

**PHYSIOTHERAPY GUIDANCE NOTES for OSTEOPOROSIS AND EXERCISE in  
ANOREXIA NERVOSA and BULIMIA NERVOSA**

**February 2015**

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## **1. Aim and scope of this publication**

### **Aim**

Osteoporosis is a common complication in Eating Disorders (ED), especially Anorexia Nervosa (AN).

The aims of this document are to;

- Provide information regarding osteoporosis particularly relevant to ED
- Provide advice regarding exercise and activity for those who are not at a healthy weight
- Combine the advice regarding exercising at an unhealthy weight with detailed appropriate exercise and activities, which should either be avoided or are safe and recommended, dependent on the severity of the osteoporosis.

At time of publication, there is no single document that brings these areas together. This document aims to provide a summary of all current evidence published to date regarding AN, osteoporosis and exercise.

### **Scope**

These guidance notes are based on current evidence based practice in Physiotherapy, Pilates, clinical experience, up to date research and information from the National Osteoporosis Society, International Osteoporosis Foundation and other sources.

Physiotherapists are often at the forefront of advice and practical groups regarding exercise and activity. These guidance notes can be used in conjunction with the 2011 Physiotherapy Guidance Notes for Exercise and Physical Activity in Adult Patients with Anorexia and Bulimia Nervosa, for evidence based practice.

It is hoped that other professionals, users and carers will find the information helpful when osteoporosis or exercise is an issue in those with ED.

## 2. Osteoporosis overview

**Osteoporosis** is a common complication of AN.

Osteoporosis is a progressive skeletal disease which leads to a reduced bone mass and reduction in the strength of the bones <sup>(1,2,3)</sup>. This leads to increased bone fragility and susceptibility to fracture, which can persist long after successful treatment for anorexia. The majority of patients do not realise that they have the disease until they sustain a fracture <sup>(3)</sup>. Osteoporosis left untreated can lead to fractures, spinal deformity and persistent pain and disability <sup>(1)</sup>.

It is estimated that 50% of people with one fracture due to osteoporosis will have another at some point in their life <sup>(2)</sup>. The risk of future osteoporotic fractures (also known as fragility fractures or minimal trauma fractures) rises with each new fracture and is known as the 'cascade effect' <sup>(5,6)</sup>.

It is estimated that 3 million people in the UK have osteoporosis and there are approximately 300,000 fragility fractures a year <sup>(3)</sup>. In the UK 1 in 2 women and 1 in 5 men will break a bone, mainly because of poor bone health <sup>(3)</sup>.

Those with ED often have decreased bone mineral density (BMD), osteoporosis and fragility fractures at a much younger age than might be expected as part of the normal ageing process and therefore we should be concerned for their prognosis in later life.

The vertebrae of the spine, the hip and the wrist are the most likely sites for fracture as they have a higher percentage of trabecular/ cancellous bone <sup>(2,3)</sup>. This is a spongy, honeycomb-like type of bone, most affected by osteoporosis.

Fragility fractures, the broken bones associated with osteoporosis, are more common in women as too are eating disorders and therefore for the purposes of this document, it is assumed that we are referring to women unless otherwise stated. It must be noted however that men with AN are also at risk.

### **3. Bone scan/ DXA scan.**

The T-score compares a person's bone mineral density (BMD) with the optimal BMD of a 30 year old adult of the same sex <sup>(7)</sup>.

Osteopenia (low bone mass) the precursor to osteoporosis, will be indicated by a T Score of -1 to -2.5.

Osteoporosis will be indicated by a T score of -2.5 or below.

Severe Osteoporosis is indicated not only by a T score of -2.5 or below, but also in the presence of one or more osteoporosis-related fractures.

The Z score compares a person's BMD with that of someone the same age, gender and ethnicity. If the Z score is below -2 then BMD is lower than it should be for that age. It is used in children, teens, adult women up to menopause and younger men. It is especially useful when a comparison with that of the healthy young adult mean at peak bone mass (T score) is not helpful, such as in younger ED patients under the age of 30. Comments such as 'values are reduced to the mean values for patients of this age, gender and ethnicity' or 'low BMD for age, gender and ethnicity' may be seen on the bone scan reports.

Low bone density as measured on a DXA scan is considered as a risk factor for fractures but is not a perfect measure of bone strength as some people with low bone density never break a bone and vice versa <sup>(3)</sup>.

Bone density measurement is only part of the story. What is most important is the likelihood of fragility fractures (i.e.: how likely the bones are to break) <sup>(1,7)</sup>. The "fragility risk assessment" FRAX identifies the fracture risk over the next 10 years. The fragility risk will be influenced by the existence or lack of other risk factors and will be indicated in the scan report.

A bone scan is usually recommended after menstruation has stopped for a year in women of menstrual age. Further scans may be repeated approximately every two years if periods do not resume. This advice though seems to be different in the field of ED, with many clinicians paying more attention to the duration and amount of weight loss than amenorrhoea and consequently scanning some after only six months. The optimum frequency of repeat DXA scans is also uncertain with some patients being scanned annually, for example those on antiresorptive therapy or whose weight is changing rapidly.

Repeat scans are necessary in determining BMD changes. However body weight affects the DXA scan and with fluctuating weight often seen in ED, the scan result may not give a fully accurate picture.

#### **4. Bone development and building a bone bank.**

Bone is alive and constantly changing. This is done through a process of bone remodelling, where old bone is broken down by cells called osteoclasts and replaced by bone building cells called osteoblasts. This bone renewal process is called bone turnover <sup>(3)</sup>.

**Childhood** Osteoblasts work faster in childhood than in adult life allowing the skeleton to increase in density and strength <sup>(2)</sup>. In girls, the amount accumulated between the ages of 11 and 13 equates to the amount lost during the thirty years following menopause. Laying down the 'bone foundation' in youth gives advantages in later life. Studies have shown that the most physically active young girls gain about 40% more bone mass than the least active girls of the same age <sup>(2)</sup>.

**Adolescence, Young adulthood** Bones stop growing in length between the ages of 16 and 18 but continue to increase in density slowly until a person's late 20s <sup>(3)</sup>.

There is some debate about the age of peak bone mass but it is thought to occur in the mid to late 20's <sup>(4, 6)</sup>.

Up to the late 20's it is vitally important to maximise bone strength by 'banking' plenty of bone <sup>(2)</sup>. This puts the skeleton in a better position to withstand the bone loss that occurs with advancing age. Plenty of weight bearing exercise and a healthy well balanced calcium rich diet can help achieve this.

**Mid to late 20s (or peak bone mass) to 35)** The balance between bone breakdown and new bone formation stays stable. Bone density remains at the same level <sup>(4, 5)</sup>.

**Around age 35 until menopause** Bone loss increases very gradually <sup>(4)</sup>.

**Menopause, post menopause** Bone loss becomes more rapid for several years following menopause when the ovaries stop producing oestrogen and bone calcium levels decrease <sup>(4)</sup>. 20% of bone mass is lost in the first 5-7 years post menopause. The rate of bone loss slows down after this time <sup>(5, 6)</sup>.

After the age of 30 and especially after menopause, building bone density is not easy but small gains have been shown in post menopausal women <sup>(2)</sup>. Importantly though, exercise at a healthy weight after the age of 30 can help reduce further bone loss, may help reduce the risk of fractures and at the same time reduce the risk of falls <sup>(2, 7, 8)</sup>.

In men bone density tends to stay relatively stable until middle age, decreasing at a slower rate than is seen in women, in a steady decline from the age of 44-55 <sup>(6)</sup>.

## **5. Risk factors for osteoporosis, related to eating disorders**

There are numerous risk factors affecting bone density, some of which are unavoidable and part of our genetic make up <sup>(3)</sup>. However, some medical conditions, medicines and/or life style choices can also be risk factors for low bone density but have the potential to be changed <sup>(3)</sup>. AN, a risk factor for osteoporosis, is one such medical condition that can be altered.

Many people with AN (and to a lesser extent Bulimia Nervosa (BN)) will have a bone density significantly lower than average <sup>(3)</sup>. The low bone density in EDs has several causes.

### 1. Hormones

The body changes its hormone production in response to low body weight and these changes can effect bone density. Levels of insulin-like growth factor I (IGF-1), a hormone related to “growth hormone” and levels of oestrogen are reduced while levels of cortisol (a steroid) are increased <sup>(5)</sup>.

Mechanisms behind osteoporosis in AN patients are different <sup>(1)</sup>. Bone turnover and endocrine levels differ to healthy individuals. Although loss of hormones, vitamins and minerals play a part in osteoporosis and restoration of these are important, weight restoration is overwhelmingly the biggest piece of the jigsaw for protecting bones <sup>(1)</sup>.

### 2. Amenorrhoea.

Amenorrhoea is the absence of a menstrual period in women of reproductive age and will have an effect on lowering bone density <sup>(3)</sup>. Oestrogen has a protective effect on bone density and low levels are indicated by the loss of menstrual periods (amenorrhoea).

It has been shown that bone density does not necessarily return to normal levels even after restoration of menstruation <sup>(4)</sup>. This leaves the individual with an overall deficit for their age (a reduced bone bank) and more vulnerable to osteopenia and osteoporosis as they age <sup>(4,7)</sup>.

Restoration of healthy weight improves bone health, but not to a level of normal bone density <sup>(9,10)</sup>. Eating disorders that start in early adolescence or young adulthood will therefore be detrimental to this bone bank and we should be especially mindful of young patients with a long duration of amenorrhoea.

HRT or the contraceptive pill containing oestrogen may be given if a woman has no menstrual periods because of low body weight, but any potential benefits on bone density are unproven <sup>(3)</sup>.

### 3. Low body fat.

Another risk factor for osteoporosis is low body fat which is found in patients with AN. This is because body fat makes a small amount of oestrogen helping to keep bones healthy <sup>(4,7)</sup>.

### 4. Low body weight.

Being underweight is a risk factor for osteoporosis <sup>(6,8)</sup>. As the mass of the body naturally bone loads it is advantageous to not have a low weight.

### 5. Excessive exercise.

Excessive/compulsive exercise behaviour may be a feature in AN or BN. Excessive exercise combined with falling body weight and loss of menstruation will affect bone by lowering bone density and leading to osteopenia or osteoporosis, in a similar way to the effect of AN <sup>(7,9)</sup>.

### 6. Nutrition

Lack of adequate nutrition contributes to the cause <sup>(5)</sup>.

### 7. Low Testosterone.

In men, low levels of the sex hormone testosterone, is thought to be a contributing factor in osteoporosis <sup>(3)</sup>.

Similarly low hormone levels, weight loss and malnutrition may be responsible for low bone density in men <sup>(5)</sup>.

## 6. Most common fractures, associated with osteoporosis and eating disorders

### a. Spinal or vertebral fractures

The bodies of the vertebrae are made mainly of cancellous/ trabecular bone, the honeycomb-like structure which is most susceptible to osteoporosis <sup>(2,3)</sup>.

- Fractures are most common in the middle thoracic area, T6 to T8 (between the shoulder blades). This is due to the vertebral bodies getting smaller as you move up the vertebral column and because thoracic vertebral bodies are orientated towards flexion. This means that force is transmitted through the weakest part of the vertebrae.
- Fractures can be referred to as compressed, collapsed or crushed. All will lead to loss of height.
- If a fracture is referred to as wedged this means that the front part of the vertebra is crushed leading to an outward curvature of the spine (kyphosis) often known as a “dowagers hump”.
- Fractures can be pain free. It is estimated that only one third of vertebral fractures come to clinical attention and under diagnosis of vertebral fractures is a worldwide problem.
- Pain can occur from the changes in biomechanics and joint loading following a fracture as well as irritation of the nerves and muscles around the spine.
- As the curvature increases, neck and shoulder muscle tension as well as pain can occur.
- Significant height loss and curvature can result if fractures are numerous and severe. This can cause shortness of breath, protruding stomach, indigestion problems and stress incontinence, due to a reduction in the available space for the internal organs.
- Following a vertebral fracture or rib fracture, it is important to advise rest and very gentle movements in the early stages when it is healing. Fractures typically take 6 to 8 weeks to heal. There is no difference between the healing processes of a fracture whether caused by osteoporosis or not.

Studies have shown that spinal flexion (bending forwards) exercises are harmful and that extension (bending backwards) exercises correlate with fewer wedge or compression fractures <sup>(11,12,13,14)</sup>.

Four separate exercise groups of subjects with osteoporosis were compared <sup>(11)</sup>. Results demonstrated the following:

- Group 1 Extension only: 16% had another wedge or compression fracture during the study.
- Group 2 Flexion only: 89% had another wedge or compression fracture during the study.
- Group 3 Extension and Flexion: 53% had another wedge or compression fracture during the study.



- Group 4 NO exercise: 67% had another wedge or compression fracture during the study.

One study showed that strong back extensor muscles correlate with fewer vertebral fractures and increased bone mineral density <sup>(9)</sup>.

In 2002, Sinaki and colleagues published the first randomized prospective study demonstrating that exercise in pre-menopausal women may not only increase bone density at the lumbar spine but also decrease the risk of vertebral fractures <sup>(15)</sup>. They found that progressive, resistive back strengthening exercises performed 5 days per week over two years reduced the risk of fractures 10 years later.

### **b. Wrist Fractures**

A broken wrist (also known as a Colles fracture) can occur when we put our hands out to break a fall <sup>(2, 3)</sup>.

Wrist fractures in middle aged women who have had a fall can often be the first indication of osteoporosis <sup>(3)</sup>.

Colles fractures usually require casting for 4-6 weeks.

### **c. Hip Fractures**

The most serious type of fracture is a hip fracture, normally as a result of a fall. The incidence of fracture goes up exponentially with age from 60 plus <sup>(3)</sup>. Breaking a hip when elderly has a major impact on independence and recovery. 20% of those who suffer a hip fracture die within 6 months after the fracture, and patients who recover may have a greater risk from dying for the next 5 years <sup>(3)</sup>.

All hip fractures require surgery with screws, pins or a full hip replacement.

### **d. Other fractures**

Other fractures common in eating disorders are often associated with compulsive exercise and it is important to be aware of stress fractures in the feet and lower limbs <sup>(2, 3)</sup>. These can result from the repetitive nature of exercise on a weakened musculoskeletal system. Stress fractures are often difficult to see on x-ray until they have actually started to heal. It is also worth noting that due to the porosity of the bones and hence darkness on x-ray, some fractures are harder to detect in those with osteoporosis. In some instances MRI scanning may be recommended.

Stress fractures require rest from the activity that caused them, to allow healing. Gradual return to activity is necessary to prevent re-injury. Re-injury can lead to harder-to-heal stress fractures and chronic problems in the future.

Approximately 50% of people with one osteoporotic fracture will have another <sup>(2)</sup>. Many young people with AN have osteoporosis and consequently may sustain fragility fractures at a much younger age than is seen in average women. Preventing these fractures is vital for future health.

The good news is that osteoporosis is now largely a treatable condition and with a combination of lifestyle changes and appropriate medical treatment, many fractures can be avoided <sup>(3)</sup>.

## 7. Exercise at an unhealthy weight/ BMI

**If there are any of the following:** AN, BN, low body weight/ BMI outside of the healthy range, inadequate calorie intake, poor nutrition, excessive or compulsive exercise behaviour, amenorrhoea, then the advice given regarding exercise will differ from that of healthy weight individuals with osteoporosis.

Although exercise is known to have a beneficial effect on bone mineral density at a healthy weight, studies are conflicting and it cannot be said that exercise in those with anorexia nervosa is beneficial to bone density<sup>(10,11)</sup>. If exercise contributes to further weight loss then the overall result will be detrimental to bone density.

With research/evidence in mind, our advice will always be that return of menstruation and restoration of body weight are paramount and any exercise that prevents this occurring will be detrimental to bone density<sup>(7,9,10)</sup>. Exercise that results in weight reduction, or a plateau for those on a weight restoration programme, is therefore not helpful and may in fact be harmful given the energy expenditure of exercise. However for anorexia, the potential benefits of exercise might be offset by the risk of fractures, delayed weight gain and exercise-induced amenorrhoea<sup>(16)</sup>.

It is likely that in anorexia the weight loss from exercise offsets any benefit<sup>(1)</sup>.

It should be noted that bed rest leads to rapid bone loss and therefore is an important consideration for the severely ill anorexic.

Unfortunately, it is not a simple case of advising patients with ED to stop or significantly reduce exercise to restore weight as often excessive or compulsive exercise and activity behaviour is a problem. Compulsive exercise refers to any form of physical activity that is associated with disordered eating attitudes, beliefs and behaviours and an inability or unwillingness to cut down or stop exercising even though it is detrimental to health. In many cases exercise can become a very powerful tool in maintaining an eating disorder because of the strong influence that it can have on weight control<sup>(17)</sup>. This needs addressing and Physiotherapists will need to work with compulsive behaviour at the same time as advising about osteoporosis.

One such programme, in use by some Physiotherapists working in ED, is 'The Loughborough Eating-disorders Activity Programme' (LEAP) which addresses compulsive exercise in the Eating Disorders<sup>(17)</sup>. The aim of the LEAP is the promotion of healthy attitudes, beliefs and behaviours towards activity and exercise. It is not the aim to make patients stop exercising, but rather to educate them about what constitutes 'healthy/non-compulsive' exercise and equip them with the knowledge and skills that will enable them to regain control of their exercise behaviour in order to participate in age, goal and health status appropriate exercise<sup>(10, 17)</sup>.

Numerous interventions such as Cognitive Behavioural Therapy (CBT), Physiotherapy, individual therapy, exercise education groups and exercise practice groups can help the individual with finding new healthier ways of thinking regarding exercise and activity and in making reductions to their exercise and activity levels, to enable weight restoration.

More serious cases involving greater weight loss (more than 20% below the ideal body weight) may require more aggressive activity cessation<sup>(10)</sup>. In some inpatient cases, close observation is necessary to prevent exercising and in many cases this relieves the patient of their guilt experienced when they don't exercise. This break in the cycle of exercise can be enough to stop

the compulsive exercise in those at very low weight for patients who are not in hospital, Recruiting others to help prevent the compulsive exercise and activities and receiving professional help will often be necessary.

It is not possible to become physiologically addicted to exercise although for some individuals the psychological dependence is so strong that it is almost identical to a real addiction <sup>(17)</sup>. Like alcohol addiction, both require a period of abstinence and both require gentle graded reintroduction with constant vigilance to keep under control <sup>(9)</sup>.

Re-introducing a healthy amount of exercise will be part of the rehabilitation process, as the aim is for healthy balanced exercise behaviours; the middle ground between excessive exercise and no exercise at all

It has to be noted that patients restoring weight most often have significant body image issues, a fear of becoming un-toned and gaining only fat and an intense dislike of central fat accumulation (a result of high cortisol levels and weight restoration) <sup>(10,18)</sup>. With this in mind, exercise, appropriate to Body Mass Index (BMI), may help with the ongoing weight restoration programme to achieve a healthy weight and menstruation.

A study undertaken in an inpatient unit for anorexic women found that those who were assigned to an exercise programme gained more than one third more weight than the control group who did not exercise <sup>(18)</sup>. The authors also noted that the women in the exercise group demonstrated significantly reduced obligatory attitudes to exercise

The “Physiotherapy guidance notes for exercise and physical activity in adult patients with anorexia and bulimia nervosa” gives further information regarding excessive exercise and its management as well as recommendations relevant to BMI <sup>(19)</sup>. Finding the balance between doing some safe and specific exercise and activity and restoring weight at a good pace to prevent further bone loss is an important part of the whole treatment process.

Although patients with anorexia are often losing bone mass when they should be optimizing bone growth, there is no robust evidence to guide medical interventions <sup>(10)</sup>.

Few studies have systematically explored exercise as part of treatment among patients with AN. Excessive moderate loading exercise while ill may put patients at higher risk of low bone mass, but high bone loading activities may provoke bone accrual during recovery <sup>(20, 21)</sup>.

## **The female athlete triad**

The female athlete triad is an important consideration for eating disorders, especially where compulsive or excessive exercise is a feature. The achievement of a healthy weight may be hindered by an excessive amount of exercise, than through dietary restriction alone .

The female athlete triad is a syndrome caused by an energy drain or calorific deficit (the athlete's energy expenditure exceeds the dietary energy intake) eventually leading to decreased oestrogen production, causing menstrual dysfunction <sup>(16, 22)</sup>. The decreased oestrogen levels result in reduced bone density.

Each component of the female athlete triad is represented along a spectrum from healthy to unhealthy. The first component, energy availability, is defined as "dietary energy intake minus exercise energy expenditure". The continuum ranges from optimal energy availability at the healthy end, to energy deficiency with or without disordered eating at the unhealthy end. The second component of the triad is menstrual dysfunction with normal menstrual cycles at the healthy end of the continuum and amenorrhea at the unhealthy end. The final component of the female athlete triad, bone health, describes a continuum extending from optimal bone health to osteoporosis.

The advice given to an athlete is to make activity and dietary modifications in the first instance, to regain menstruation and this advice would be the same for those with eating disorders.

In mild to moderate cases of the female athlete triad, some improvement in bone health is thought to happen once menstruation resumes. The lost BMD is unlikely to be replaced entirely, and the bone mass that should have been accumulated during the important time in bone development may or may not be regained. However, many case studies show that bone density does not increase, suggesting that losses may well be permanent. Unfortunately, no long-term, controlled studies are available <sup>(22)</sup>.

Although not yet proven, it is thought that osteoporosis at a young age in either an athlete or person with an ED may lead to a greater risk of severe osteoporosis, fragility fractures and early mortality in the long term.

Educating athletes may lead to earlier detection or prevention of the female athlete triad. If women know that amenorrhea is not a positive sign of hard work but a warning of disease, they may seek treatment sooner <sup>(22)</sup>.

## 8. Summarising the Physiotherapy role.

Physiotherapists working in ED are often at the forefront of promoting 'healthy exercise'. In addition to working individually many Physiotherapists will run educative and practical groups for all stages of illness/recovery levelled appropriate to BMI and taking into account the health risks and depth of understanding necessary in working with this group of patients. The name of each group, how they run and with whom they may share the group all differ but in principle they will share elements of: addressing compulsive exercise behaviour; providing a wide range of educative themes regarding healthy exercise and activity; body image/awareness; education about osteoporosis and how to manage it; and safe practical BMI related exercise. For example the group at the Vincent Square Eating Disorder Service is called The Body Awareness Group and covers all the elements above.

Physiotherapists have numerous types of exercise in their repertoire and the principles in these guidelines can be adapted to many forms of exercise.

- There is growing evidence for the effectiveness of Physiotherapy/exercise and Pilates <sup>(15, 23, 24, 25, 26, 27)</sup>. Pilates has been specifically chosen for those with osteoporosis as a result of current research and focus. It is a controlled type of exercise that uses a low energy consumption to produce the specific desired effects and therefore of much use to the AN and BN population. The 'modified Pilates' exercise programme fully incorporates what to avoid and what is safe and effective for osteoporosis.
- **Pilates** specifically focuses on retraining the core stabilisers to support the spine during every day activities, building strength and stability around the joints, improving posture, flexibility and stamina. The strength training and weight bearing aspects of Pilates are thought to stimulate bone production. As many as one third of women over the age of 55 attending Pilates classes will have diagnosed or undiagnosed osteoporosis, therefore the Australian Physiotherapy and Pilates Institute (APPI) advocate a 'bone building programme' including "standing Pilates" for people who are at risk. The focus is on re training strategies for good balance, posture and a strong core during everyday tasks in standing, weight bearing exercises for the hips and wrists, resistance exercises using additional small equipment for the muscles around the wrists, spine (extension), hips and pelvis, and overall flexibility and mobility, which are all particularly important in osteoporosis. Exercises are carefully considered for this group, educating the client on how to avoid risky loads while maintaining full functional movements. The level to which each individual works will be determined by the severity of their osteoporosis, in general terms meaning whether they have or have not already sustained an osteoporotic fracture and their risk of fractures in the near future <sup>(8)</sup>.

Physiotherapists also make healthy and safe plans on an individual basis solely or in addition to groups at any stage of the recovery journey.

## 9. Following the right advice about exercise and activities.

There are two highly recommended leaflets available online from the National Osteoporosis Society (NOS); “All about osteoporosis” and “Exercise and Osteoporosis”. Though much of the information within these guides is excellent it must be noted that the exercise advice given is for healthy weight individuals. AN and amenorrhoea are mentioned in both leaflets as causes of low bone mineral density leading to a diagnosis of osteoporosis or osteopenia. The leaflets advise seeking professional help to increase body weight, restore menstruation and hormonal levels.

In addition, the “Anorexia nervosa and osteoporosis” fact sheet provides relevant information, but does not address exercise in detail <sup>(5)</sup>. It states that for those recovering from anorexia nervosa advice about suitable activity levels and exercise should be sought from the team who is treating them and where ever possible under the direct supervision of a Physiotherapist. The information within these guidance notes addresses exercise and osteoporosis and compulsive exercise behaviour for those with ED.

Where osteoporosis is present, it is advisable to establish the fragility of the bones, before exercising. For those who have not menstruated for more than a year, a bone density scan may be recommended. Exercise is important for health for everyone at all stages of their lives. Finding the right kind of exercise is important for those with a diagnosis of osteoporosis.

The NOS leaflet “Exercise and osteoporosis” details the information in 3 parts as shown below. These guidance notes follow this format so that they can be used together. Information for the guidance notes have also been compiled from other relevant references into Pilates and osteoporosis <sup>(4, 6, 8, 26, 27)</sup>.

### Part 1

- Exercises for people who are **fit and healthy**
- Are at **low risk of fracture**
- Wish to use exercise to maintain or strengthen bone
- Want to reduce the risk of future fractures

### Part 2

- Information and exercises for people who have a diagnosis of **osteoporosis or osteopenia**
- Are at **higher risk of fracture** and may have **broken bones easily** in the past
- Want safe and effective exercises to keep fit
- Want to reduce the risk of broken bones occurring again in the future

### Part 3

- Exercises that have been shown to improve stability and balance and thus reduce the risk of falls, which can cause broken bones in older, frailer people.

## 10. Choosing to follow Part 1 or Part 2

Choosing part 1 or part 2 is really important and having an eating disorder complicates things further.

With a diagnosis of osteoporosis or osteopenia where there is a high risk of fractures (high fragility risk) or a person has fractured (broken) bones easily in the past then choosing safe and effective exercises are really important. The individual should be advised to follow Part 2 “What to avoid” section and part 2 “Safe and effective Exercise” in these guidance notes.

Where there are any of the following: AN, BN, unhealthy weight/BMI, excessive / compulsive exercise behaviour with amenorrhoea (no menstruation) then this indicates that the individual is not healthy. They are most likely to be losing further bone mass leading to a worsening picture of the osteopenia or osteoporosis. The individual would be in a higher fragility risk group. The advice would be to restore weight and menstruation and reduce the level of exercise until they are healthy again. It would be advisable to recommend that these individuals follow part 2 “What to avoid” section and Part 2 “safe and effective exercise” in these guidance notes.

With a diagnosis of osteopenia or osteoporosis where there is a low fracture risk (low risk of breaking a bone in the near future) and the individual has never broken a bone easily and they are fit and healthy, and younger in age then the advice given now by the NOS is that these individuals may follow part 1 (Part 1 in the NOS “Exercise and osteoporosis leaflet) and be on a bone building programme, incorporating all forms of exercise including high impact weight bearing and weight training and resistance exercise and sports. There is no definitive advice and the benefits must be weighed up against the possible risk of fracture. Adapting the level of activity and types of activities will still be necessary where osteoporosis is present as certain exercises should always be avoided (see part 2 “What to avoid”).

Individuals who have restored menstruation, weight and health and who have a diagnosis of osteopenia or osteoporosis and have never broken a bone easily and have a low fracture risk and are younger in age may be recommended to follow Part1 in these guidance notes. Adapting the level of activity and types of activities will still be necessary where osteoporosis is present as certain exercises should always be avoided (see part 2 “What to avoid”).

A ‘Modified Pilates’ for Osteoporosis class, follows Part 2 and should teach “What to avoid and be cautious of”, as well as teaching “safe and effective exercises”. The principles should be followed for any exercise and activity classes or individual exercise training that is undertaken.

### **Following a fracture.**

Fractures typically take 6 to 8 weeks to heal, whether there is osteoporosis present or not. Following a vertebral compression fracture or rib fracture, it is important to advise rest and very gentle movements in the early stages when it's healing. Medical advice should be taken seriously for all fractures as doing too much can prevent good healing and jeopardise the outcome. A Doctor or Physiotherapist will advise on what shouldn't be done while specific fractures are healing and a Physiotherapist may plan an exercise programme as part of the rehabilitation process. Once fractures have healed exercise can resume and it is important then to regain mobility and strength.



## 11. PART 2      **What to avoid.**

Where osteoporosis is present certain exercises or movements should be **avoided** to lower the risk of fragility fractures.

In those who have already had an osteoporotic fracture or are at a high risk of fragility fractures more caution is necessary.

In those with osteoporosis who have never had a fragility fracture, are at low risk of fractures and are otherwise fit and healthy, it may be possible to do high impact exercise and more risky sports and activities whilst bearing in mind all of the risky movements and exercises described below and making adaptations as necessary. Benefits versus risk must be considered.

**High impact** exercises such as jumping, running, jogging or skipping as these types of exercise may cause further fractures.

**Exercise and activities that increase the risk of falling** such as horse riding, skiing, ice-skating and sports or activities which involve a quick change of direction, as there is a possibility of a fracture in the event of a fall. Care should be taken in situations that can lead to anyone of any age falling, such as unstable ladders and chairs and the icy, snowy pavements and consider precautions such as ice grippers. Contact sports are also not advisable.

**Exercises in which the spine bends forwards** (flexion) especially in standing as the spine is loaded by gravity, such as touching the toes and the roll down in Pilates. Avoid sit-ups, abdominal crunches, collapsed 'C' curve and any other exercises which compress the anterior aspect of the thoracic spine where most of the trabecular/cancellous bone is located, which may result in a compression or wedge fracture in the spine. Adding weight or force would further increase the risk.

**Spinal flexion combined with twisting exercises**, such as a twisting sit up, as the combined movements of flexion and rotation cause high compression forces in the spine and can result in a compression or wedge fracture.

**Activities which require bending or twisting forcefully** such as golf, tennis, bowling and some yoga poses are not suitable.

**Spinal twisting or side bending exercises which are forced, uncontrolled or loaded** by weights, resistance bands and long levers should be avoided. Maintaining movement and building strength are advisable as long as the movement is controlled and good posture is maintained.

**Rolling like a ball and rolling around on the spine** are not safe and should be avoided as these transfer pressure from the floor on to the spine., **Spinal articulation into a high bridge position** should be avoided. Non-articulation in a low bridge position is a safer option and a pelvic curl is safe. Avoid placing body weight on the neck.

**External rotation of the hip from an adducted position (CLAM exercise)** should be avoided due to the increased risk of avulsion fractures, however the clam can be modified using a pillow between the knees.

**Loaded neck flexion** where the head is unsupported should be avoided, instead support the head in the hands when lifting it from the ground.

Be **careful when coughing and sneezing**. Fractures can occur from the forceful cough or sneeze if the back is rounded or twisted. Sitting or standing against something for support or bracing in an upright position are advisable.

**Take extra care when lifting, moving and handling**. Lifting and picking up things from the floor can lead to compression fractures in the spine especially if the back is bent or twisted. The back should always be kept straight and the legs should be doing the hard work. Heavy cases and shopping bags can cause fractures too, so carrying less and spreading the load will help to avoid fractures. Consider placing shopping bags on a chair rather than the floor.

In general, avoid **rapid, jerky movements and exercise**, instead opt for controlled movements.

Use common sense in order to maintain normal functional movements.

## 12. Part 2      **Safe and effective exercise**

For a diagnosis of osteoporosis or osteopenia where there is a high risk of fractures (high fragility risk) or an individual has fractured (broken) bones easily in the past and is not healthy (amenorrhoeic, underweight, AN, BN or excessively/ compulsively exercising.)

Remember always, that restoring a healthy weight, menstruation and diet are the most effective treatment for restoring bone mass or preventing further bone loss.

The level of activity and exercise advised will depend on how stable an individual's medical condition is currently, how well they are maintaining their target weight and whether dietary intake is sufficient to support an increased activity level <sup>(5, 6)</sup>. The intensity and number of each exercise will be determined by BMI. However further research is still needed and if any exercise is done during a weight restoring programme, then *potential* bone stimulating exercises would be the obvious choice. Such exercises will be useful in the future, if a healthy weight is achieved.

In a 'Modified Pilates' for osteoporosis class, all elements of the following types of exercises will be taught as they are proven to stimulate bone activity in the healthy weight population and have the *potential* to stimulate bone activity in those who are underweight. The class will be safe because all of the activities or exercises that should be avoided will not be included. Pilates has also been chosen because it is a controlled type of exercise that uses a low energy consumption to produce the specific desired effects and therefore of much use to the AN and BN population.

No matter what type of exercise is considered, beginning under the supervision of a Physiotherapist is the preferred option. A Physiotherapist will take into account medical history and be able instruct on performing exercises safely and offer safe modifications of favourite exercises, tailored to specific needs.

Not all forms of exercise stimulate bone. Bone is a living tissue that reacts to increases in loads and forces, by growing stronger. Exercise will only increase bone strength if it increases the loading above normal levels. Exercise should progress over time to challenge the muscles and the bones.

Weight or resistance should be increased steadily when strength training. Low impact weight bearing exercise, for example walking, will need to become brisk enough to avoid acclimatization. A hold for some exercises may allow time for the bone to 'load'. Bone responds to intensity, not duration, meaning that it responds to a force greater than it has been used to, not a repetition of the same force. So after about 10 minutes of repetitive exercise, bone will stop responding. Types of exercise and activities should therefore change frequently'.

If exercise needs to be reduced, it is better to reduce the length of each session rather than the number of sessions per week.

Exercise must be regular, at least three times a week to maintain or increase the stimulus and maintain the adaptation.

These are important considerations for those who are underweight as a short duration of regular non-repetitive exercise is effective, whereas excessive exercise is no more stimulating and will have the effect of burning more calories and hence worsening the bone density.

Progressing bone loading and intensity with activity and exercise is necessary for bone acquisition in the healthy population. However in under-weight, non-menstruating people we cannot assume the same occurs if weight is not being restored. Progression should therefore happen alongside weight restoration for an optimal outcome. It is also worth noting that muscle is heavier by volume than fat, leading to a leaner look and burns more calories than fat.

Although rapid movements are more stimulating than slow movements, exercises should be performed slowly and with control to reduce the likelihood of fragility fractures.

It is vital to maintain normal functional movement.

The types of exercises recommended should include:

- **Strengthening** exercises, especially for the back.
- **Weight-bearing** exercises.
- **Flexibility** exercises.
- **Stability and balance** exercises to reduce the risk of falling.
- **Classes** with controlled movements.

## **Part 2 Strengthening exercises**

Strengthening exercises build bone density because muscle is attached to bones by tendons and as the muscle contracts they tug at the tendons which pull on the bones stimulating bone cell activity. The stronger the pull, the bigger the effect on the bone. These exercises should target specific muscle groups around areas that are most vulnerable to osteoporotic fractures.

To continuously progress these exercises one can change the resistance caused by the pull of gravity on body weight (by using short or long levers) or the addition of weights or other simple equipment.

**1. Back strengthening exercises.** Aimed at increasing bone density and protecting against wedge fractures.

- The most important exercises are ones which encourage back extension, especially thoracic spine extension.
- These exercises are performed lying on the tummy and lifting head and shoulders away from the mat against gravity. (Modified Pilates exercises will be taught with a neutral spine and pelvis.)
- Any exercises performed in four point kneeling or in standing, with the trunk hingeing forwards from the hip will also strengthen the back extensors.
- Many modifications to these exercises involve adding movements of the arms and legs.

**2. Wrist strengthening exercises.** Aimed at increasing bone density and protecting against wrist fractures.

- Wrist curls using dumbbells or resistance bands.
- Arm presses against a wall, push ups, 4 point kneeling exercises and Planks.

**3. Hip strengthening exercises.** Aimed at strengthening the muscles around the hip, improving posture, gait and balance. Any positions involving weight bearing through the hips would also improve bone density.

- Performed In standing, side-lying and shoulder bridge position, four point kneeling and prone.
- Squats (to 90 degrees), step-ups, standing series exercises and swimming in four point kneeling are examples of exercises that facilitate bone density. Hip abduction, clams with a pillow between the knees, swimming series in prone are examples of exercises that will increase strength and stability around the hip and pelvis..

**4. Core strengthening exercises.** Aimed at improving stability around the spine and pelvis to support the spine during everyday activities, optimising posture and balance. They should be performed with a neutral spine.

- The preparation for every exercise in modified Pilates would involve recruiting the core stabilisers. Moving the arm or leg away from the core increases the challenge to the core stabilisers.
- Any exercise can be adapted to eliminate thoracic flexion for example:  
Hundreds/ abdominal series in supine, with head on the mat.  
In the shoulder bridge series lifting the spine as a whole (avoiding articulation).  
In the standing series, hip hinging i.e flexion at the hip without rounding the back (dissociating hip from pelvis).

**5. Foot and ankle strengthening exercises.** Aimed at improving stability and balance.

- Performed in standing.
- Balance exercises, stepping, foot series, one leg stand, standing scooter and simple rises.

**6. Pelvic floor exercises.** The pelvic floor muscles can become weak as a result of the downward pressure caused by vertebral fractures, and this can cause stress incontinence.

- Pelvic floor exercises can strengthen the muscles necessary to reduce or prevent these problems.

## **Part 2 Weight bearing exercises**

These types of exercises work directly on the bones in the legs, hips and lower spine to stimulate bone production.

- **Low to medium impact** (characterised by always having one foot on the floor)
- Examples of this type of exercise are walking and power walking, stair climbing, dancing, steps, aerobics and gym machines such as treadmills for walking, (not running), cross trainers and stair climbers.
- Push- ups, planks and 4 point kneeling facilitate weight bearing through the wrists, an area prone to fragility fractures.
- Swimming, water aerobics and cycling have many benefits, but they are not weight-bearing and don't have the impact on the skeleton required to influence bone strength.

## **Part 2 Flexibility exercises**

Maintaining flexibility is essential for good posture, function and balance. Flexibility also maintains joint wellbeing and protects against pain.

Poor posture increases the risk of fragility fractures and a pronounced kyphotic posture impedes lung function, eating and swallowing. Postural and ergonomic advice should be given as well as breathing exercises.

- Thoracic extension, shoulder girdle retraction, rib cage mobilization, hip flexor stretches
- Rotation and one sided elongation (rather than side flexion) should be in neutral spine and not forced or loaded.

## **Part 2 Stability and balance exercises**

These types of exercises have been shown to help the muscles work together in a way that helps to improve stability and reduce the likelihood of a fall.

- Reducing base of support, shifting weight and challenging balance by closing eyes in standing and high kneeling.

## **Part 2 Classes**

- **Tai chi** is one of the most highly recommended classes for people living with osteoporosis because it is gentle, works in a pain free joint range, strengthens muscles and improves body awareness and balance.
- **Pilates** as previously described.

### 13. Part 1 Effective Exercise

For a diagnosis of osteopenia or osteoporosis where there is a low fracture risk and an individual has never broken a bone easily and is fit and healthy and has restored menstruation and weight.

- It may be possible to slowly begin a bone building programme. If in doubt of the fragility risk, it is always best to be more cautious and seek medical advice.
- Doing too much exercise for the amount of energy consumed will lead to calorific drain. The amount of exercise undertaken should only be as much as is possible to maintain a healthy weight and menstruation.
- If re-starting exercise leads to the return of compulsive or excessive exercise behaviour, help should be sought quickly.
- Begin with what is known to be safe and progress at an appropriate pace for age and ability. Young, fit and healthy individuals with osteopenia will be able to progress further with weight-bearing, level of impact, strength training, sports and exercises than those with osteoporosis.
- With the diagnosis of osteoporosis certain exercises and activities should always be avoided and these include, flexion (forward bending) of the spine in standing, rolling like a ball on the spine, the collapsed 'C' curve and sit-ups and crunches. Loaded twisting and side bending exercises and those combining flexion with twisting should also be avoided. The 'clam' exercise and bridging can be adapted for safety. For more information see Part 2 "What to avoid".
- Sports and activities can be adapted to lessen risk and weighing up the benefits of a bone building programme against the possible risk of fracture is important.
- Finding appropriate exercise and activities that are enjoyable are a good idea.
- Consult a Physiotherapist where possible and always seek professional guidance before working out in a gym. Clinicians with knowledge of osteoporosis are the preferred option.

Bone is a living tissue and responds to increases in loads and forces by growing stronger. Exercise should therefore progress with time, gradually increasing in difficulty to be stimulating.

Bone responds to intensity, not duration, meaning that it responds to a force greater than it has been used to, not a repetition of the same force. So after about 10 minutes of repetitive exercise, bone will stop responding. Types of exercise and activities should therefore change frequently. A hold for some exercises may allow time for the bone to 'load'.

Rapid short bursts of high impact activities such as jumping, jogging, running up and down stairs and skipping are more stimulating to bone cells than low impact activity such as walking.

Moderate to high intensity weight-bearing exercise such as team sports, racket sports, aerobic classes and some forms of dancing have been shown to increase bone density.

High intensity progressive resistance training such as resistance machines, free weights, resistance bands have been shown to have a positive effect on bone.

Strengthening exercises build bone density because muscle is attached to bones by tendons and as the muscle contracts they tug at the tendons which pull on the bones stimulating bone cell activity. The stronger the pull, the bigger the effect on the bone. It is best to target specific muscle groups around areas that are most vulnerable to osteoporotic fractures.

Mixed weight-bearing exercise classes such as aerobics, step classes and Pilates provide a variety of bone-loading exercises, proven to be successful for improving bone density.

Exercise must be regular, at least three times a week to maintain or increase the stimulus and maintain the adaptation.

If exercise needs to be reduced, it is better to reduce the length of each session rather than the number of sessions per week.

Swimming and cycling are non-weight bearing and hence do not enhance bone density. When choosing an exercise regime more suitable forms of exercise would be more appropriate.

## **Becoming Healthier Inside and Out**

A health promotion message relevant to ED might be as follows,

“You may think that how you feel you look on the outside (how you picture your size, shape and appearance and your feelings towards it, known as your body image) is the most important thing right now, but soon you will begin to realise that how you look on the inside (the state of your bones) will have the greatest impact on your future. Osteoporotic spinal fractures can change your posture and your height therefore affecting how you actually look in the future. If you want to avoid this, you can start today by following the advice in this document and becoming healthier inside and out.”



## 14. Future Research

I suggest this is an important area for research.

“Do back extension exercises in those with Anorexia Nervosa, result in any improvement in BMD in the spine or decrease the number of wedge or compression fractures, as has been shown in people with low bone density who are of normal weight?”

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Yvonne Hull, Specialist Physiotherapist Eating Disorder Service, Bristol

Dana Bregman, Physiotherapist and APPI Pilates Instructor.

Jody Phillips, Specialist Physiotherapist, Regional Eating Disorder Unit, Edinburgh

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