



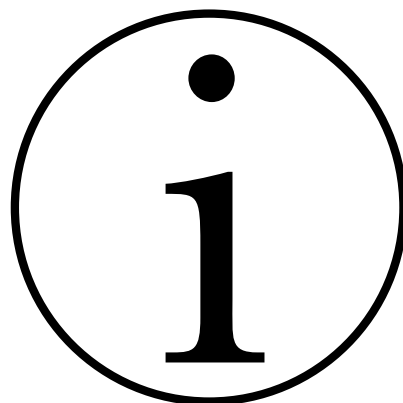
# **The clinical and cost effectiveness of physiotherapy in the management of older people with common rheumatological conditions**

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March 2002

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## Executive Summary

- Rheumatological conditions are amongst the most prevalent pathologies affecting older people causing disability and incurring very large direct and indirect healthcare costs. The prevalence of osteoarthritis (OA), rheumatoid arthritis (RA), osteoporosis and polymyalgia rheumatica (PMR) are age-related and will increase as the size of the elderly population increases, with a consequent rise in healthcare utilization and costs.
  - OA is one of the commonest causes of disability in the community dwelling elderly population.
  - RA is less common but may be a more aggressive disease than OA. Per-patient costs are higher because of the use of powerful drugs to control symptoms, but the much greater prevalence of OA means the total cost of treating OA is much greater.
  - Osteoporosis has less direct costs than OA and is less debilitating than RA, but the treatment of osteoporotic fractures following innocuous incidents is extremely costly.
  - PMR is almost as common as osteoporosis, but less debilitating and less costly to treat.
- Physiotherapy interventions are widely used to reduce pain, improve function and maintain independence.
- There is good evidence for the benefits of exercise in the treatment of OA. Despite this, the majority of patients receive little information or encouragement to exercise, so they remain confused about what they should (or should not) be doing. Several studies have shown exercise to be beneficial in the treatment of RA without causing joint damage in the longer term. During acute exacerbations of joint pain and inflammation, exercise should be decreased until the pain has settled. In osteoporosis exercise is used to improve posture and balance, to prevent falls that cause fracture, and maintain bone mineral density with high impact exercises.
- In order to maintain benefits, physical activity and exercise must be performed regularly and indefinitely. The most effective ways to maintain the patient's long-term participation in regular exercise and physical activity need to be elucidated. Rather than formal exercise classes, participation in regular physical activity such as walking provides an ideal and relatively easy way of maintaining bone, joint and muscle health. Methods of service delivery that best promote regular participation in physical activity/exercise require evaluation.
- Physiotherapists are closely involved in promoting patient education and self-management. These enable patients to appreciate what is good and bad for their joints, promote simple pain coping strategies and encourage healthy lifestyle changes. Self-management is essential for the efficient long-term management of chronic, fluctuating rheumatological conditions that affect large patient populations, for which finite resources are available and long-term dependency on hospital management is inappropriate and unaffordable.
- Pain reduction is claimed for physiotherapy modalities such as thermotherapy (heat/cold), electrotherapy, manual therapy, acupuncture, orthoses and walking aids. Although weak evidence supports the use of transcutaneous electrical nerve stimulation, thermotherapy and walking aids in OA and RA, there is little or no evidence to support the use of manual therapy, acupuncture and other electrotherapies that are widely used in the pain management of OA, RA, osteoporosis and PMR.
- Few of the physiotherapeutic modalities used in the treatment of rheumatic conditions are supported by evidence from high quality clinical trials. Most of the studies that have investigated physiotherapy have fundamental design and methodological errors (inadequate randomization, insufficient blinding, small sample sizes, absence of control groups, and limited or inappropriate data analysis) that undermine the inferences that can be drawn from their findings.
- In addition, most studies have investigated efficacy of physiotherapy (i.e. whether physiotherapy works on specific patient groups under the ideal, controlled conditions of research trials), but few have investigated the clinical effectiveness of physiotherapy (i.e. whether physiotherapy works under the conditions that exist in routine clinical practice and on the typical patient population).

Consequently, generalization of the results to the general patient population in the clinical environment is unclear.

- Cost benefit/effectiveness analysis of physiotherapy in rheumatological conditions has not been performed. This must be an integral component of future clinical trials enabling policy makers, healthcare providers and consumers to decide which physiotherapy modalities are effective, acceptable and affordable in the management of rheumatic conditions.

## **1.0 Introduction**

### **1.1 Background to the National Service Framework for Older People**

The National Service Framework (NSF) for Older People (England) was launched on 28 March 2001 (Department of Health, 2001). The framework presents eight standards which focus on: rooting out age discrimination; person-centred care; intermediate care; general hospital care; stroke; falls; mental health in older people and promoting an active healthy lifestyle in older age. The NSF will impact on physiotherapy and provide important opportunities for developing services centred on the needs of older people, by setting standards of service delivery for implementation at a local level.

The Government is to invest an extra £1.4 billion in services for older people in England by 2004 in order to improve the health and social care services for this sector of the population. The framework aims to ensure:

- High quality care and treatment, regardless of age
- That older people are treated as individuals, with respect and dignity
- Fair resources for conditions which most affect older people
- Easing of the financial burden of long term residential care

The Chartered Society of Physiotherapy (CSP) has produced a Policy Briefing on the NSF. It provides an overview of the content of the NSF for older people (England); considers the impact of each of the NSF standards on the profession and the delivery of physiotherapy services as well as highlighting the opportunities available to the profession; and makes recommendations for action (CSP, 2001a).

The NSF rightly asserts that older people have the right to top quality healthcare and challenges the healthcare professions to deliver this so that older people can live full and active lives, with minimal pain and disability and optimal independence and dignity. Delivering this will be challenging because older people are the largest consumers of healthcare, the prevalence of multiple pathologies increases with age and the number of people living longer has increased and will increase further over the next 2–3 decades. In addition, this will have to be performed with finite healthcare resources, necessitating the best use of available resources.

### **1.2 Purpose of this Report**

The CSP is committed to supporting physiotherapists in maximizing the opportunities provided by the NSF to improve patient care. Feedback from previous reports produced by the CSP, to support the mental health and coronary heart disease NSFs, suggests that physiotherapists are using these reports to:

- Inform service reviews and planning
- Develop business cases
- Inform Continuing Professional Development (CPD) activities, including qualifying programmes and postgraduate courses
- Develop research areas
- Submit topics for research priorities
- Inform briefing papers

- Provide evidence to commissioners
- Raise the profile of physiotherapy

This report is one of four commissioned to support physiotherapists implementing the Older People's NSF. They are:

- Effectiveness of falls prevention and rehabilitation strategies in older people: implications for physiotherapy.
- The effectiveness of physiotherapy in the palliative care of older people.
- The clinical and cost effectiveness of physiotherapy in the management of common rheumatological conditions of old age.
- The clinical and cost effectiveness of physiotherapy in the management of older people following a stroke.

A report on the clinical effectiveness of physiotherapy in mental health, produced by the CSP to support physiotherapists implementing the NSF on Mental Health, is also relevant to physiotherapists implementing the NSF for Older People (Donaghy and Durward, 2000). The Society has also produced a position statement on intermediate care and rehabilitation (CSP, 2001b).

Physiotherapists can use these reports and the position statement, alongside the NSF, to develop business plans, ensuring that physiotherapy is at the forefront of delivering improvements in services for older people.

While the NSF refers to England, Frameworks and action plans for the other Nations will draw on the same evidence base, but local application and context may vary, affecting how services are delivered.

Although the NSF does not make explicit any standards concerning the management of common rheumatological problems in this population, the Society felt that this was a relevant area to be addressed in improving the care of older people. In addition, as much of the evidence drawn upon is not specific to the older population (over 65 years) it will also be of interest to physiotherapists working with any adult with one of the rheumatic conditions covered.

### **1.3 Literature Search**

The following key words were used for the searches: systematic review(s), review(s), clinical trial(s), controlled trial(s), randomised controlled trial(s), meta-analysis, physiotherapy, physiotherapist(s), physical therapist(s), physical therapy, rehabilitation, electrotherapy, exercise(s), arthritis, rheumatism, rheumatic diseases, rheumatoid arthritis, osteoarthritis, osteoarthritic, osteoarthrosis, polymyalgia rheumatica, polymyalgia arteritica, temporal arteritis, giant cell arteritis, osteoporosis, clinical effectiveness, cost benefit analysis, economic evaluation.

The following sources were used for the search: Cochrane Library, DARE, MEDLINE, EMBASE, CINAHL and AMED.

## **2.0 Osteoarthritis**

### **2.1 Definition**

Osteoarthritis (OA) is the most common form of arthritis. OA can affect any synovial joint but those most commonly affected are the knees, hips, hands and spinal apophyseal joints. Rather than a single disease entity OA is best regarded as a group of overlapping but distinct diseases, which may have different aetiologies but have similar biologic, morphologic and clinical outcomes. The disease processes do not just affect the articular cartilage, but involve the entire joint including the subchondral bone, ligaments, capsule, synovial membrane and periarticular muscles (Keuttner and Goldberg, 1995). This definition highlights that changes can occur to any of the structures that make up the joint whether these are intra- or peri-articular structures.

## 2.2 Diagnosis and Clinical Features

OA is usually diagnosed and categorized using pathological and radiological criteria rather than clinical features. Radiologically it is characterized by focal areas of damage to the articular cartilage, mild synovitis, joint space narrowing, bony outgrowths from the joint margins called osteophytes and subchondral bone sclerosis. Clinical features include pain, joint stiffness with loss of range of movement and sometimes fixed deformities and disability, which are associated with pain or weak, de-conditioned muscles.

## 2.3 Prevalence

OA is found in all human populations, affecting women more often than men (EULAR Standing Committee, 1996). Although radiological changes are common there is little association between radiological changes and symptoms, radiological changes are evident in at least some joints in virtually all adults over 60 years of age but these changes are frequently asymptomatic. Clinical disease probably affects about 10–20% of the population over 60 years and has reported to be 30% in people over 75 years (Badley et al, 1994).

## 2.4 Aetiology

The causes of OA are multifactorial and include age-related changes to the joint and muscles, hormonal changes (particularly in women following menopause), excess body weight, congenital abnormalities, and previous joint injury leading to muscle weakness and joint instability (Felson and Zhang, 1998). Although the incidence and prevalence of OA increase with age, OA is not an evitable consequence of ageing. There is a strong association between biomechanical insults sustained during normal use of an abnormal joint, as a result of previous injuries or malformation, and abnormal use of a normal joint, e.g. due to occupation or recreational activities. There is some evidence that the synovial joints most commonly affected are under-evolved for the activities they are routinely subjected to, i.e. knees and hips for weight bearing and joints of the hands for pincer grip activities.

## 2.5 Prognosis

There have been few longitudinal epidemiological studies documenting the natural course of OA and participants of clinical trials are rarely followed for more than 6 months. The studies that have been performed, and anecdotal reports, suggest that OA has a very variable course. Most patients experience a slow, progressive deterioration, characterized by episodic exacerbations of pain that insidiously increase in frequency, intensity and length, resulting in muscle weakness and fatigue, joint stiffness and reduced function. The risk factors for progression have not been identified.

## 2.6 Aims of Physiotherapy

Physiotherapy cannot reverse established articular damage, therefore the aims of physiotherapy are to control pain, reduce joint stiffness, limit subsequent joint damage, improve function and health-related quality of life, and educate the patient in self-management, with the least amount of adverse detrimental treatment effects.

## 2.7 Specific Physiotherapy Interventions in the Management of OA

The American College of Rheumatology's (ACR) revised guidelines for management of lower limb OA describe non-pharmacological interventions, including physiotherapy, as "...the cornerstone of OA management and should be maintained throughout the treatment period. Drug therapy is most effective when combined with non-pharmacological strategies." (Altman et al, 2000)

This recommendation is echoed by the European League Against Rheumatism (EULAR) (Pendleton et al, 2000). However, very few of these recommendations are supported with research demonstrating the efficacy of physiotherapy in the management of OA. This is because so little research has been carried out and the studies that have been published have fundamental methodological flaws (too few subjects, inappropriate and/or inadequate control groups, non-randomized, unblinded assessment) that limit the inferences that can be made and the practical conclusions that can be drawn.

Well-conducted systematic reviews of the efficacy of physiotherapy interventions used in the management of OA have been used to guide this report. The findings of systematic reviews of interventions utilized in other rheumatic conditions (rheumatoid arthritis (RA), back and neck pain) have been cited as they might be

extrapolated to treatment of OA, provided the pathological processes of these conditions, the underlying treatment aims, rationale and mode of action of the interventions are similar.

Most of the research studies of physiotherapy for OA have investigated the involvement and treatment of the knees, hips and axial joints. There has been very little evaluation of physiotherapy in OA of the joints of the wrist, hand and fingers. While it is likely that modalities that attempt to reduce pain will result in similar outcomes as when used for weight-bearing joints, the role of muscles in the pathogenesis of the condition in the hand joints means that the role exercise may play in reducing pain and increasing function of hand joints is unclear.

### 2.7.1 Exercise

Exercise is frequently utilized by physiotherapists in the management of peripheral joints affected by OA and for patients with spinal pain. It has been shown to decrease pain and to increase strength and function without exacerbating OA (Minor 1999; van Baar et al, 1999). In addition, exercise can: re-educate neuromuscular skills; decrease reaction times; improve joint stability and proprioception (Hurley and Scott, 1998); restore the shock-absorption function of muscle, rebalance agonist and antagonist muscle groups, and thus protect against further joint damage. Exercise also has psychological benefits, improving a patient's self-confidence and self-esteem.

However, most efficacious research regimens are prolonged and involve complicated exercises using sophisticated equipment. Given the size of the population suffering from OA, the chronic nature of the condition and the limited time, personnel and financial resources, the clinical applicability of prolonged regimens is limited. In addition, exercise has been criticized for being of temporary benefit – when regular exercise stops the benefits are lost – which would be expected if any exercising has a positive effect. More clinically practicable regimens (Hurley et al, 1998), home exercise regimens (van Baar et al, 1997; O'Reilly et al, 1999) and relatively simple physical activities, e.g. recreational walking (Kovar et al, 1992; Ettinger et al, 1997; Sullivan et al, 1998) are likely to lead to greater compliance and therefore improved outcomes, but the best ways of sustaining the benefits of exercise over time with continued participation in habitual exercise need to be established (Dexter, 1992; Jenson and Lorish, 1994).

### 2.7.2 Hydrotherapy / Balneotherapy

Exercises performed in water utilize the buoyancy, assistance and resistance of warm water to relieve pain, induce muscle relaxation and unload the lower limbs, promoting more effective exercise. Balneotherapy can take the form of hydrotherapy performed in NHS (and private) hospital facilities, or spa therapy (predominantly used in other European countries), which involves a residential stay at a spa resort, and combines exercise in naturally heated water that has high mineral content, with application of mud packs and the psychological benefits of respite care. Although relatively well-designed trials of hydrotherapy (Green et al, 1993; Hall et al, 1996) and spa therapy (Elkayam et al, 1991; Guillemin et al, 1994; Nguyen et al, 1997) have shown them to improve physiological and psychosocial parameters effectively, methodological deficiencies limit the inferences we can draw from studies of balneotherapy (Verhagen et al, 1997). This review also included studies of mud pack therapy which is not used in physiotherapy in the UK. The cost implications of hydrotherapy / balneotherapy preclude widespread implementation (see economic analysis para 2.9).

### 2.7.3 Patient Education and Self-Management

The incurable, chronic, fluctuating and unpredictable nature of OA and the large patient population make it imperative to provide patients with information and advice about the causes, course and strategies of managing OA. This will dispel widely held fallacies about the condition and enable individuals to help themselves by adopting healthy life-styles that will accommodate and deal their condition. Patient education and self-management can be provided through formal education programmes (Lorig et al, 1993; Holman and Lorig, 1997). These aspects are regarded as essential components of physiotherapy management. Physiotherapists can exploit the opportunity to advise patients about simple pain coping strategies, the benefits of regular exercise and physical activity, the importance of maintaining correct body weight, joint protection, rest-activity cycling, and how to cope with problems that arise during self-care, household, work and leisure activities, to enable people to maximize their function and independence. This will include advice on pacing activities.

## 2.7.4 Thermotherapy

Cold and heat treatments have been used to relieve arthritic pain for many thousands of years. Patients use hot water bottles, heat lamps, ice packs etc, by their own instigation or after advice from healthcare professionals. There are few trials of thermotherapy in OA, but in RA the modality has been shown to be effective when used by itself or in combination with other modalities, safe and well liked by patients and its use is strongly recommended (Welch et al, 2000).

## 2.7.5 Electrotherapy

Modalities such as diathermy, pulsed electromagnetic fields, ultrasound (US), low level laser therapy (LLLT) and transcutaneous electrical nerve stimulation (TENS) are very often used in the treatment of OA. In spite of their widespread use there are very few high-quality studies supporting the efficacy of these modalities; those that have been performed not only have fundamental methodological flaws but also great heterogeneity in their dosage, duration, and site of treatment. Systematic reviews of high quality studies into the efficacy of US (Gam and Johannsen, 1995; van der Windt et al, 1999) and LLLT (Beckermen et al, 1992; de Bie et al, 1998; Brosseau et al, 2000) suggest they have little, if any, beneficial analgesic effect. The efficacy of TENS in reducing OA knee pain has been established by employing high frequency or strong burst TENS repeatedly for more than 4 weeks (Osiri et al, 2000).

## 2.7.6 Walking Aids, Orthoses and Patellar Taping

The healthy, well-conditioned musculoskeletal system is extremely efficient at attenuating harmful, mechanical stress and forces encountered during gait by appropriate muscle activity, joint movement and articular cartilage and bone deformation. Unfortunately the pathological changes associated with OA compromise these capabilities. Sticks and crutches, lateral heel wedges (Keating et al, 1993), neoprene sleeves and valgus braces (Kirkley et al, 1999) are used to relieve pain and promote better function by attenuating and re-distributing excessive forces. Other studies have failed to find benefits (Hewett et al, 1998) and in low back pain there was limited evidence that lumbar supports are more beneficial than no treatment, and considerable uncertainty as to whether they are any more effective than other treatments (van Tulder et al, 2001).

Even if they can be shown to be efficacious, these aids and devices can be very unpopular with patients who perceive that walking sticks make them appear old, infirm and 'giving in' to the condition. They limit upper limb function and are unsuitable for patients with weak or painful upper limbs, while neoprene sleeve, and particularly braces, are hot and cumbersome to wear, aesthetically unattractive and elderly patients have difficulty putting them on correctly. Thus, compliance with their use is poor (Rogers and Holm, 1992).

Patellar taping might be considered a special type of orthosis that is used in combination with specific exercises to reduce pain for patients with anterior knee pain. Application of patellar taping on patients with patellofemoral OA showed some promise in a small study (Cushnaghan et al, 1994), but a larger study has failed to substantiate those findings (Quilty et al, 1998). Moreover, the necessity of taping has been questioned since pain relief can be achieved with exercise alone (Minor, 1999; van Baar et al, 1999).

## 2.7.7 Manual Therapy

For chronic back pain, there is some evidence that manipulation (low amplitude, high velocity thrusts) can affect short-term pain relief (Swedish Council on Technology Assessment in Health Care, 2000). However, most trials investigating spinal manipulation are poorly designed. New evidence is expected to emerge shortly from the UK BEAM (Back, Exercise, Active Management and Manipulation) trial, which is funded by the Medical Research Council (Harvey, 2001). Joint mobilizations are used more often than manipulations to increase movement in peripheral joints, but studies of their efficacy for relieving pain, improving ROM or function have failed to demonstrate their effectiveness (Hurwitz et al, 1996).

Massage of a painful joint is an intuitive reaction to illicit pain relief. Although there are no specific trials investigating massage in OA, massage for back pain has been shown to be no better than manipulation and inferior to TENS for pain relief (Furlan et al, 2000).

## 2.7.8 Acupuncture

The utilization of acupuncture by physiotherapists has gained popularity and about half of all acupuncture treatments are for axial or peripheral OA. Two well-designed trials reported benefits of acupuncture in knee

OA (Takeda and Wessel, 1994; Berman et al, 1999). A recent systematic review of acupuncture for OA of the knee found only limited evidence that acupuncture was more effective than being on a waiting list for treatment or having treatment as usual, in terms of pain and function.

However, it did show that real acupuncture was more effective than sham acupuncture in relieving pain. There was insufficient evidence to determine whether acupuncture was as efficacious as other treatments (Ezzo et al, 2001). Two other systematic reviews, one on chronic pain (Ezzo et al, 2000) and a second specifically on OA (Ernst, 1997) report conflicting results. Importantly, both of these reviews highlighted that studies supporting the efficacy of acupuncture for pain relief tend to be poor quality, whereas well-designed studies suggest there is no benefit or increased pain following acupuncture.

## 2.8 Service Delivery and Organisation of Care

The vast majority (approx. 90%) of patients with OA are managed in the community by their general practitioners (GPs). Physiotherapy is often prescribed for lower limb OA and is usually performed in hospital outpatient departments, but may be carried out in GP surgeries or private clinics. In a study of several conditions, including OA, direct referral by GPs to physiotherapy was shown to be more convenient for patients, reducing patient waiting time, cost per patient treated and recovery time (Stevens, 1997).

The content and length of physiotherapy varies greatly, but typically consists of a short course of individual patient treatment (usually once or twice a week) for 4–6 weeks. This largely involves palliative modalities to reduce pain (e.g. electrotherapy, thermotherapy) combined with a package of care incorporating supervised exercises (on individual patients or small groups of patients) to improve physical function, reassure, advise, educate and encourage self-management. Patients are then discharged, but follow-up appointments to assess continued compliance with exercise and advice are rarely arranged and opportunities for patients to continue exercising in the community are not usually supplied, do not exist, and/or are inaccessible, inappropriate or intimidating for the elderly. In some areas of the UK, regular exercise sessions and support groups are operated on a voluntary basis through charitable organisations, such as Arthritis Care.

Whether this form of management is successful is unknown because no evaluation of the effectiveness of this service delivery has been reported. It is unlikely to be an effective way of managing elderly patients with chronic, variable, slowly progressive conditions such as OA. It is likely that a better management regimen would involve an initial supervised bout of clinically effective physiotherapy modalities, followed by regular (6 monthly or annual) monitoring to check adherence with discharge advice and (if necessary) brief interventions to re-enforce previous treatment and self-management advice.

The effectiveness of spa therapy is also suggested to be partially due to the nature of the service delivery, as patients are removed from their domestic pressures and a more holistic approach to healthcare is taken (Elkayam et al, 1991; Guillemin et al, 1994; Nguyen et al, 1997). A recent review of back and neck pain (Swedish Council on Technology Assessment in Health Care, 2000) reported that intensive treatment in health resorts reduced short-term pain in elderly patients with chronic low back pain.

Whether changing the way a service is delivered enhances or detracts on the effectiveness of physiotherapy for OA has not been evaluated. If shown to be effective the implications and acceptability of implementing these services will need to be considered, as they may have clinical, financial and political implications.

## 2.9 Economic Analysis

OA is a prevalent, incurable, chronic condition for which physiotherapy is frequently prescribed. The costs of physiotherapy management for this condition can therefore be significant. Many of the physiotherapy modalities utilized (hydrotherapy, acupuncture, electrotherapy, manual therapy) are labour intensive, and use expensive, sophisticated equipment and facilities delivered to individual patients in a way that makes these interventions expensive, limits their availability and may be cost-inefficient. Furthermore, these modalities encourage patients to rely on the therapist. When the intervention and therapist are eventually withdrawn, patients can feel helpless and resentful, and their symptoms may be intensified. It would be clinically and financially more desirable to develop service delivery models that encourage and enable patients actively to participate in their management by implementing simple, effective, self-management and coping mechanisms, that result in better care during short-term exacerbations of pain, and effect long-term improvements in disability and independence.

**Box 1. Approaches to economic analysis of health care interventions (Adapted from Sim, 1997)**

Cost-benefit analysis	Cost of intervention is compared to its outcome as expressed in monetary units (e.g. dollars saved)
Cost-effectiveness analysis	Cost of intervention is compared to the outcome as expressed in natural units (e.g. increased function, reduced morbidity, reduced incidence of disease)
Cost-utility analysis	Cost of intervention is compared to its outcome as expressed in utility units (e.g. increase in quality-adjusted life years)
Cost-minimization analysis	Given equivalent outcomes, alternative interventions are compared in terms of their cost, and the least costly intervention identified

There have been few cost analyses (cost-effectiveness, cost-benefit, cost-utility, cost-minimization; see Box 1) of physiotherapy management of OA. There has been some evaluation of costs in respect of exercise and patient education/self-management, the best-researched modalities in which physiotherapists are involved. While efficacious, exercise research regimens tend to be prolonged and labour intensive and therefore expensive. Moreover, compliance with these demanding programmes is likely to be poor, making them cost-inefficient. The effectiveness and costs of those regimens that aim to make exercise intervention easier to perform are likely to be more cost-effective but their clinical and cost-effectiveness has yet to be determined. Patient education and self-management programmes that are shown to be effective also tend to be prolonged and of most use for patients willing to undertake them (Lorig et al, 1993). Their effectiveness for the wider population has not been established. However, less intensive regimens have been shown to be effective in a large community population (Mazzuca et al, 1999). It may well be that management programmes combining self-management and exercises have the best prospects for long-term clinical and cost-effective management.

The cost-effectiveness of hydrotherapy in OA has yet to be established, but in a recent report the costs of hydrotherapy are very high particularly relative to the benefits obtained (Patrick et al, 2001). One study, funded by the NHS Health Technology Assessment Research and Development Programme, is currently looking at the clinical and cost effectiveness of hydrotherapy compared to dry land treatment, but only for children with rheumatological conditions (Epps, 2001).

Future trials of physiotherapy interventions for OA must include cost-analyses to enable providers of healthcare to evaluate their clinical and cost effectiveness.

## 2.10 Conclusions

Physiotherapy is widely used in the management of OA and guidelines encourage its early and prolonged utilization. Unfortunately, the efficacy of interventions is grossly under-researched and methodological flaws limit the inferences we can draw from published trials. There is some evidence for the pain-relieving effect of some modalities (e.g. exercise, thermotherapy, TENS), but not for other frequently used modalities (e.g. electrotherapy, manual therapy). The effectiveness of interventions that aim to improve function and maximize independence (occupational therapy, walking aids, workplace adaptation) also remains very unclear. The clinical effectiveness of individual modalities, complex healthcare intervention and the effect service delivery of interventions has on outcome has not been established.

However, it is very important to appreciate that the style, content and delivery of efficacious physiotherapy regimens must be further developed to establish whether physiotherapy is clinically effective, i.e. whether the intervention is effective when delivered to typical patients and under typical clinical conditions. This will establish practice-based evidence of relevant and clinically effective healthcare.

In addition, non-pharmacological management rarely involves single treatment modalities but is composed of a complex package of healthcare interventions, integrating individual treatment modalities with exercise, patient education, reassurance and self-management advice, which collectively control pain and improve function.

## 2.11 Practice Points

- In the management of OA physiotherapy is popular with patients, safe and widely used. Its early and prolonged utilization is recommended in clinical guidelines.
- Modalities are not administered in isolation but in combination with other interventions.

- Exercise is very frequently employed and has been shown to be effective in relieving pain and improving function.
- Hot and cold packs, lateral shoe wedges, TENS and acupuncture have also been shown to relieve pain.
- There is no, or very weak, evidence for the efficacy of other physiotherapy interventions (e.g. electrotherapy, manual therapy).
- The way in which an intervention is delivered may influence outcome and patient satisfaction.

## 2.12 Research Agenda

It is essential that well-designed clinical trials be performed to establish the efficacy of physiotherapy modalities in the management of OA. However, the results of efficacy studies may lead to erroneous conclusions regarding their role in complex healthcare interventions, such as physiotherapy, in the management of OA. These interventions usually involve clinicians delivering a package of healthcare that utilizes more than one modality or profession, and aims to influence complex physical and psychosocial variables that are nebulous and subjective (e.g. pain, disability, quality of life, health beliefs, work capacity). Efficacy studies of isolated aspects of patient management, while beneficial, will tell us little about the effectiveness of complex healthcare interventions, and may miss important clinical issues.

- Most physiotherapy interventions used in the management of OA require rigorous evaluation.
- Establishing the efficacy of individual modalities used in isolation may be of some value, but because physiotherapy is usually delivered as a package of healthcare the clinical effectiveness of physiotherapy – assessed on patients who will typically receive the interventions and in the context that physiotherapy will normally be delivered – will be more enlightening and clinically relevant.

## 3.0 Rheumatoid Arthritis

### 3.1 Definition

Rheumatoid arthritis (RA) is a systemic, autoimmune, inflammatory disease that primarily affects the peripheral synovial joints, causing chronic, symmetrical, erosive synovitis. This results in articular destruction, muscle dysfunction and pain, leading in turn to functional impairment and physical dependence (Ekdahl and Broman, 1992b; Badley and Tennant, 1993; Harwood et al, 1996).

### 3.2 Prevalence and Incidence

RA affects approximately 0.5–1% of the UK population (Scott et al, 1998). In adults, the incidence of inflammatory arthritis (mostly RA) is 50/100,000 per year (Scott et al, 1998). It is three times more prevalent in women than in men and the peak age of onset is usually in the sixth decade. The increasing prevalence with age results in as many as 5% of women over the age of 70 having RA in the UK (Joint Working Group of the British Society for Rheumatology and the Research Unit of the Royal College of Physicians, 1992).

### 3.3 Aetiology

The aetiology of RA is unknown, but there is evidence a combination of genetic and environmental factors act as triggers for the disease (Silman et al, 1993).

Family studies indicate severe RA is found at approximately 4 times the expected rate in first degree relatives of RA patients and twin studies suggest the genetic concordance in RA is 15–30% (Silman et al, 1993).

In addition, environmental factors e.g. infectious antigens, viruses and retroviruses have been widely investigated as possible causative or amplifying agents in RA, although, to date, no causative aetiological agent has been identified for RA.

### 3.4 Diagnosis and Clinical Features

The onset of RA is usually insidious, occurring over several weeks, although 8–15% of patients experience an acute onset of symptoms, which develop in a few days.

As no specific laboratory tests are available to define the disease, the diagnosis of RA is based on the presence or absence of a combination of clinical, laboratory and radiological features defined by the American College of Rheumatology (Arnett, 1988).

Persistent active synovitis of specific joints is the central diagnostic feature of RA. Early RA usually involves synovial inflammation of the metacarpophalangeal (MCP) joints, proximal interphalangeal (PIP) joints, wrists and feet. Systemic features of ill health such as malaise, weight loss and intermittent fever often accompany the synovitis.

Later in the disease, typical features include morning stiffness, fatigue, pain and inflammation of many synovial joints. The symptoms may exacerbate and remit – characteristic disease ‘flares’. As the arthritis progresses, joint destruction – due to subchondral cyst formation, cartilage destruction and bony erosions – may lead to joint instability and characteristic deformities e.g. Swan neck and Boutonnière deformities of the fingers.

Associated extra articular features include subcutaneous nodules, muscle atrophy, myositis, vasculitis, pericarditis and osteoporosis.

### **3.5 Risk Factors**

In addition to the genetic factors that play a role in the development of RA, the predominance of RA in women, and the remission of the disease during pregnancy, suggests gender (hormonal or reproductive factors) may be a predisposing factor for RA. Other socio-economic factors such as stress and education may also influence its onset (Sangha, 2000).

### **3.6 Prognosis**

Despite its destructive potential RA has a variable disease course. Some patients experience only a brief, mild oligoarthritis with minimal joint damage, but most (55–70%) patients with progressive RA will exhibit joint destruction at some point during the disease course. However, a proportion of patients (less than 20%) with extremely aggressive arthritis may experience erosive changes within two years of disease onset (Wilske, 1996). Mortality is increased in RA patients (Corbett et al, 1993; Symmons, 1994; Turesson et al, 1999).

### **3.7 Aims of Treatment**

The management of RA aims to control symptoms, and prevent or minimize joint erosions and damage, thereby maintaining physical capacity and preventing disability. It involves a combination of pharmacological treatment, physical therapy and, if necessary, surgical intervention. The physiotherapy management of RA aims to relieve pain and stiffness, prevent deformity, maximize function and provide education and advice to enable self-management.

### **3.8 Specific Physiotherapy Interventions**

#### **3.8.1 Exercise Therapy**

Exercise is the cornerstone of physiotherapy treatment for RA. It aims to improve motor function, particularly muscle strength, by repetitive muscle overloading. Traditionally, isometric exercise, which results in moderate strength gains, has been used to treat patients with inflammatory RA, due to fears dynamic exercise may exacerbate pain and disease activity, damage delicate periarticular tissues (Ytterberg et al, 1994) and contribute to joint destruction (Blake et al, 1989; Dekker et al, 1993). There is some biochemical evidence to support these concerns and it is postulated that exercise may cause persistent synovitis in RA patients by the mechanism of ‘hypoxic reperfusion injury’ (Merry et al, 1988; Blake et al, 1989; Bodamyali et al, 1998). This implies that physical activity and exercise may hasten articular destruction and is detrimental to RA patients.

However, there is a growing body of evidence supporting the efficacy and safety of dynamic exercise in RA patients. Improvements in physiological variables (e.g. muscle strength, aerobic capacity, endurance and function) and psychological measures (self efficacy, well being) following dynamic exercise regimens have been reported (Ekblom et al, 1975a; Nordemar et al, 1981; Minor et al, 1989; van den Ende et al, 1996; Bearne et al, 2002). The findings of a recent systematic review confirm dynamic exercise therapy is efficacious for patients with RA (van den Ende et al, 1998a). Furthermore, several trials report no exacerbation of clinical disease activity (Minor et al, 1989; Ekdahl, 1990; Kirsteins et al, 1991; Hakkinen et al, 1994; Lyngberg et al,

1994; Daltroy et al, 1995; van den Ende et al, 1996; Noreau et al, 1997; Sanford-Smith et al, 1998) or acceleration of joint destruction following exercise, challenging the suggestion that exercise is detrimental to RA patients (Nordemar et al, 1981; Stenstrom et al, 1991; Hansen et al, 1993; Hakkinen et al, 1994; Bearne et al, 2002).

Unfortunately few clinical trials adequately analyze the biochemical effect of exercise in RA (Hazes and van den Ende, 1996) and although some studies show no increase in biochemical inflammatory markers (e.g. proinflammatory cytokines) following exercise, most have very small sample sizes (Baslund et al, 1993; Rall et al, 1996).

A large randomized, controlled trial evaluating exercise in RA, that concurrently measured clinical and biochemical parameters of disease activity, confirms the findings of these previous smaller studies that exercise does not exacerbate disease activity in patients with stable RA (Bearne et al, 2002).

Although there is a growing body of evidence to support the safety and efficacy of exercise in inflammatory arthritis, many exercise studies have serious methodological weaknesses – e.g. lack of randomization, poor control groups, poor allocation concealment. These methodological flaws limit interpretation of the findings and the inferences we can make from them (Dekker et al, 1993; van den Ende et al, 1998). Furthermore, a variety of subject selection criteria, outcome measures and follow up protocols are employed and key goals (e.g. functional performance and disability) are not evaluated (Stenstrom, 1994; Hazes and van den Ende, 1996). This creates difficulties in the comparison of data and in establishing an appropriate exercise regimen for patients with RA (Stenstrom, 1994).

Additionally, few studies evaluate the effect of exercise in patients with active disease (van den Ende, 1998) and the effect of long term exercise or the long-term effect of a short exercise programme is rarely measured (Nordemar et al, 1981; Stenstrom et al, 1991; Hansen et al, 1993).

Implementation of training programmes within clinical practice is further hampered by the multitude of treatment protocols employed, which are often lengthy (more than 12 weeks) and utilize expensive equipment. This makes them costly and impracticable.

### 3.8.2 Hydrotherapy / Balneotherapy

Hydrotherapy produces physiological (Chu and Rhodes, 2001), functional (Minor et al, 1989; Stenstrom et al, 1991) and psychological benefits (Hall et al, 1996) in RA patients. Many of these studies suffer the methodological flaws highlighted in the review of balneotherapy studies (Verhagen et al, 1997). Long-term hydrotherapy reduces the rate of hospital admissions and does not increase joint destruction, suggesting prolonged treatment is not detrimental to RA patients (Stenstrom et al, 1991). However, it is not suitable for all RA patients due to contra-indications and the cost of hydrotherapy reduces its widespread availability.

### 3.8.3 Bedrest

Historically, prolonged bed rest and joint immobilization in hospital were utilized to control disease activity (Ropes, 1961). Although effective in the short term for acute disease flares, bed rest does not alter the course of the disease in the long term and may exacerbate the deleterious musculoskeletal effects of RA, such as muscle weakness and osteoporosis (Scott and Wolman, 1992; Ytterberg et al, 1994). Therefore current recommendations suggest patients with RA should 'rest acutely inflamed joints and if [the] arthritis is especially active, a short period of bed rest in hospital may help' (Scott and Wolman, 1992). Patients may also be advised to rest at home. However, they should not stay in bed for more than 48 hours without consulting a doctor.

### 3.8.4 Thermotherapy

As with OA, heat and cold are used to relieve pain and reduce stiffness, muscle spasm and swelling. In the short term, both heat and cold appear to be useful in managing pain and stiffness (Minor and Sanford, 1993), although heat may be more effective at reducing stiffness (Dellhag et al, 1992) and cold superior at pain relief (Hayes, 1993).

A Cochrane Review found thermotherapy to be effective, safe and recommended its use (Welch et al, 2000). Neither heat nor cold therapy has deleterious effects on disease progression and there is little evidence that alteration of joint temperature has any impact on joint destruction (Hayes, 1993). Heat is not usually

recommended for active joints and ice tends to be preferred by patients at these times. As heat and cold therapy can be applied easily at home, these treatments provide patients with a convenient means of gaining short-term relief of symptoms. However, heat is not usually recommended for use on active joints and ice is usually preferred by the patient.

### 3.8.5 Joint Protection and the Provision of Walking and Disability Aids / Splinting

The provision of walking aids (sticks or crutches) to reduce lower limb loading during weight-bearing are effective in relieving pain and improving mobility in RA patients. However, redistribution of load to the small joints of the upper limbs, which are very often affected by the disease process, may increase upper limb joint pain and damage, necessitating the use of especially designed walking aids, e.g. gutter frames and Fisher sticks. These aids also suffer the same compliance problems as reported for OA because perceptions of the walking aids making the patient feel old and infirm, and limits their upper limb function.

Splinting can reduce pain and improve function (Callinan & Mathiowetz, 1996; Kjekken et al, 1995; Pagnotta et al, 1998; Stern et al, 1996). Unfortunately these studies are small, underpowered and have methodological flaws that undermine their results, thus better designed studies are required to validate their findings. In addition splinting is usually applied by occupational therapists (OTs), and the relevance to physiotherapists is limited, but in small departments without adequate OT input, physiotherapists who have been trained may supply splints.

### 3.8.6 Patient Education and Self-Management

The role of patient education and self-management is as important in RA as it is in OA, and the important studies demonstrating the benefit of patient education and self-management usually use a mix of OA and RA patients (Lorig et al, 1993). Although physiotherapists have a vital role in patient education regarding the importance of exercise, physical activity and joint protection advice, because RA patients are usually managed in specialist rheumatology centres the lead in patient education and self-management frequently falls on clinical nurse specialists in these departments. Physiotherapists should liaise closely with rheumatology nurses and occupational therapists to ensure all the healthcare team are reinforcing the correct advice about exercise and physical activity

### 3.8.7 Electrotherapy

There are many electrotherapy modalities (e.g. interferential, ultrasound, laser) used to treat synovitis and pain in RA patients although the effectiveness of these forms of treatment is uncertain, as many are poorly evaluated (Minor and Sanford, 1993). Many of these modalities have been reviewed in the section on OA, and have been shown to have little if any effect (Gam and Johannsen, 1995; van der Windt et al, 1999; Beckermen et al, 1992; de Bie et al 1998; Brosseau et al, 2000). As with OA, of the various forms of electrical stimulation proposed for pain relief TENS has undergone most extensive research (Kumar and Redford, 1982; Levy et al, 1987) and it is widely accepted as an effective method of pain control for RA and can be applied and controlled by the patient at home, after appropriate education (Minor and Sanford, 1993). However, better designed studies are required to confirm the usefulness of TENS.

### 3.8.8 Acupuncture

Acupuncture has been used in the treatment of RA, but there are few well designed trials to support its use (Berman et al, 2000). A systematic review of acupuncture for chronic pain suggests well designed trials do not support the use of acupuncture for pain relief (Ezzo et al, 2000).

## 3.9 Service Delivery and Organisation of Care

Currently, most RA patients are managed by regular, specialist, rheumatology follow-up, where consultants review the medical treatment of the patients and clinical nurse specialists monitor drug effects. The rate and reason for referral to physiotherapy by rheumatologists is decided on an ad hoc basis because there are no studies that have led to guidelines suggesting the best time for initial or subsequent referral to physiotherapy. Consequently, referral patterns (timing and reasons) may vary from unit to unit. Physiotherapy management should follow the CSP core standards (CSP, 2000).

### 3.9.1 Physiotherapy During Inpatient Admission

Patients are admitted to hospital during an acute disease exacerbation or for surgery. Following an assessment and goal setting, physiotherapy may include appropriate symptom relief, rehabilitation (e.g. strengthening and gait retraining), education, the provision of a home programme, and then follow-up with regular monitoring as an outpatient. There are no audits confirming this is taking place, or research to establish if it is effective.

### 3.9.2 Physiotherapy on an Outpatient Basis, Including Primary Care

Outpatient physiotherapy may be prescribed for a specific problem, which may be delivered in an acute or community hospital department or GP surgery. There are few data about which patients are referred, at what stage, how frequently they are referred, or whether single, regular or no referrals has any effect on the patient's pain, disability, short or long term outcome or progress of the disease. A recent study demonstrated that physiotherapy comprising of education, exercise and pain relief modalities, delivered in the community, improved patients' understanding of their condition and decreased morning stiffness (Bell et al, 1998), and that these improvements can be maintained for one year (Lineker et al, 2001).

## 3.10 Economic Analysis

The cost of managing RA is high (Magnusson, 1996). In 1992, an independent economic review, taking a societal perspective (the total cost to all parties), estimated the total annual cost of RA in the UK to be £1.25 billion. More recently, the annual cost of RA was calculated to be between £0.8 billion and £1.3 billion (Department of Health 1996). This expense is partially offset by effective disease control, which increases productivity (Magnusson, 1996; Clarke et al, 1999). There are no studies that have formally evaluated cost effectiveness of physiotherapy treatment of RA, although, the efficacy and cost effectiveness of self-management programmes (many elements of which are incorporated into physiotherapy management) suggest this is effective for patients with RA (Lorig et al, 1993).

## 3.11 Conclusions

Physiotherapy has an important role in the management of RA and aims to maximize function and reduce disability. Whilst exercise is the cornerstone of physiotherapy treatment for RA, many other modalities (e.g. electrotherapy, hydrotherapy, thermotherapy) are commonly used. Some of the treatment techniques have well designed studies to support their use (exercise therapy, thermotherapy, TENS). However, many have little evidence to confirm their effectiveness (acupuncture, electrotherapy, balneootherapy, joint protection). Additionally, many of these studies are methodologically flawed (e.g. lack of randomization, poor control groups, poor allocation concealment) and the variety of subject selection criteria, outcome measures and follow up protocols used hampers comparison of data and establishment of appropriate treatment regimens.

As the cost of managing RA is high, further research is essential to determine the efficacy and cost effectiveness of physiotherapy treatment and to establish appropriate intervention strategies (reasons, frequency and timing of referral to physiotherapy) to optimise physiotherapy service delivery.

Physiotherapists play an extremely important role in the multidisciplinary team who look after patients with RA, providing specific advice to patients, but also supporting and reinforcing the advice given by other members of the team – the doctors, nurses, OTs and podiatrists who contribute to these patients healthcare.

## 3.12 Practice Points

- Rheumatoid arthritis is an auto immune, systemic disease that causes pain, articular destruction and disability.
- Physiotherapy aims to reduce pain and stiffness, prevent deformity, maximize function and provide patient education and advice.
- In the short term, exercise therapy is effective and safe for patients with RA.
- Currently there is some evidence to support the use of other physiotherapy treatment modalities (thermotherapy, TENS) but only weak support for the use of electrotherapy, hydrotherapy, acupuncture and disability aids.

- There are no clear guidelines recommending the optimum time for physiotherapy intervention, consequently access to physiotherapy for RA patients varies from unit to unit.

### **3.13 Research Agenda**

- Well designed studies are needed to evaluate the efficacy and safety of physiotherapy treatment of RA (electrotherapy, hydrotherapy, acupuncture and disability aids).
- The long-term effect of all physiotherapy modalities needs to be established for this chronic disease (duration of over 20 years).
- Evaluation of the optimum time for physiotherapy intervention should to be established to ensure appropriate patient management and optimize service delivery.
- Further studies are needed to assess the effectiveness of walking aids.
- The cost effectiveness of all physiotherapy treatments requires investigation.

## **4.0 Osteoporosis**

### **4.1 Definition / Statement of the Problem**

Osteoporosis is a disease of the skeleton, characterized by low bone mass, leading to reduced bone strength and increased risk of fractures. It primarily affects post-menopausal women, although younger women and men are also affected. The World Health Organization (WHO) has defined osteoporosis, on the basis of bone mineral density (BMD), as follows:

- normal (within 1 standard deviation (SD) of young adult reference mean),
- osteopenia (more than 1 SD below young adult reference mean, less than 2.5 SD below this value)
- osteoporosis (2.5 SD or more below young adult reference mean).

The most common outcome is fracture of the hip, spine or forearm (Sedrine et al, 2001).

Osteoporosis is a common disease associated with ageing and the menopause. It is recognized as one of the major health and socio-economic problems worldwide. The two main determinants of risk of osteoporosis are peak bone mass (reached in the third decade of life) and bone loss thereafter. Bone mass is of importance for strength of bone and risk of fracture (Castelo-Branco, 1998). Physical activity is a determinant of peak bone mass and activity in later life can reduce age-related bone loss (Henderson et al, 1998).

### **4.2 Prevalence**

Osteoporosis affects 30% of post-menopausal white women in the USA (9.4 million women) and up to 70% in women over the age of 80 years (Melton, 1995). In the UK 1 in 3 women and at least 1 in 12 men will develop osteoporosis during their lifetime (Cooper et al, 1992a).

### **4.3 Risk Factors**

Risk factors include: genetic predisposition, poor nutrition in youth, early onset of the menopause, low vitamin D intake or limited exposure to sunlight, low calcium, alcohol use and smoking, caffeine consumption, low weight and lack of regular exercise (Kisely, 1996). Osteoporosis is associated with corticosteroid use and inflammatory arthritis (e.g. rheumatoid arthritis and ankylosing spondylitis). Fracture risk increases greatly with age and is generally higher in women than in men, and in whites than in other races (Black and Cooper, 2000).

### **4.4 Prognosis**

The most serious sequel of osteoporosis is hip fracture, which is responsible for substantial mortality, particularly in the first 6 months after fracture (Cooper et al, 1993; Sedrine et al, 2001), and morbidity, related to loss of independence and need for long term care (Ray et al, 1997).

Epidemiological studies indicate 26 million American women are at risk of osteoporotic fracture (Gabriel, 1996). Worldwide in 1990 there were an estimated 1.66 million hip fractures (Cooper et al, 1992b; Gullberg et al, 1997; Sedrine et al, 2001) and it is predicted that this will increase to 6.26 million by 2050 (Gullberg et al, 1997). Osteoporosis is estimated to cause 1.5 million fractures annually in the USA in people aged 50 years and older (Layne and Nelson, 1999). Half of all elderly people admitted to hospital with a hip fracture never regain former functional levels. In 1996, 340,000 admissions for hip fractures were in 65 year olds and over, and 80% in women. Women of 85 years and older are nearly eight times more likely than 65–74 year olds to be admitted (Stevens and Olson, 2000).

It is estimated that a lifetime risk of fracture in the hip is 17.5% in white women and 6% in white men. An overall reduction in survival of 15% follows hip fracture, the majority of deaths occurring in the first 6 months following fracture. The lifetime risk of clinically diagnosed vertebral fractures is about 15% in white women. Around one quarter of clinically diagnosed vertebral deformities result in hospitalization (Dennison and Cooper, 2000).

In the elderly, osteoporotic fractures are a major cause of morbidity and cost. There is an age-related increase in incidence of hip fractures, resulting in a one-year incidence of 1% in women aged 80 in western countries. The incidence of wrist fractures reaches a plateau at age 60–70 years (De Laet and Pols, 2000). Improvements in life expectancy, coupled with trends in inactivity in youth, will lead to a growing population of older people with increased risk of hip fracture (Gullberg et al, 1997; Cooper et al, 1992b; Sedrine et al, 2001).

## 4.5 Aims of Treatment

The main aims of non-pharmacological intervention are to prevent osteoporosis and osteoporotic fracture (primary prevention), and to treat or alleviate the consequences of osteoporosis and fracture should it occur. Physiotherapists have a role in exercise prescription, therapeutic treatments and techniques, and education. Goal setting following detailed assessment of signs, symptoms, risk factors and functional ability is of importance. In older adults with osteopenia or osteoporosis the aim of physiotherapy is to maintain bone mass, reduce the risk of falls, improve posture, reduce pain, and improve mobility and function (Bennell et al, 2000). In older adults with immobility, activities to improve functional independence, preserve bone mass and prevent further decline are of the utmost importance. Following a fracture physiotherapy can assist with mobilisation of the patient, reduction of muscle spasm and pain, and improving balance and co-ordination. In the very elderly the occurrence of falling may be more important than a failure in the bone strength.

## 4.6 Specific Interventions

The CSP and the National Osteoporosis Society (NOS) have endorsed physiotherapy guidelines for the management of osteoporosis (CSP, 1999). The development of the guidelines has been managed under the guidance of the Glasgow Royal Infirmary Physiotherapy Department. Systematic search strategies covering exercise and other interventions for prevention and control of osteoporosis led to development of key evidence statements and recommendations for the management of osteoporosis. These guidelines should be used alongside this report.

### 4.6.1 Health Promotion, Disease and Fracture Prevention

This report focuses on the evidence for older adults, but the majority of preventative initiatives should be targeted in youth (Goldberg and Chavin, 1997). Dietary calcium intake, exercise, hormone replacement therapy (HRT), bisphosphonates, calcitonin, anabolic steroids, SERMS (Selective Estrogen Receptor Modulators), sodium fluoride and vitamin D are used as therapeutic strategies (Hallworth, 1998).

The frequency of osteoporosis in older women may be modified by implementation of therapeutic strategies in pre- and peri-menopausal ages. Lifestyle risk factors include misuse of alcohol, smoking, physical inactivity, and imbalance of dietary intake (Sowers, 2000).

For details on the prevention and management of falls in the elderly readers are referred to the report by Lamb (2001).

## 4.6.2 Exercise

A systematic search (see para 1.3) identified reviews of the effectiveness of exercise on BMD and osteoporotic fractures, and was limited to those abstracts published 1998–2000 involving older adults over the age of 50 years. A review of reviews (appendix 1) summarizes the evidence for exercise in osteoporosis (1998–2000) in relation to maintaining BMD and preventing fractures. This builds on the evidence used in the development of the CSP guidelines (CSP, 1999).

Exercise can improve muscle strength and balance in the elderly, so as to minimize the risk of falls. Low impact exercise programmes are a useful adjunct to pain-relieving modalities in physiotherapy treatment of osteoporotic fractures (von Feldt, 1997).

The type of exercise, e.g. aerobic exercise, balance exercises, and when they are to be recommended, is not considered in detail here, but the reader is directed to the CSP guidelines (CSP, 1999).

The overall conclusion is that exercise is an effective treatment in osteoporosis in older adults. Low impact exercises designed to improve muscle strength and balance aim to prevent fractures by reducing the risk of falls (Turner, 2000). Special adaptations for older patients, like low-intensity exercises (fewer repetitions), low impact exercises (cycling, exercise whilst seated), and modified equipment (lighter weights, correct footwear and clothing), should be considered. Motivation of older people and sustaining participation in exercise programmes are additional considerations (Petrella, 1999). Elderly women have more barriers than other groups, possibly because of higher disability rates. Potential barriers need to be taken into account in planning exercise programmes for older women (Taunton et al, 1997).

Walking is ideal for most patients, but especially for the inactive and mobile elderly person, building up independence and social well-being. Levels can be increased according to each individual's abilities (Morris and Hardman, 1997).

Additional benefits of regular exercise include: improved bone health, reduction in risk for osteoporosis, improved postural stability, reduced risk of falls and associated injuries and fractures, increased flexibility and range of movement. It also helps to improve a number of psychosocial factors (Mazzeo et al, 1998).

## 4.6.3 Pain Relief

Pain relieving modalities, although without a substantial evidence base, are used by physiotherapists for individual cases as appropriate. Again, detail is provided in the clinical guidelines (CSP, 1999).

## 4.7 Service Delivery and Organisation of Care

A year after the publication of the CSP osteoporosis clinical guidelines, an integrated physiotherapy and exercise service for people with osteoporosis was officially launched in Glasgow. Following referral of appropriate patients to the physiotherapist and assessment, there are options for management, including individual treatment, participation in physiotherapy-led exercise programmes in acute hospital sites, attendance at community-based exercise classes and advice or home exercise programmes. A part-time specialist physiotherapist coordinates the different elements in various settings. It is estimated that up to 600 patients will be in contact with the physiotherapy service in one year.

The implementation of the physiotherapy guidelines into clinical practice has been recognized as an example of excellence in putting evidence based guidelines into practice. The physiotherapy team from Glasgow were awarded the Frontline Excellence Award for 2000 (Chadda, 2001).

## 4.8 Economic Analysis

As life expectancy has increased, so has incidence of post-menopausal osteoporosis, and this not only impacts on the quality of life of the individual, but has a significant economic impact in terms of public health. Preventative strategies may be more cost effective than screening for the disease (Hallworth, 1998).

Osteoporosis is associated with significant morbidity, mortality and economic costs relating to admission to hospital and long term nursing care. In 1995, the health care expenditure attributable to osteoporotic fracture in the USA was estimated at \$13.8 billion (Ray et al, 1997; Sedrine et al, 2001). Hip fracture affects around 57,000 people per year in the UK (Hollingworth et al, 1995). The average cost of inpatient admission in women aged 75 is £12,000 (Dolan and Torgerson, 1998). The total cost to the NHS is estimated to be about

£280 million (Hollingworth et al, 1995). Hip fractures account for more than 20% of orthopaedic bed occupancy in the UK (Cryer et al, 1993).

Randell et al (1995) examined the direct costs associated with osteoporotic fractures (1989–1992) in 151 men and women studied as part of a large cohort of elderly subjects (Dubbo osteoporosis epidemiology study, Australia). They reported median costs of hospital treated fractures as \$A10 511 per fracture, and \$A455 for outpatient managed fractures. Rehabilitation hospital costs were the largest proportion of hospital treated fracture costs (49%). Community services were the major cost of outpatient treated fractures (40%). Interestingly, quadriceps strength was shown to be the best overall predictor of costs. Extrapolation of these figures suggests direct cost may increase twofold in most western countries by 2025. Reducing costs by fewer hospital admissions and greater efficiency in community rehabilitation is desirable.

Geelhoed et al (1994), in a hypothetical model, compared the cost effectiveness of four interventions (oestrogen aged 50 for life, aged 50 for 15 years, from aged 65 years for life and a lifestyle programme, which included exercise). The lifestyle intervention programme was the most expensive but was sensitive to the cost of exercise reducing cardiovascular mortality as well as hip fracture.

## 4.9 Conclusions

Osteoporosis is a common and serious disease that can lead to fractures, causing substantial morbidity and mortality in older adults. Important risk factors can be identified and there is now ever increasing evidence of the importance of activity and exercise at all ages. Physiotherapists are well placed to provide a dynamic service for older people, in all settings, primary and secondary care, and in the community as a whole, to complement other pharmacological and non-pharmacological interventions. Exercise tailored to individuals and groups at every stage of the disease should help to combat its serious consequences.

## 4.10 Practice Points

- Osteoporosis is a common disease, affecting women more than men and is associated with numerous risk factors e.g. lack of regular exercise. It is prevalent in the older population.
- Physiotherapy aims to prevent osteoporosis, increase and maintain BMD, and treat and alleviate the consequences of osteoporosis.
- Therapeutic strategies need to start in youth.
- Exercise is an effective treatment in older adults with osteoporosis.
- The needs of the individual must be considered in planning and implementing exercise interventions.

## 4.11 Research Agenda

- Effectiveness of community based exercise programmes in pre and postmenopausal adults needs evaluating with long term follow up.
- Impact of osteoporosis in elderly men needs to be explored.
- Effectiveness of pain relieving strategies needs evaluating.

## 5.0 Polymyalgia Rheumatica

### 5.1 Definition

Polymyalgia rheumatica (PMR), first described in 1888 (Cimmino and Salvarani, 1995), is a connective tissue disorder characterized by symmetrical, bilateral pain and stiffness, localized to the neck, shoulder girdle and pelvic girdle. Tenderness is characteristically present in the painful areas (Hazleman, 1997). The condition is closely linked with giant cell arteritis (GCA), and the diagnostic criteria for the two diseases developed by Jones and Hazleman (1981) are shown in Table 1.

Table 1. Diagnostic criteria for PMR and GCA according to Jones and Hazleman (1981). CRP = C-reactive protein, ESR = erythrocyte sedimentation rate

<b>Polymyalgia rheumatica</b>	<b>Giant cell arteritis</b>
Shoulder and pelvic girdle pain, which is primarily muscular in the absence of true muscle weakness	Positive temporal artery biopsy or cranial artery tenderness
Morning stiffness	One or more of the following: visual disturbance, headache, jaw pain, cerebrovascular insufficiency
Duration of at least 2 months unless treated	ESR over 30 mm/hr or CRP over 6µ/ml
ESR over 30 mm/hr or CRP over 6µ/ml	Response to systemic corticosteroids
Absence of rheumatoid or inflammatory arthritis, or malignant disease	
Absence of objective signs of muscle disease	
Prompt and dramatic response to systemic corticosteroids	

Differential diagnoses include osteoarthritis, rheumatoid arthritis, fibromyalgia, polymyositis, hypothyroidism, other vasculitides, connective tissue disorders such as systemic lupus erythematosus, and various neoplastic diseases. Gamez-Nava et al (1998) suggest that there may be low levels of diagnostic agreement between primary care physicians and rheumatologists in respect of PMR.

## 5.2 Prevalence

PMR is more common than GCA (Panayi, 1998), though up to 50% of patients with PR also have GCA (Guerrero and Fang, 1999). The condition primarily affects older, white populations, displays an approximately two-fold female preponderance, and onset may be dramatic or insidious (Hazleman, 1997). Reliable incidence and prevalence figures are hard to obtain, owing to the overlap of PMR with GCA, the use of different diagnostic and classification criteria, and the varying susceptibility of different age and racial groups. In a North American study, Chuang et al (1982) report age-specific incidences of 19.8/100 000 for those in the fifties and 112.2/100 000 for those in the seventies. According to Dasgupta and Kalke (2000), annual incidence rates reported by individual studies range from 12.7 to 68.3 per 100 000 persons aged 50 or over.

## 5.3 Aetiology

An increased frequency of the HLA-DR4 antigen in patients with PMR suggests a possible immunogenetic susceptibility to the disease (Cid et al, 1988; Sakkas et al 1990). The lower frequency of HLA-DR4 in black populations may explain, at least in part, their lower susceptibility to PMR than white populations.

## 5.4 Clinical Features

Patients with PMR usually display proximal stiffness and pain in the neck, shoulder girdle and pelvic girdle. Marked and prolonged morning stiffness is a prominent symptom (Panayi, 1998). Although muscle weakness is not considered part of the condition, pain evoked by muscular contraction makes objective strength testing difficult. In addition to musculoskeletal symptoms, patients may present with pyrexia, anorexia, fatigue and weight loss. With coexisting GCA, headache, temporal tenderness and visual disturbance are likely.

## 5.5 Prognosis

Prognosis is generally considered good in PMR (Chuang et al, 1982; Myles, 1991). Schreiber and Buyse (1995) propose that the initial response of C-reactive protein to steroid therapy may be a prognostic indicator. In contrast, ESR may be an unreliable indicator (Kyle and Hazleman, 1989a). Prognosis appears to be poorer in patients who have GCA as well as PMR (Kyle and Hazleman, 1993).

## 5.6 Aims of Treatment

Pharmacological management of PMR aims to reduce pain and influence inflammatory disease processes. Physiotherapy aims to relieve pain and stiffness and maximize function.

## 5.7 Specific Interventions

### 5.7.1 Pharmacological Therapy

Corticosteroids are first line management in PMR, and Hazleman (1997) regards them as 'mandatory'. Indeed, dramatic response to steroids is seen as an important diagnostic marker of PMR (Vaile and Davis, 1998). Weyand et al (1999) argue that patients with PMR can be classified into different groups according to their disease activity and consequent requirement for steroid therapy.

In a double-blind trial (n=20), Salvarani et al (2000) showed that, compared to placebo, local corticosteroid injection to the shoulder provides good relief of pain and morning stiffness, and favourable changes in biochemical markers of disease.

Steroid therapy may give rise to complications (Box 2), which physiotherapists should be aware of. Gabriel et al (1997) studied 232 patients with PMR who were on steroid therapy, non-steroidal anti-inflammatory therapy, or both, with a mean follow-up of eight years. They found that 65%, 67% and 80% of the three groups respectively had experienced at least one adverse event. Dasgupta et al (1998), in a 96-week study of 60 patients, found intramuscular steroid administration to be associated with comparable long-term clinical benefit to that of oral administration, but with fewer side effects.

Other pharmacological agents used include methotrexate, azathioprine and nonsteroidal anti-inflammatory drugs (Kyle, 1991; Hazleman, 1997; Gran, 1999).

<b>Box 2. Principal complications of steroid therapy (Kyle and Hazleman, 1989b; Hazleman, 1997)</b>	
Weight gain	Skin atrophy
Oedema	Raised intraocular pressure
Cataracts	Diabetes mellitus
Gastrointestinal disturbance and bleeding	Osteoporosis
Mood change	Steroid resistance
Poor disease control (if dosage is inadequate or inexpertly titrated)	

### 5.7.1 Physical Therapy

There have been no systematic evaluations of physical modalities in PMR, and recommendations on the management of this condition tend to focus solely on pharmacological interventions (Hazleman, 1997; Panayi, 1997; Dasgupta and Kalke, 2000). Evidence exists, however, in relation to non-specific regional musculoskeletal symptoms (Hay et al, 1999; van der Heijden, 1999), and this can plausibly be extrapolated to PMR. Equally, local modalities reviewed in Sections 2 and 3 of this report, in relation to osteoarthritis and rheumatoid arthritis, may be indicated. The absence of evidence for specific physical interventions in PMR is not, therefore, a reason for physiotherapists not to be involved in the care of this client group (Altman and Bland, 1995).

Chadwick (1999) provides guidance as to how usual physiotherapeutic modalities can be applied to patients with vasculitides:

#### Pain relief

- general – hydrotherapy
- local– hot packs, transcutaneous electrical nerve stimulation.

#### Exercise

- mobilizing exercise for both lower and upper limbs
- strengthening exercises for pelvic and should girdle musculature
- aerobic exercise to improve exercise tolerance
- functional exercise and reeducation.

A key consideration in selecting a management strategy is the role of pain inhibition leading to muscle atrophy and joint stiffness, and the consequent value of pain management strategies. It should be remembered that the patient will in most cases have been on steroids and, depending on the dose and duration of treatment, this may contraindicate certain forms of physical therapy, such as inadequately controlled high-resistance exercise, high-grade mobilization or manipulation, or those modalities for which steroid-induced skin atrophy would constitute a contra-indication.

## 5.8 Outcome Measures

Outcome measures specific to PMR do not seem yet to have been developed, and most treatment effectiveness studies have relied heavily on indices of disease activity and straightforward symptom reporting. The Health Assessment Questionnaire has been shown to be responsive to change and to correlate with indices of disease activity in PMR (Kalke et al, 2000).

## 5.9 Conclusions

Overall, management of PMR in the acute stage should be directed at the presenting signs and symptoms, and be guided by disease indicators. In the longer term, attention to pain-management, energy conservation and functional reeducation are likely to be appropriate. It should be noted that steroid therapy is likely to be discontinued after about two years in a large proportion of patients (Hazleman, 1997), and after this point the onus for effective management may lie increasing on physical approaches.

## 5.10 Practice Points

It is usually appropriate to offer reassurance on the generally good outcome for PMR. Interventions commonly used in the treatment of conditions such as OA and RA can usually be applied to this population. Physiotherapy should be based on a functional problem-solving approach.

## 5.11 Research Agenda

- Evidence for physical management has at present to be extrapolated from research on allied conditions; there is a clear need for systematic evaluation of physiotherapy in PMR.
- Investigative strategies need to take into consideration the overlap of PMR with GCA, and the relative low incidence of PMR compared with other rheumatological conditions. has at present to be extrapolated from research on allied conditions; there is a clear need for systematic evaluation of physiotherapy in PMR.

## 6.0 Important Resources

Chartered Society of Physiotherapy (1999) Physiotherapy Guidelines for the Management of Osteoporosis. London: Chartered Society of Physiotherapy.  
Price £6.00 available from: Rowena Clarke, Administrator, Research and Clinical Effectiveness Unit, Chartered Society of Physiotherapy, 14 Bedford Row, London, WC1R 4ED Tel: 020 7306 6632 or e-mail: [clarker@cspphysio.org.uk](mailto:clarker@cspphysio.org.uk)

Scottish Intercollegiate Guidelines Network (2000) Management of Early Rheumatoid Arthritis. SIGN Publication No. 48. Edinburgh, SIGN, Royal College of Physicians.  
Available on the SIGN website: [www.sign.ac.uk](http://www.sign.ac.uk)

## 7.0 Useful Organisations and Websites

### Age Concern

[www.ageconcern.org.uk/](http://www.ageconcern.org.uk/)

Age Concern England Astral House 1268 London Road	<a href="http://www.ageconcern.org.uk/">Age Concern Scotland</a> 113 Rose Street Edinburgh EH2 3DT
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London SW16 4ER Tel: 020 8765 7200	Tel: 0131 220 3345
<a href="#">Age Concern Cymru (Wales)</a> 4th Floor, 1 Cathedral Road, Cardiff CF11 9SD Tel: 029 2037 1566	<a href="#">Age Concern Northern Ireland</a> 3 Lower Crescent Belfast BT7 1NR Tel: 028 9024 5729

### Arthritis Research Campaign

Copeman House  
St Mary's Court  
St Mary's Gate  
Chesterfield  
Derbyshire  
S41 7TD  
Tel: 01246 558033  
Fax: 01246 558007  
General enquiries e-mail: [Info@arc.org.uk](mailto:Info@arc.org.uk)  
Website: [www.arc.org.uk/](http://www.arc.org.uk/)

### Arthritis Care

18 Stephenson Way  
London  
NW1 2HD  
Tel: 020 7380 6500  
Fax: 020 7380 6505  
Website: [www.arthritiscare.org.uk](http://www.arthritiscare.org.uk)

### British Health Professionals in Rheumatology

41 Eagle Street  
London  
WC1R 4TL  
Tel: 020 7242 3313  
Fax: 020 7242 3277  
E-mail: [bhpr@rheumatology.org.uk](mailto:bhpr@rheumatology.org.uk)  
Website: [www.rheumatology.org.uk](http://www.rheumatology.org.uk)

### National Service Framework for Older People: Department for Health England

NSF for Older People Implementation Team  
Department of Health  
133-155 Waterloo Road  
London SE1 8UG  
Tel: 020 7972 3000  
Fax: 020 7972 4863  
Email: [nsf-for-older-people@doh.gsi.gov.uk](mailto:nsf-for-older-people@doh.gsi.gov.uk)  
Main website: [www.doh.gov.uk/nsf/olderpeople.htm](http://www.doh.gov.uk/nsf/olderpeople.htm)

### Help the Aged

[www.helptheaged.org.uk](http://www.helptheaged.org.uk)

Head Office: 207-221 Pentonville Road London N1 9UZ Tel: 020 7278 1114 Fax: 020 7278 1116	Scotland: Heriot House Heriothill Terrace Edinburgh EH7 4DY Tel: 0131 556 4666 Fax: 0131 557 5115
Wales Office: Room 123 CSV House Williams Way Cardiff	Northern Ireland: Ascot House 24-30 Shaftesbury Square Belfast BT2 7DB

CF10 5DY  
Tel: 02920 415 711  
Fax: 02920 415 700

Tel: 02890 230 666  
Fax: 02890 248 183

Healthy Bones : A Help the Aged advice leaflet Endorsed by National Osteoporosis Society  
[www.helptheaged.org.uk/TXTFILES/hbones.txt](http://www.helptheaged.org.uk/TXTFILES/hbones.txt)

### **National Osteoporosis Society (NOS)**

PO Box 10  
Radstock  
Bath  
BA3 3YB  
Tel: 01761 471771 (for general enquiries)  
Helpline: 01761 472721 (for medical queries)  
Fax: 01761 471104  
E-mail: [info@nos.org.uk](mailto:info@nos.org.uk)  
Website: [www.nos.org.uk](http://www.nos.org.uk)

## **Acknowledgements**

The CSP commissioned and funded this report. Anna Sewerniak (CSP) conducted the searches. Tracy Bury managed the production and editing of the report. Hilary Jones (Research Secretary, Primary Care Sciences Research Centre, Keele University) assisted in the drafting of the osteoporosis section. Dr Andy Hassell and Dr Karen Mounce commented on an earlier draft of the osteoporosis section, and Jackie Waterfield advised on the polymyalgia rheumatica section. Thanks are also due to the independent reviewers who provided helpful comments on the first draft of the manuscript: Jane Hall, Panos Barlas, Nora Price, Anne Chadwick, Valerie Blair, Katy Baines, Gisela Creed, Fiona Gough and Thor Egerton.

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## Appendix 1

### Summaries of Reviews on the Effectiveness of Exercise for Osteoporosis 1998–2000

Table 1 – Exercise and Bone Mineral Density in Osteoporosis

Author	Type of review	Summary of work	Main conclusions
Ernst, 1998	Systematic review of RCTs of exercise for female osteoporosis.	The aim of the review was to determine whether exercise is beneficial in the treatment and prevention of osteoporosis. 21 randomised controlled trials were identified on MEDLINE, EMBASE and Cochrane Library (to 1997).	Regular physical exercise can reduce the risk of osteoporosis and delay decrease in BMD. Regular exercise for women of all ages is advised.
Kelley, 1998 a	Meta-analytic evaluation of studies of the effect of aerobic exercise on lumbar spine BMD in postmenopausal women.	Studies were published in English language journals 1975 – 1994. 10 studies met the criteria for inclusion.	Aerobic exercise helps to maintain lumbar spine BMD in postmenopausal women.
Kelley, 1998 b	Meta-analytic evaluation of studies to evaluate the effect of exercise on regional BMD in postmenopausal women.	11 randomised trials were identified in English language journals between 1975 – 1995.	Exercise may slow the rate of bone loss in postmenopausal women.
Layne & Nelson, 1999	Review of the effects of progressive resistance training on bone density.	Cross sectional, longitudinal and other studies over the past 10 years assessing the relationship between the effects of resistance training and bone density.	There is a positive relationship between the effects of resistance training and BMD. In contrast to traditional approaches for improving bone health in older adults, high intensity resistance training has the added benefit of improving strength and balance, and muscle bulk.
Sheth, 1999	Review on exercise in osteoporosis.	MEDLINE search. English language articles on prospective studies after 1989.	Evidence that exercise may improve BMD in selected individuals.
Wolff et al, 1999	Meta-analysis of trials on the effect of exercise training programmes on bone mass of the lumbar spine and the femoral neck in pre- and postmenopausal women.	1966-1996 search and quantitative review of RCTs and controlled trials. 25/62 articles identified met the inclusion criteria.	Exercise training programmes prevent or reverse almost 1% of bone loss per year in both the lumbar spine and femoral neck for both pre- and postmenopausal women.
Kelley et al, 2000	Meta-analysis of studies on the effects of exercise on BMD in men.	8 studies representing 225 subjects met the inclusion criteria.	Site specific exercise may help improve and maintain BMD at the femur, lumbar and os calcis sites in older men.
Wallace & Cumming, 2000	Systematic review and meta-analysis of exercise in	35 randomised controlled trials were identified from	Impact exercise programmes have a

	women.	computerised MEDLINE search 1966-1997, on the effectiveness of exercise on bone mass in pre- and postmenopausal women.	positive effect at the femoral neck in postmenopausal women (5 studies). There were too few trials for meta-analysis of non-impact exercise on neck of femur. Both impact and non-impact exercise have a positive effect at the lumbar spine in postmenopausal women.
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Table 2 – Exercise and Osteoporotic Fractures

<b>Author</b>	<b>Type of review</b>	<b>Summary of work</b>	<b>Main conclusions</b>
Henderson et al, 1998	Review of the role of exercise in osteoporosis.	An overview of the literature based upon an optimal model for prevention of osteoporotic fractures: increasing and maintaining bone strength. reduction of the risk of trauma.	Optimal forms of exercise vary through life. In the elderly progressive strength training is safe and effective and reduces the risk of falling. In frail elderly activity to improve balance and confidence e.g. Tai Chi may be cost effective. Increased physical activity is a sensible strategy in reducing osteoporotic fracture.
Gregg & Tonino, 1998	Epidemiological review on physical activity and BMD in osteoporotic fractures.	Observational studies and clinical trials relating to physical activity, BMD, falls and fractures in older adults were included.	Regular physical activity determines BMD in youth. Weight bearing exercises increase BMD in young adults and reduced bone loss in older adults. An active lifestyle reduces risk of hip fracture, possibly through a combination of the effect of exercise on BMD, improved balance, strength and reducing the risk for falls.
Scheiber & Torregrosa, 1998	Review of diagnosis and treatment of postmenopausal osteoporosis	1983 – 1997 MEDLINE search of all reports of interventions in diagnosis and treatment of osteoporosis.	Properly implemented prevention and treatment strategies e.g. exercise may reduce the fracture risk in many individuals.
Willhite, 1998	Review on individual therapies and interventions in osteoporosis.	MEDLINE search 1974 – 1988. English language, prospective clinical trials and epidemiology studies.	Increasing exercise and minimising falls are two of a number of strategies, which can help prevent osteoporosis and fractures.
Rose & Maffulli, 1999	Review on the epidemiology of hip fractures.	56 articles identified by computerised literature search (mainly from developed Western countries).	Mortality is high. A third of people do not live beyond one year after fracturing their hip. The two main determinants for hip fracture are falls and increased bone fragility. Prevention shown to be single most important factor to reduce increasing incidence of hip fractures.
Rutherford, 1999	Review of the role of exercise in increasing BMD in postmenopausal women	Literature search over a 20 year span of landmark papers.	Exercise through the life span may maximise peak bone mass, reduce age related bone loss, maintain muscle strength and balance. Being active reduces the incidence of hip fractures in the older

			population.
Gregg et al, 2000	Review of epidemiology studies on physical activity, falls and fractures in older adults.	MEDLINE search, review and synthesis of studies (RCTs, case-control, prospective cohort), evaluating physical activity, falls and fractures.	Exercise improving balance and lower limb strength training may reduce risks of falling. Physical activity is associated with a 20-40% reduced risk of hip fractures relative to sedentary individuals.