1994)	QE				D4				
Lord and Green (1995)	QE-uc				D4				
Burton et al. (1995)	RCT		D4	D4	D4	D4		D4	D4
Elder et al. (1995)	RCT					D4			
Calfas et al. (1996)	QE		D4	D4	D4	D4	D4	D4	
Dowell et al. (1996)	QE		D4			D4			
Long et al. (1996)*								D4	
Marcus et al. (1997)	QE			D4	D4	D4	D4	D4	
Munro (1997)	RCT				D4				
Wiesemann et al. (1997)	QE				D4				

Study	Design[6s]	Ashenden et al. (1997)	Eaton & Menard (1998)	Simons-Morton et al. (1998)	Riddoch et al. (1998)	Eakin et al. (2000)	Lawlor & Hanratty (2001)	Petrella & Latanzio (2002)	Eden et al. (2002)
Swinburn et al. (1998)	RCT		[D4]	[D4]	[D4]	[D4]		[D4]	[D4]
Bull and Jamrozik (1998)	QE			[D4]		[D4]	[D4]	[D4]	
Taylor et al. (1998)	RCT				[D4]				
Stevens et al. (1998)	RCT			[D4]	[D4]	[D4]		[D4]	
Pinto et al. (1998)*								[D4]	
King et al. (1998)*								[D4]	
Goldstein et al. (1999)	RCT					[D4]	[D4]		[D4]
Naylor et al. (1999)	QE				[D4]				
Riddoch et al. (unpubl)	QE				[D4]				
Steptoe et al. (1999)	RCT								[D4]
Kerse et al. (1999)	RCT								[D4]
Petrella and Wight (2000)*								[D4]	
Smith et al. (2000)	QE								[D4]
Norris et al. (2000)	RCT								[D4]
Writing Group for the ACT (2001)	RCT								
Calfas et al. (2002)*	RCT								[D4]

[6s] RCT – randomised controlled trial; QE – quasi-experimental study; QE-uc – uncontrolled quasi-experimental study
*physical activity outcomes after intervention not reported

Appendix 2. Reasons for poor ratings given to certain studies

Table A2.1 Reasons for poor rating given to multiple risk factor intervention studies

Study	Rating	Reason
Graham-Clarke and Oldenburgh (1994) A Fresh Start	I-poor	High losses to follow-up, but missing values not imputed Baseline differences between study groups
Dowell et al. (1996)	II – poor	Analysis by treatment received, with no adjustment for potential confounders Physical activity measure had no reported validity or reliability

Table A2.2 Reasons for poor rating given to single risk factor intervention studies

Study	Rating	Reason
Lewis and Lynch (1993)	I-poor	Analysis by treatment received, with no adjustment for potential confounders
Taylor et al. (1998)	I – poor	High losses to follow-up Low compliance
Sims et al. (1999)	I – poor	Baseline differences between groups but not adjusted for in analysis
Naylor et al. (1999)	II – poor	High losses to follow-up Non-systematic allocation to treatment group

Appendix 3. Multiple risk factor studies addressing physical activity included in the review

Table A3.1 Study designs and intervention methods of multiple risk factor physical activity intervention studies in health care settings

Study	Design	Intervention content	Intervention implementation	Theoretical basis	Process data
Kelly (1988) Healthy Choices Program Rating: II-fair	QE	Three levels of intervention: self-completed assessment in waiting room; assessment and a set of 7 brochures addressing various risk factors; assessment, followed by advice, written prescription and brochure(s) corresponding to patient need and interest	Nurses and physicians	Not stated	Not stated
Logsdon, et al. (1989) INSURE study Rating: II-fair	QE	Age-sex specific medical screening and 15 min. education and counseling on risk reduction	Physicians	Not stated	57% received intervention as intended
Cupples and McKnight (1994 (2 yrs), 1999(5 yrs)) Rating: I-fair	RC T	Advice about modifying cardiovascular risk factors (e.g., smoking, exercise, diet) after an assessment. Further health education given at follow-up at 4 mth intervals	Health visitors	Not stated	Not stated

Study	Design	Intervention content	Intervention implementation	Theoretical basis	Process data
Muir et al (1994 (1yr)); ICRF OXCHECK Study Group (1995 (4 yrs)) OXCHECK study Rating: I-fair	RCT	Annual health checks (45-60 min. initially and 30 min. in subsequent years) and 10-20 min. follow-up visits to address risk factors identified in the assessment	Nurses	Patient-centred counseling model	82.2% of those allocated to health checks in yr 1 attended and 78.8% of the random sub-sample allocated to rechecks attended; 81.7% of those allocated to checks at yr 2 attended and 76.8% of those allocated to re-checks returned; 79.1% allocated to checks at yr 3 attended
Lindholm et al. (1995) CELL study Rating: I-fair	RCT	Brief risk factor advice from doctor, a pamphlet plus 6 group sessions (5 of 90min. and one full day), incorporating videos, discussions and regular self-assessment	Doctors and nurse	Not stated	78% attended all sessions
Burton et al. (1995 (2yrs), 1997(4yrs)) Senior Health Watch Rating: I-fair	RCT	Annual telephone assessment of lifestyle risk factors, followed by preventive visit with physician for physical exam, screening, immunisations and risk factor advice. A follow-up visit 6 mths later for counseling and health behavior review was offered	Physicians	Not stated	In yr 1 63% made a preventive visit and 53% returned for follow-up counseling and at yr 2 32% made preventive visit and 33% returned for counseling; sedentary lifestyle discussed in 91% of counseling visits

Study	Design	Intervention content	Intervention implementation	Theoretical basis	Process data
Kerse et al. (1999) Rating: I-fair	RCT – cluster	Five stage education program for GPs: audit of patients by GPs to improve skills in discussing exercise and social activity and reviewing drugs and vaccination status; 15 min. of individual training for GPs with reading material about the above issues; introduction of card prompt to be attached to patients records for GPs to record discussions with patients about these issues; 3 hr education seminar for GPs on addressing this issues, and; written materials about health services and recreational resources for patients	GPs	Not stated	39% of intervention and 19% of control groups reported discussing exercise with their GP
Steptoe et al. (1999 (all subjects), 2000 (overweight)) Change of Heart Study Rating: I-fair	RCT – cluster	Two-to-three 20 min. behavioural counseling sessions (depending on no. of risk factors) tailored to the patient's stage of change and 1-2 telephone calls between sessions	Nurses	Transtheoretical Model	90% of intervention subjects attended at least one counseling session, 73% attended two and 56% three

Table A3.2 Recruitment of intervention deliverers and subjects in multiple risk factor physical activity intervention studies in health care settings

Study	Intervention deliverers		Subjects		
	Setting and practitioners	Representativeness	Sample size and characteristics	Recruitment	Representativeness
Kelly (1988) Healthy Choices Program	18 physicians in one family medicine training practice in Cleveland, Ohio	Not stated	326 18-60 yr olds	All patients screened in waiting room	79% of eligible patients recruited; most were female (70%), white and few were of low SES
Logsdon, et al. (1989) INSURE study	5 multispeciality group practices in Wisconsin, Florida and Pennsylvania. 14-21 physicians per practice	17.8% of the 28 group practices participated. Not stated if these practices were representative. Participation rate for physicians ranged 74%-100%	2216 18-74 yr olds with over-sampling of 40-59 yrs	Mailed survey to random sample of eligible patients	51% of eligible patients recruited; control participants less likely to be male than non-participants; subjects mainly white; middle-aged (40-59 yrs) males oversampled in intervention sites; non-respondents at follow-up were of lower education, lower income and more were smokers
Cupples and McKnight (1994 (2 yrs), 1999(5 yrs))	18 group general practices in Belfast	Not stated	688 people under 75 yrs known to have had angina for at least 6 mths	Mailed invitation to attend interview	48% of patients identified by GPs were recruited, but not clear if GPs identified all eligible patients; mostly older (mean age 63 yrs) and male (59%)

Study	Intervention deliverers		Subjects		
	Setting and practitioners	Representativeness	Sample size and characteristics	Recruitment	Representativeness
Muir et al (1994 (1yr)); ICRF OXCHECK Study Group (1995 (4 yrs)) OXCHECK study	5 general practices in Bedfordshire, UK	3 of the five 5 big general practices (>10,000 patients) in area recruited, two smaller practices (> 7,500) recruited	8307 35-64 yr olds	Mailed screening questionnaire	80% of those sent the screening questionnaire returned this and were enrolled
Lindholm et al. (1995) CELL study	32 health centres in rural or small towns in Sweden	3.7% of all health centres in Sweden. Not stated if those were representative	681 adults aged 30-59 yrs with at least two CVD risk factors in addition to moderate-high lipid levels	Invitation to patients on practice files and local advertisements	Recruitment rate not given; subjects mainly male (85%)
Burton et al, (1995 (2yrs), 1997(4yrs)) Senior Health Watch	223 physicians, 10 nurses and 2 osteopaths in 119 primary care medical practices in Baltimore, Maryland	63% of the 374 clinicians invited contributed patients to the study	4195 Medicare beneficiaries aged 65 yrs and over	All Medicare beneficiaries in region sent invitation to screening interview	40% of 11271 invited for screening took part and 37% were enrolled; slightly higher proportions of subjects were black, female, less-educated and had low income compared with national averages
Kerse et al. (1999)	42 GPs in Melbourne	51% of eligible GPs who were sampled were recruited; participants had higher mean yrs in practice and were less likely to charge a fee to patients than non-participants	267 patients over 65 yrs who had attended practices for more than 18 mths and for 3 of their last 5 consultations	Random samples of 10 patients were identified from each practice register and sent postal invitation	64% of patients identified from practice registers; non-participants were more likely to be dependent for transport and shopping

Study	Intervention deliverers		Subjects		
	Setting and practitioners	Representativeness	Sample size and characteristics	Recruitment	Representativeness
Steptoe et al. (1999 (all subjects), 2000 (overweight)) Change of Heart Study	20 general practices	48% of invited training practices; no. of potential practices not given	883 adults with one or more CVD risk factors	Invitations in consultations, letters to those on practice register and leaflets in practices	Recruitment rate not given; almost all white and most were middle-aged, employed and moderately educated; study completers were older, less likely to smoke and more likely to have high cholesterol

Table A3.4 Findings in physical activity in multiple risk factor intervention studies in health care settings

Study	Results	Comments
Kelly (1988) Healthy Choices Program	After 4 wks patients receiving one or more components of the intervention significantly more likely than control to report a "major change" in at least one risk factor (P<0.001). The maximal intervention condition showed the greatest change, but this did not reach significance. Results concerning changes in physical activity were not reported separately	Different measurement methods at baseline and follow-up (self-complete vs telephone survey); physical activity measure had no reported validity or reliability; non-systematic allocation to control group
Logsdon, et al. (1989) INSURE study	At 12 mths the findings by intention to treat did not show that a higher proportion of intervention subjects started to exercise vigorously at least once per wk compared with control subjects	Physical activity measure had no reported validity or reliability; baseline differences between study groups, which was adjusted for in analysis
Cupples and McKnight (1994 (2 yrs), 1999(5 yrs))	After 2 yrs there was a higher proportion of intervention than control group subjects who reported 7 or more 20 min. sessions of exercise per wk (44% vs 24%, P<0.01), also higher proportion of intervention than control subjects who increased their no. of exercise sessions (34% vs 21%, P<0.01). At five yrs the proportion of intervention subjects who increased their no. of 20 min. sessions was still higher than the control group (data not given) but the mean no. of sessions did not differ between the groups (3.0 vs 2.8)	Physical activity measure had no known validity and reliability; no indication of whether exercise measured was of moderate- and/or vigorous-intensity
Muir et al (1994 (1yr)); ICRF OXCHECK Study Group (1995 (4 yrs)) OXCHECK study	After 2 yrs the proportions of interventions subject who were sedentary (i.e., undertook walking, gardening or heavy housework < 3 sessions/wk) did not differ from the control group. This result was also found after 4 yrs	No baseline measures taken of control group, so cannot determine if differed from intervention group in physical activity at baseline; physical activity measure had no known validity and reliability
Lindholm et al. (1995) CELL study	After 1 yr the proportion of intervention subjects who reported vigorous activity less than once per mth was lower than that of controls (65.3% vs 70.4%, P<0.05). After 3 yrs the difference between the intervention and control groups on this outcome was still significant (67.6% vs 70.9%, P<0.05)	Physical activity measure had no reported validity or reliability

Study	Results	Comments
Burton et al. (1995 (2yrs), 1997(4yrs)) Senior Health Watch	At 18 mths the mean difference in exercise score between the groups was not significant	Physical activity measure had no known validity and reliability
Kerse et al. (1999)	After 1 yr mean walking per wk was 44 min. greater in the intervention group (P=0.03) and intervention groups were more likely to have increased their min. walked on the previous day (P<0.001); categorical measures of walking per day were also significantly higher in intervention group; total min. of activity per wk did not differ between the groups	Patients blinded to group allocation of their GPs; used validated measure of walking on previous day, while other measures did not have reported validity or reliability
Steptoe et al. (1999 (all subjects), 2000 (overweight)) Change of Heart Study	In the whole study group the average increase in episodes of moderate or vigorous physical activity in the past 4 wks was higher in the intervention than control group at 4 mths (7.6 vs 3.8, P<0.05) and 12 mths (8.2 vs 4.3, P,0.05); among sedentary overweight subjects there were also greater improvements in this outcome in the intervention group at 4 mths (8.8 vs 4.1, P<0.01) and 12 mths (10.1 vs 4.6, P<0.01)	Considerable loss to follow-up at 12 mths (41%); smokers and those with low cholesterol were more likely to drop out of the control group; physical activity measure did not have reported validity or reliability

Appendix 4. Single risk factor studies addressing physical activity included in the review

Table A4.1 Study designs and intervention methods of single risk factor physical activity intervention studies in health care settings

Study	Design	Intervention content	Intervention deliverer(s)	Theoretical basis	Process data
Calfas et al. (1996) Project PACE Rating: II-fair	QE	3-5 min. of structured counselling based on assessment completed in waiting room, written exercise prescription, a mailed postcard prompt and 10 min. booster call two wks later (tip sheets mailed if requested)	Physicians and health educators	Transtheoretical Model; Social Cognitive Theory	Delivered to 90% of patients
Marcus et al. (1997) Rating: II-fair	QE	3-5 min. of structured counseling based on waiting room survey, written exercise prescription, stage-matched written materials and follow-up visit after four wks	General internal medicine internists	Transtheoretical Model; Social Cognitive Theory	100% of subjects received first intervention and 95% a follow-up visit
Swinburn et al. (1998) Green Prescription Trial Rating: I-fair	RCT	5 min. of physical activity assessment, advice and goal setting; a random half of patients had this written on an exercise prescription	GPs	Not stated	Not stated

Study	Design	Intervention content	Intervention deliverer(s)	Theoretical basis	Process data
Bull and Jamrozik (1998) Rating: II-fair	QE	2-3 min. of exercise advice followed by either a mailed generic brochure or mailed tailored brochure	GPs	Transtheoretical Model; Social Cognitive Theory	84% of subjects given intervention
Stevens et al. (1998) Rating: I-fair	RCT	Exercise assessment and goal setting, exercise diary, a 10 wk program of leisure centre and home-based exercises and a second consultation to discuss progress	Exercise development officer	Not stated	35% of subjects attended first consultation and 25% the second one
Harland et al. (1999) Rating: I-fair	RCT	Five intervention conditions: 75 min. assessment with feedback, brochures, leisure centre leaflets and risk factor advice; this base intervention plus 40 min. of counselling; base intervention plus 40 min. of counselling and 30 activity vouchers; base intervention plus six 40 min. counselling sessions, or; base intervention plus six 40 min. sessions of counselling plus 30 activity vouchers	Health visitor	Transtheoretical Model	82% attended at least one interview; av. of 3 interviews attended by those offered multiple interviews; 41% of those with vouchers used at least one
Goldstein et al. (1999) Physically Active for Life Project Rating: I-good	RCT – cluster	5 min. of counselling, written exercise prescription, physical activity manual, a follow-up appointment and five monthly mailings (another manual and four newsletters)	Primary care physicians	Transtheoretical Model; Social Cognitive Theory; health education theory	99% of patients received first intervention; 77% received a follow-up visit

Study	Design	Intervention content	Intervention deliverer(s)	Theoretical basis	Process data
Halbert et al. (2000) Rating: I-fair	RCT	20 min. of counselling and a pamphlet including a three mth exercise plan	Exercise scientist	Transtheoretical Model; Social Cognitive Theory	Not stated
Norris et al. (2000) Rating: I-fair	RCT – cluster	Two levels of intervention: brief counselling based on assessment completed in waiting room, written exercise prescription, written information materials and a booster call four wks later (information sheets mailed if requested); this intervention plus three additional telephone booster calls and four postcard reminders (including a physical activity diary)	Family physicians	Transtheoretical Model; Social Cognitive Theory	94% of all intervention subjects and 65% of control subjects reported receiving physical activity counselling; 64% of intensive intervention arm received three or more follow-up calls
Smith et al. (2000) Active Practice Project Rating: II-fair	QE	Two levels of intervention: brief physical activity advice and a written physical activity prescription, or; this intervention supplemented by a mailed, stage-matched, self-help booklet	GPs	Transtheoretical Model; Social Cognitive Theory	62% of intervention subjects were given their intended intervention

Study	Design	Intervention content	Intervention deliverer(s)	Theoretical basis	Process data
Writing Group for the Activity Counseling Trial Research Group (2001) Rating: I-good	RCT	Three levels of intervention: advice, with 2-4 min. of physician advice plus written and verbal information from a health educator, with follow-up by physician and health educator at subsequent visits; assistance, with this intervention as well as 30-40 min. of counseling from a health educator, a telephone follow-up, monthly mailed newsletter, a pedometer and erasable calendar for self-monitoring and mthly mailed feedback about this, or; counseling, with this intervention plus telephone counseling biweekly for the first 6 wks then monthly after that, as well as weekly classes about physical activity	Physicians and health educators	Social Cognitive Theory	Mean contacts for each group were: advice, 3 contacts (18 min. total); assistance, 22 contacts (about 3 hrs total), and; counseling, 44 contacts for women (9 hrs total), or 38 contacts for men (5.6 hrs total)
Hillsdon et al. (2002) Rating: I – fair	RCT	Two levels of intervention: brief negotiation, 30 minutes of counseling plus 3 min. follow-up calls at 2, 6, 10, 18, 26 and 34 weeks, or; direct advice, 30 min. of advice plus the same no. and duration of follow-up calls	Health educator	Brief negotiation based on Motivational interviewing approach and direct advice based on the Health Belief Model	55% of brief negotiation group and 52% of direct advice group received intervention, on average each group had 3 follow-up calls of 7 min. duration

Table A4.2 Recruitment of intervention deliverers and subjects in single risk factor physical activity intervention studies in health care settings

Study	Intervention deliverers		Subjects		
	Setting and practitioners	Representativeness	Sample size and characteristics	Recruitment	Representativeness
Calfas et al. (1996) Project PACE	17 mixed specialty medical practices using 16 physicians and one nurse	Not stated	255 inactive people over 18 yrs scheduled for well visit or follow-up for chronic condition	Mailed invitation and telephone call to those with appointment	62.7% of eligible patients, however 25.7% of possible recruits of unknown eligibility; 84% female
Marcus et al. (1997)	One medical practice using four physicians	Not stated	63 inactive people 50 yrs and over	Telephone invitation to those with appointment	50.4% of eligible people; 72% female
Swinburn et al. (1998) Green Prescription Trial	37 GPs - no. of practices not stated	Not stated	491 inactive people seen to be willing and able by GPs to undertake increased physical activity	Invitation from GP in consultation	Not stated; 62% female
Bull and Jamrozik (1998)	10 general practices, no. of GPs not stated	Not stated	763 sedentary patients 18 yrs and over	Invitation to patients in waiting room	84.9% of eligible patients; eligibility unknown for 6.2% of patients; 65.3% female

Study	Intervention deliverers		Subjects		
	Setting and practitioners	**Representativeness**	**Sample size and characteristics**	**Recruitment**	**Representativeness**
Stevens et al. (1998)	One general practice and one leisure centre	Not stated	714 inactive 45-74 yr olds	Mailed invitation to all on practice register	55.4% of eligible patients; eligibility of 43% of people unknown; highest recruitment rate among older patients (65-74 yrs) and among men
Harland et al. (1999)	One general practice	Not stated	523 inactive 40 to 64 yr olds	Invitations to patients in waiting room; mailed invitations to patients registered with practice	29.4% of eligible, but not clear if eligibility determined for all patients; noted to be a lower SES group
Goldstein et al. (1999) Physically Active for Life Project	24 general internal and family medical practices using 34 physicians	Not stated	355 inactive people 50 yrs and over, ambulatory and scheduled for routine visits	Telephone invitation to those with appointment	80% of eligible patients; eligibility unknown for 36.4% of patients; 65% female, mostly white and in middle SES group
Halbert et al. (2000)	Two general practices	Not stated	299 sedentary people 60 yrs and older	Mailed invitation to those on practice register	85.2% of people eligible; eligibility unknown for 68.3% of patients

Study	Intervention deliverers		Subjects		
	Setting and practitioners	Representativeness	Sample size and characteristics	Recruitment	Representativeness
Norris et al. (2000)	Three HMO clinics using 32 family physicians in three clinics	Not stated	847 patients 30 yrs and over who were scheduled for a well-visit	Telephone invitation to those with scheduled appointments	44% of patients scheduled for a well-visit, however eligibility of 15% of these could not be determined
Smith et al. (2000) Active Practice Project	55 GPs in 27 practices were recruited	GPs represented 32% of those invited from Divisions of General Practice	1142 patients 25-65 yrs attending for routine care	Invitations to patients in waiting room	60.2% of eligible control and 56.8% of eligible intervention subjects recruited; most (60%) were female
Writing Group for the Activity Counseling Trial Research Group (2001)	51 physicians, 2 physician assistants and one nurse in 11 primary care facilities	Not stated	874 inactive 35 to 75 yr olds	Mailed, waiting room, physician and telephone invitations (approach varied at study sites)	38.9% of 2246 eligible subjects were enrolled; higher SES group; African American and minorities well-represented; 85% had one or more cardiovascular risk factors (plus being inactive)
Hillsdon et al. (2002)	2 medical centres, with one health educator	Not stated	1658 inactive 45-64 yr olds	Mailed invitations to those on practice register	73% of patients sent a survey returned this and all 1658 eligible patients were randomised

Table A4.3 Outcome measurement and data analysis in single risk factor physical activity intervention trials in health care settings

Study	Results	Comments
Calfas et al. (1996) Project PACE	At 4 wks the intervention groups reported higher mean minutes of walking per wk for exercise (75 vs 42, P<0.05), mean minutes of walking for any reason (188 vs 148, P<0.05) and mean accelerometer scores per hour (83 vs 57, P<0.01). Mean hrs/wk of total activity were not significantly higher in the intervention group	Allocation of GPs to control or intervention group was based on their personal interest
Marcus et al. (1997)	There were no significant differences in physical activity scores between the study groups at 6 wks	The sample size in this pilot study was small, providing little power to detect group differences
Swinburn et al. (1998) Green Prescription Trial	Follow-up at 6 wks showed greater proportions of subjects given the prescription reporting any physical activity compared to those given verbal advice alone (86% vs 77%, P<0.05), while the proportion who increase their activity was greater in the prescription group also (73% vs 63%, P<0.05). The mean increase in duration of physical activity did not differ between the groups	No non-intervention control group
Bull and Jamrozik (1998)	At 1 mth the proportion of the combined intervention groups reporting any activity was higher than the control group (40% vs 31%, P<0.05), and the difference remained significant at 6 mths (38% vs 30%, P<0.05), but not at 12 mths. The proportion of intervention subjects reporting an average of 5 or sessions/wk of activity was higher than the control group at 1 mth (35.8% vs 21.6%, P<0.05), but not at 6 or 12 mths. There were no differences between the group in duration of total activity	Follow-up rates were 70%, 60% and 57% at 1, 6 and 12 mths respectively, and baseline substitution was used in analysis for the physical activity of those lost to follow-up; potential selection bias because subjects were excluded if GPs did not have sufficient time to advise them or GP considered an intervention to be inappropriate

Study	Results	Comments
Stevens et al. (1998)	At 8 mths the mean no. of 20 min. sessions of activity in the past 4 wks was higher in the intervention than control group (6.0 vs 4.4, P<0.05). There was a 20% higher proportion of intervention than control group members who increased their activity, and an 11% greater reduction in the proportion of sedentary subjects in the intervention group, but the significance of these differences was not reported. There was difference between the groups in the proportion of subjects who reached recommended levels of activity	The follow-up rate at 8 mths was 58%, and baseline levels of outcome values were substituted in for subjects not contacted
Harland et al. (1999)	At 12 wks the combined four intervention groups showed a higher proportion who increased their no. of 20 min. sessions of exercise compared with the control condition (38% vs 16%, P<0.001). Additional counselling sessions or extra leisure centre vouchers were not independently associated with improvements in physical activity scores, but both of these factors together lead to higher proportions reporting improvement compared with the control group at 12 wks (55% vs 16%, P<0.001). There were no significant intervention related improvements at 12 mths	Data collection methods differed from baseline (face-to-face) to 12 wks (self-completed), while at 12 mths participants reported using either method; the baseline assessment was considerable, and could have been an intervention itself, leaving no true control condition
Goldstein et al. (1999) Physically Active for Life Project	There were no significant differences between the study groups at 6 wks or 8 mths in average total physical activity or the proportions meeting recommended levels of activity	

Study	Results	Comments
Halbert et al. (2000)	At 3, 6 and 12 mths the median no. of sessions/wk of vigorous activity were higher in the intervention than control group (2 vs 0 at every follow-up, P<0.05), while the median duration of vigorous activity sessions was also higher (20 min. vs 0 min. at every follow-up, P<0.05). The median frequency of moderate activity sessions/wk was higher in the intervention group (3 vs 2 at every follow-up, P<0.05), but the median duration of moderate activity sessions did not differ between the groups	The reliability or validity of the physical activity measures were not reported
Norris et al. (2000)	There were no significant differences between the study groups at 6 mths in average walking, total physical activity or total energy expenditure	The proportions of subjects adequately active at baseline (48%) was much higher than the US average, therefore study may not have had adequate power to detect change from this level; the high proportion of control physicians reporting activity counselling during the trail period (81%) suggests possible contamination
Smith et al. (2000) Active Practice Project	At 6 wks the proportion of inactive subjects in the prescription plus booklet group who increased their physical activity by 60min/wk or more was higher than the control group (45.7% vs 35%, P<0.05). The prescription alone was not associated with significantly greater increases in physical activity at 6wks, while neither intervention was found to lead to increases in physical activity at 8 mths	Control and intervention groups were not contemporaneous; baseline levels of physical activity differed between the control and intervention groups

Study	Results	Comments
Writing group for the Activity Counseling Trial Research Group (2001)	After 2 yrs women in the assistance group had higher VO_2 max than those in the advice group (adjusted difference 80.7 mL/min, P=0.02) and women in the counseling group had higher VO_2 max than those in the advice group (adjusted difference 73.9 mL/min, P=0.046). There were no differences between the groups in cardiorespiratory fitness among men, nor were there any differences between the groups (in either gender) in self-reported physical activity	Lack of no intervention control made it impossible to detect the effect of physician advice alone, and may have made it more difficult to detect differences between groups
Hillsdon et al. (2002)	After 12 mths there were no significant differences between the groups in mean or percent changes in energy expenditure	Large losses to follow-up in each intervention group (over 65%) and the control group (over 40%) and imputed values of energy expenditure in the control group were substituted for all missing values; different tools for measuring energy expenditure used at baseline and follow-up

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