Consultation Draft:

Strong, Steady & Straight: An expert consensus statement on physical activity and exercise for osteoporosis

All comments on this consultation should be submitted on the consultation response form available online. Further details available here. Please submit your form to s.leyland@nos.org.uk by 8 October 2018.

Please note that this consultation document has not been professionally proof read. Typographical errors and grammar will be corrected prior to final publication. An additional summary document will accompany this statement.
STRONG, STEADY & STRAIGHT: AN EXPERT CONSENSUS STATEMENT ON PHYSICAL ACTIVITY AND EXERCISE FOR OSTEOPOROSIS

This statement provides recommendations for best practice based on evidence and expert consensus principles.

Background

Fragility or osteoporotic fractures are common especially in older age, and have a huge personal impact and economic cost to society [figure 1]. Fragility fractures cost the National Health Service (NHS) an estimated £4.4 billion per annum. For the individual, these fractures (especially in the hip and spine) can lead to loss of independence, disability and reduced life expectancy. Vertebra fractures* are also associated with long-term pain and other physical and psychological symptoms. 

Definition of osteoporosis used in this document*

The term osteoporosis is used throughout this statement as an umbrella term to include someone with low bone mineral density (BMD) in the osteoporosis range or a significant fracture risk (based on fracture risk assessment) with or without fragility fractures (including vertebral).

* Vertebral fractures (or spinal fractures) as a result of osteoporosis, can be ‘silent’ and cause no pain or symptoms. However, some vertebral fractures cause acute pain at the time of the fracture. In addition, (and particularly after multiple fractures) people with a vertebral fracture may experience shortening of the trunk and height loss, leading to abdominal discomfort, long term back pain, breathlessness, issues with body image and low self-esteem.
It is widely understood that exercise helps to make bones strong, but a lack of clarity exists about the role of physical activity and exercise for bone health and prevention of frailty, and for people with osteoporosis [figure 2] in particular. Many guidance documents warn against ‘forward-bending’; high-impact-exercise (often interpreted as anything more than brisk walking) and lifting weights. This is based on a theoretical increased risk of vertebral fracture through increasing force or strain through the bones by high intensity resistance, high-impact exercise or increased load on the spine. Some guidance originally developed for those with vertebral fracture has been generalized to all those with osteoporosis. For some health and exercise professionals, uncertainty around what is appropriate or safe persists, and may be accompanied by concerns about liability. As a result, people with osteoporosis often find the advice provided to be inadequate, confusing, varied or inconsistent.

People with osteoporosis want to know what type of physical activity and exercise they need to do to effectively maintain or improve their bone strength. Even where the evidence is inconclusive they are keen to incorporate non-drug approaches where they feel they are participating and taking some control in the management of their condition. They fear, however, that some types of physical activities and exercise interventions may be unsafe and may cause fractures, especially in the spine. They worry as to whether, or how, they should modify moving, lifting, sports and leisure activities to prevent a vertebral fracture occurring. People living with painful vertebral fractures are often unaware that specific exercise interventions might help relieve pain. As a result, people significantly reduce activity levels, limiting both function and enjoyment. This may have important adverse implications for their bone health, falls and future fracture risk.

In fact, for the vast majority of adults and older adults, taking part in activities that promote muscle and bone strength is safe and will help maintain or improve function, irrespective of age or health. Giving people confidence about exercise for osteoporosis by means of authoritative and effective guidance may also prompt an increase in physical activity and exercise. This will have wider beneficial effects on physical, social and psychological health, wellbeing and self-efficacy.
PURPOSE AND OBJECTIVE
The document is intended for UK health professionals, exercise professionals, policy makers and those commissioning services. It was developed by an Expert Group of clinicians scientists and practitioners (see Appendix) from the UK. The objectives of this document are to:

- Clarify the role of physical activity and exercise for bone strength, reducing falls and fracture risk reduction.
- Explain any safety issues for those with osteoporosis, and especially to address fears of causing fracture (particularly in the spine) whilst engaging in exercise or day-to-day activities.
- Clarify the role of exercise to help with the pain and symptoms of vertebral fracture.
- Promote confidence and a positive approach so that people with osteoporosis do more rather than less exercise and physical activity.
- Ensure consistent advice for people with osteoporosis so that people are exercising safely and effectively.

This document updates the principles underpinning previous guidance on exercise and physical activity [figure 3] and distils current research evidence on the subject. It is designed for UK health and exercise referral systems. It integrates as far as possible with broader UK government recommendations about physical activity for health.

Physical activity refers to any bodily movement produced by skeletal muscles that results in energy expenditure. This could be anything from walking to the shops, taking part in activities of daily living such as gardening or taking part in occasional leisure or sporting activities.

Exercise is defined as physical activity that is planned, structured, repetitive and purposive in the sense that improvement or maintenance of one or more components of physical fitness is an objective. This could be anything from regularly attending a gym or exercise class to regular and repetitive sporting activities.

This document also supplements reference to the role of exercise in existing UK clinical guidance on osteoporosis management. It endorses the current clinical approach to osteoporosis management - that exercise should complement rather than replace the use of pharmacological therapies recommended for those with a significant fracture risk to improve bone strength.

The authors recognise the current limitations of the research evidence as identified in existing guidance. Trials investigating the effectiveness of exercise interventions rarely have clinical primary outcomes (fracture), and rely on proxy measures e.g. Bone Mineral Density (BMD) measured by Dual X-ray Absorptiometry or Quantitative Computed Tomography (QCT). There is also a lack of data relating to men, people with osteoporosis and older frailer people. Research indicates that those with the lowest bone density may have the greatest potential for improvement through
exercise, however those who have frequent fractures may still in practical terms not be able to exercise at a frequency, intensity or duration necessary to improve their bone strength to the extent that they no longer fracture.

Due to the lack and limitation of the research evidence confirming the benefits of exercise, the phrase 'promote bone strength' rather than 'improve bone strength' is used throughout this document, unless there is discussion about one specific aspect such as changes or improvements in BMD, preventing loss of or maintaining bone strength or reduction in fracture risk, when this is specified. Where the evidence was insufficient or conflicting, the Expert Group reached a consensus based on potential benefits and the key principles derived from other national statements, in order to make recommendations.

Further research is recognized as as important, and research recommendations will be developed in a future document.

Using this document

This document is structured around three themes for physical activity and exercise for osteoporosis - Strong, Steady & Straight. Under each theme recommendations are specified for all people with osteoporosis (defined broadly* figure 2) with additional recommendations for those with vertebral fractures (or with marked fragility who usually will have had multiple fragility fractures) and for those who are frail and unsteady or those experiencing falls. Themes will have more relevance for individuals depending on their needs or preferences.

Recommendations are made in each section based on the evidence reviewed or expert consensus reached.
SUMMARY:

PRINCIPLES AND KEY RECOMMENDATIONS

PRINCIPLES

- **Physical activity and exercise has an important role** in the management of osteoporosis. It has the potential to reduce fracture risk by promoting bone strength and reducing falls risk. Exercise may also help with the management of the symptoms of vertebral fracture.

- **People with osteoporosis should be encouraged to do more rather than less.** This requires professionals to adopt a positive and encouraging approach focusing on ‘can do’ messages rather than ‘don’t do’. Although specific levels and types of exercise are likely to be most effective, even a minimal increase in physical activity should be encouraged to provide at least some benefit.

- The evidence indicates that **exercise is not associated with significant harm including vertebral fracture**, though some caution is advised for people with a vertebral fracture, marked bone fragility (multiple other fractures) or for those at a high risk of falling in general, the benefits of exercise outweigh the potential risks.

- Professionals need to be careful to **avoid restricting exercise unnecessarily according to bone mineral density (BMD) or fracture risk thresholds** as these are often unhelpful and may discourage exercise or activities that promote bone as well as other health benefits.

- **People with painful vertebral fractures need clear and prompt guidance** on how to adapt movements involved in day-to-day living, including how exercises can help with posture and pain. Anyone with osteoporosis may benefit from guidance on amending some postures and movements to care for their back.

KEY RECOMMENDATIONS

Statements in the recommendations are based on available evidence [marked E] or on expert consensus for best practice where limited or no research evidence is available [marked C].
STRONG
Outlines the type, intensity including duration and frequency, or amount, of physical activity or exercise needed to promote bone strength. It also addresses safety concerns about impact or increased muscle loading causing vertebral or other fractures. This is relevant for all groups seeking information about how to exercise to promote bone strength→ p.8

For all people with osteoporosis (with or without fractures)

➢ A combination of impact and muscle strengthening exercise, is recommended to promote bone strength. Either type alone may provide some benefit and individual skeletal sites may benefit from one type more than another [E]

➢ Variety is important to load the relevant skeletal sites with forces in different directions. People should gradually build up their levels of activity and exercise and aim to maintain an exercise regime in the long term [E]

➢ Muscle strengthening exercise is recommended to maintain bone strength and should include progressive muscle resistance training - up to moderate or high intensity is recommended to promote maximum benefit to bone strength [E]

➢ Daily physical activity is recommended, spread across the day avoiding prolonged periods of sitting [C]

In addition:

For people with osteoporosis without vertebral fracture or marked fragility (multiple other fractures)

➢ Impact exercise up to a moderate level is recommended (e.g. jogging, low-level jumping, hopping) [C]

For people with vertebral fractures or marked fragility (multiple other fractures)

➢ Impact exercise at a lower impact level (eg. brisk walking rather than jumping) is recommended. This a precautionary measure because of potential (but unproven) risks of causing further vertebral fracture in this group * [C]

➢ Individualised advice from a physiotherapist is recommended to ensure good spinal alignment and correct technique (at least for those with painful vertebral fractures at the start of a new programme of exercise or activity) [C]

*Moderate impact in some situations might be appropriate if the vertebral fracture didn’t occur during a specific impact exercise and impact levels are increased gradually (see pg 14-15 for further details) [C]

For people with osteoporosis who are frail and/or less able to exercise

➢ Physical activity and exercise to maintain bone strength should be adapted according to individual ability [C]

➢ Strength and balance exercise to prevent falls may be needed for confidence and stability before physical activity levels to promote bone strength are increased [C]
STEADY
Describes the importance of exercise and physical activity to reduce falls and resulting fractures. This section will be most relevant for people who are frail and/or less able to exercise; people who are falling; and those who have a significant fracture risk and want to increase their exercise levels → p.16

For all people with osteoporosis particularly those with balance problems

Exercise to improve balance and muscle strength is recommended [E]

For people with osteoporosis who are already having falls

Specific and highly challenging balance and muscle strengthening exercises, supervised by a trained health or exercise professional, are recommended [E]

STRAIGHT
Focuses on spine care - keeping the back straight – in a positive approach to bending, lifting and moving safely to reduce the risk of vertebral fracture associated with day to day activities. It also includes advice on developing muscle strength to improve posture and relieve pain after vertebral fractures. This section will be most relevant for: 1) people who have concerns about how to adapt movements to reduce vertebral fracture risk, and 2) people with symptomatic vertebral fractures causing pain or postural problems → p.20

For all people with osteoporosis

Safe techniques for day-to-day moving and lifting are recommended [C]

Movements or exercise that involve sustained, repeated or end-range flexion should be amended or avoided unless someone is already practiced and has no vertebral fractures [C]

Exercises to improve muscle strength in the back are recommended to improve posture and support the spine [C]

In addition:

For people with a vertebral fracture causing pain and posture problems

Daily exercises to strengthen back muscles (with a focus initially on endurance by exercising at low intensity), are recommended to reduce muscle spasm, relieve pain, improve flexibility and promote good posture, with a referral to a physiotherapist for tailored advice [C]
**Physical activity and exercise to promote bone strength and prevent fractures**

Muscles, bones and joints are interconnected systems. As we age, maintaining muscle strength helps to prevent bone loss, keep bones strong, and reduce falls risk. Levels of activity may be reduced but keeping muscles healthy and working well should help to keep bones strong.

Bone is strengthened when muscles and or impact forces [figure 4] create a 'load' on the bone that causes adaptations inside. Bone is constantly repairing and regenerating itself so that it can adapt and respond to the regular pulling, twisting and bending that muscles exert on it. This adaptive response is greatest the higher the intensity and frequency, and in response to force that is 'variable and dynamic'.

Immobility has been established as a major risk factor for fracture. Without the pull of gravity, bone density is reduced. Even with short periods of bedrest for example, bone density and strength are lost rapidly although to some extent this is reversible with remobilisation.

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**Lower-impact activity or exercise** is a broad term that includes activity in which there is a small amount of impact through the bones, including standing or walking. Usually, at least one foot remains on the ground.

**Moderate impact activity or exercise** is when a moderate force is created by pushing off and returning to the ground, usually both feet leave the ground although with less height and force than with high impact activity. This would include running, stride jumps, jump rope, side steps, highland-type dancing, jumps and hops. Sports such as racquet sports, track events, most ball games and martial arts may include moderate impact activity.

*In this statement, ‘moderate impact’ is used to refer to running, jogging, skipping, hopping, low level jumping (from the ground as opposed to a raised surface without exertion as in star jumps). Although the distinction between moderate and high impact is subjective, a pragmatic distinction is made to aid advice to patients.*

**High impact activity or exercise** is when a large force is created on returning to the ground usually from a greater height eg. from a higher jump or from a higher jump to a lower level. This would include landings from exertional jumps such as high vertical jumps, star jumps, tuck jumps, and drop landings. Sports such as volleyball, basketball, gymnastics, and may include high impact activity.

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*Figure 4*
Types of exercise

A combination of weight bearing (with impact) and muscle strengthening (resistance) exercise are important for building, maintaining and improving bone strength (both are sometimes described as ‘load bearing’ exercise):

WEIGHT-BEARING EXERCISE involves the skeleton bearing the whole weight of the body (‘load’) usually through the lower limbs (feet and legs). Moving the body, such as walking will increase load and force through the skeleton. This is described as ‘impact’. Throughout this document ‘impact exercise’ is the term used to denote the optimum type of weight bearing exercise for bone health. Impact physical activity or exercise can be stratified according to intensity of impact [see Figure 4]

MUSCLE STRENGTHENING (OR MUSCLE RESISTANCE) EXERCISE is another way to add load by contracting muscles against an external resistance. This could be applied externally by using resistance bands, lifting a weight or wearing a weighted vest for example. Alternatively, the body’s weight provides the resistance, such as in a ‘wall press up’ or raising the upper body from a prone position to strengthen back extensors.

Muscle strengthening exercise may help to prevent loss of bone strength, however more intense exercise, increasing the load at intervals so that fatigue is reached, is necessary to maximise improvements in bone strength. This is described as progressive resistance training (PRT) [see page 12]

Both impact and muscle strengthening exercise may be provided by physical activities such as day-to-day leisure or sports activities or by a specific exercise programme [figure 6]. PRT will generally need to be supervised at least initially by an exercise professional to ensure good technique, both for effectiveness and safety eg. how best to avoid exacerbating concomitant arthritic conditions. Another consideration is that, moderate intensity aerobic exercise (as recommended in UK government guidance for general health [Figure 5] may strengthen muscles (although probably with insufficient resistance to promote bone strength), and may not provide any impact e.g. swimming.

The UK government physical activity guidelines recommend that to maintain or improve physical and mental health, adults and older adults aim to accumulate 150 minutes a week of moderate intensity physical activity (that which makes you warmer and slightly out of breath), engage in muscle strengthening activities at least twice a week and avoid prolonged bouts of sitting. They also recommend that older adults at risk of falls engage in balance training activities at least twice a week

Professionals therefore need to help people to find the most beneficial combination of exercise bearing in mind that personal preference and enjoyment will be important for successful participation. Those who cannot manage incorporating both impact and muscle strengthening exercise should be encouraged to do what they can as some benefit to bone strength may be provided by one type.

Promoting bone strength at specific skeletal sites

As the effects of exercise on bone are site specific, exercises may be needed for different skeletal sites. Whilst not all published studies have clearly indicated the specific exercises employed, examples of some of the exercises that increased bone density (or reduced rates of loss) at particular sites are listed below [figure 6].
### Research evidence

#### Types of exercise

- The combination of impact and muscle strengthening exercise best promotes bone strength \(^{25}\) as reflected in other national guidance \(^{10\ 11\ 26\ 27}\)

#### Specific sites

- Impact exercise maintains or improves BMD in the hip \(^{28}\)
- High intensity muscle strengthening exercise may maintain or improve BMD at the hip \(^{25\ 29\ 30}\) and spine \(^{29\ 30}\)
- High intensity muscle strengthening exercise, in combination with impact exercise maintains or improves spine BMD \(^{25\ 31}\)
- Improving the strength of back muscles may maintain or improve BMD in the spine and reduce the risk of vertebral fracture \(^{32}\)
- Sports such as tennis that involve impact through the forearm are associated with higher BMD at the wrist and forearm \(^{33\ 34}\)

### Recommendations

#### Types of exercise

- A combination of impact and muscle strengthening exercise, is recommended to promote bone strength. Either type alone may provide some benefit and individual skeletal sites benefit from one type more than another \([E]\). (see below)

- Variety is important to load the relevant skeletal sites with forces in different directions. People should build up their levels of activity and exercise gradually and aim to maintain an exercise regime in the long term \([E]\)

#### Site-specific recommendations

- All sites: muscle strengthening exercise that targets all the main muscle groups is recommended to maintain bone strength across the skeleton, and to promote bone strength especially at key fracture sites, the wrist, spine and hip \([E]\)

- Spine: A combination of impact and muscle strengthening exercise is recommended with specific back exercises targeting the spinal muscles \([E]\)

- Hip: Impact exercise is recommended \([E]\)
Figure 6. References: (Giangregario 2016, Beck 2017, DoH 2011, Strain 2016, Foster & Hillsdon 2018)

SUMMARY

Weight-bearing impact:
Most days of the week, do 30 moderate intensity ‘imparts’ – some jumping, dancing, hopping.

If you are less well or mobile, or have vertebral fractures – do some lower impact like walking, for longer or whenever you can manage. Avoids setting for long periods.

Build muscle:
2-3 times a week, do muscle strengthening exercise that work on upper and lower body for most bone benefit. Work your muscles at a load/resistance that makes the last repetition hard to do (local muscle fatigue). Back exercises and posture training to help with and prevent vertebral fractures.

Improve balance:
If you are less steady, or once 65, 2-3 times a week do some balance exercises. If you feel yourself falling over when you really should have stayed upright, get specialist advice.

SAFETY

With osteoporosis:
Muscle strengthening - ensure proper technique and back/neck straight.
Avoid end range, sustained or repeated forward flexion (bending) unless experienced.
To reduce risk of falls, build progressively and increase intensity and duration according to fitness.
Muscle gradually and aim to do more each day/week for benefit.

With osteoporosis and vertebral fracture:
Avoid jumping/lifting unless individualized supervised advice.

With poor balance:
Prioritize improving balance and strength before increasing physical activity levels.
**Exercise intensity, frequency, duration or amount**

There is considerable evidence available on the effect of increased impact and progressive muscle resistance training on BMD (although very limited evidence on fracture risk).

**Progressive resistance training** (or progressive overload) uses a gradual increase in resistance or weight in training over time, as muscle strength increases to stimulate continued adaptation. In practice, this means exercising to muscle fatigue and increasing the load when the participant is able to lift the load for only 1-2 repetitions over the desired number.  

The presence of frailty or other health conditions may reduce the ability to exercise especially at higher levels of intensity or impact although some evidence is reassuring. Frail individuals are at a higher risk of fracture, but are less likely to undertake physical activity. Reassurance may be required to dispel the idea that exercise is only useful if vigorous. Bone is lost rapidly during inactivity, and preventing this inactivity related loss should be a priority. Although muscle strengthening exercise improves physical function and maintains independence, the evidence supporting exercise or physical activity as an intervention to promote bone strength for frail older people remains weak.

**Research Evidence**

Optimum levels of intensity (both impact or muscle strengthening) and frequency have been described in national guidance from the US, Canada, and Australia and are reflected in this statement.  

**Intensity**

- Recent evidence suggests that older fit women with low to very low BMD gained improvements in BMD using high-impact and high intensity muscle resistance (or strengthening) exercise. However the benefits of high-impact (exertion jumps; jumping from a height) over moderate impact (running, jogging, hopping) is unclear.

- Moderate impact weight-bearing exercise, is more effective than low impact exercise to maintain improve measures such as BMD.  

- There is evidence that high intensity progressive resistance training increased spine and hip BMD.  

- Observations from population studies suggest keeping physically active in later life decreases the risk of hip fracture and that less sitting is associated with higher BMD. This suggests standing and weight-bearing activities may have a protective role in maintaining BMD. However in the context of an exercise intervention, walking may need to brisker than a usual pace to generate sufficient forces to improve BMD.  

- A recent study found it was difficult to modify and increase levels of impact in day-to-day weight-bearing activity because of intrinsic factors linked to frailty and sarcopenia such as gait speed and muscle strength. However, a further study found that reductions in fracture seen with day-to-day physical activity remained
after adjustment for risk factors for frailty such as age, comorbidity, smoking and socio-economic status. 

Frequency/duration/amount

- Physical activity and exercise on a day-to-day basis are associated with improved bone strength and a lower risk of hip fracture. For example, a study of men and women aged 49 - 83 identified that regular walking or cycling, reduced fracture risk by up to 23% relative to hardly ever walking or cycling. 
- Intermittent bursts (1-2 minutes) of moderate impact exercise may be more beneficial to maintain or improve BMD than longer periods of low impact exercise. 
- Two sessions per week of a combination of moderate impact and high intensity muscle resistance exercise or more frequently for impact exercise alone was needed to improve bone density.

Other considerations

There are some groups with specific risk factors for fracture such as people with anorexia and ‘over exercisers’ for whom much of this advice is appropriate. However excessive exercise can increase a negative energy balance and delay recovery and an exercise programme should therefore be individualised for people with these conditions by a multidisciplinary eating disorders team.

Addressing safety concerns especially exercise causing vertebral fracture

Encouraging people with osteoporosis to participate in exercise and physical activity will, in many cases, require professionals to be reassured (and provide reassurance) that it will not cause a fracture, specifically in the spine. To address these concerns, the Expert group specifically investigated the question of whether exercise was associated with any harms.

Research evidence on exercise and safety

The Expert Group conducted a series of mini reviews of the literature to support this document and to add to existing guidance that has considered harms. First, a review was conducted of observational studies, case reports, case studies, and non-RCTs that reported on adverse events and safety issues associated with a wide spectrum of physical activities and exercise interventions in people with osteoporosis. The majority of studies reported no adverse events during the physical activity or exercise intervention, apart from muscle soreness or joint discomfort. However, there was one vertebral fracture moving from supine to prone between exercises, and in two small studies vertebral fractures were associated with extended flexion exercises including sit ups and some yoga positions. There was also one other fracture (dropping a weight on the foot).

The Expert group also updated three previously published systematic reviews (to March 2018) looking at exercise for bone strength, improving symptoms after vertebral fracture, or reducing falls, with a view to both efficacy of and harms associated with the interventions. New studies added since these original reviews confirmed efficacy. There were no reports of significant harms (fractures) associated with the exercise interventions. In particular, there was no evidence of symptomatic vertebral fracture in association with impact exercise or moderate to high muscle
strengthening exercise. There were, however, modest improvements in quality of life, balance, pain and fear of falling.

In a recent study of high impact and high intensity muscle resistance exercise for people with significantly low BMD, there were no reports of fractures although the sessions were supervised by an instructor for technique and overall safety (including falls risk). Further follow up and assessment has not identified any evidence of vertebral fracture in the study group (personal correspondence with Belinda Beck). In a further study, adverse events (both falls and fractures) did not differ significantly between the control and the intervention group but were more common in those undertaking unsupervised exercise (strength, balance and daily moderate to vigorous physical activity) although still relatively rare.

There is some evidence that brisk walking increased fracture risk in a population already at risk of falls and fracture and who perhaps required strength and balance exercises to improve stability before embarking on brisk walking or fatiguing exercise.

Overall, there is little evidence of harms, including fractures, occurring whilst exercising. Furthermore, those cases that were identified comprised a mixture of people with and without osteoporosis (as defined by DXA). Bone strengthening exercises therefore, are unlikely to cause a fracture (and specifically a vertebral fracture) so they do not need to be adapted in those with osteoporosis according to fracture risk or low BMD (including osteoporosis or osteopenia from a DXA scan measurement) [C].

When starting an impact or muscle strengthening programme, factors including general fitness, previous exercise and co-morbidities must be considered. Building up gradually, employing good technique, and monitoring both progress and any adverse effects, is the best approach. Learning correct posture and technique, including a 'neutral spine', is recommended as part of any progressive muscle resistance training.

There are some sports and leisure activities that involve an inherent risk of injurious impact, falling and fracture, such as contact sports, horse-riding and skiing. However, for those who practice these regularly, the benefits provided by the activity, including enjoyment and benefits to muscle and bone strength, are likely to outweigh the risks unless people have had multiple fragility fractures or painful spinal fractures. People with osteoporosis may need some reassurance to continue with activities they enjoy.

The Expert Group recommends more caution however, for people with vertebral fractures or marked fragility (multiple other fractures) who will have greater general bone fragility and a higher risk of further fracture especially if they are wishing to take up these activities without previous experience. A discussion about personal preferences and concerns is recommended to aid decisions about amending or excluding specific leisure or sports activities. An individualised progressive tailoring of intensity, both impact and muscle strengthening exercise, under supervision would be appropriate in this situation. Depending on how fractures occurred and personal perceptions and preferences, increasing impact could be appropriate but progressive muscle resistance training may be preferable to moderate impact exercise in most situations. Balance and muscle strength training will be important for those at risk of falling prior to increasing to activities such as brisk walking.
Recommendations

Intensity, frequency, duration, amount (volume)

For all people with osteoporosis

➢ Muscle strengthening exercise is recommended 2-3 times a week to maintain bone strength either via leisure or sports activity or structured exercise [E]
➢ To promote bone strength (for maximum benefit), muscle strengthening should include progressive muscle resistance training (PRT). In practice this is the maximum that can be lifted 8-12 times. (x 3 sets for each exercise) [E]
➢ All muscle groups should be targeted including back muscles to promote bone strength in the spine [C]
➢ Daily physical activity is recommended as a minimum, spread across the day avoiding prolonged periods of sitting [C]

In addition:

For people with osteoporosis without vertebral fracture or marked fragility (multiple other fractures)

➢ Moderate* impact exercise is recommended on most days to promote bone strength (e.g. stamping, jogging, low-level jumping, hopping) to include at least 50 impacts per session (jogs, hops etc) [C]
➢ Brief bursts of moderate impact physical activity should be considered. - 3-5 sets x10 with reduced impact in between (e.g. walk-jog) [C]

*High impact is not included as there is a lack of information about bone benefit or safety although it may be appropriate for someone practised to continue.

For people with osteoporosis with vertebral fracture or marked fragility (multiple other fractures)

➢ Impact exercise on most days at a lower level* up to brisk walking is recommended, aiming for 150 mins over the week. This a precautionary measure because of theoretical (unproven) risks of further vertebral fracture in this group [C]
➢ Individualised advice from a physiotherapist is recommended for both impact and PRT to ensure good spinal alignment and correct technique, at least at the start of a new programme of exercise or activity [C]

**Moderate impact in some situations might be appropriate if the vertebral fracture didn’t occur during a specific impact exercise and impact levels are increased gradually [C]

For people with osteoporosis who are frail and/or less able to exercise

➢ Physical activity and exercise to maintain bone strength should be adapted according to individual ability [C]
➢ Strength and balance exercise to prevent falls may be needed for confidence and stability before physical activity levels are increased. In practice, falls prevention may be a priority [C] [see pg 16]
Considering falls and fractures

95% of non-vertebral fractures \(^{69}\); and about 20% of vertebral fractures occur following a fall.

Falls and injurious falls are a significant problem in older age, with a third of people over the age of 65 falling every year.\(^{69} \text{ 70}\) There is a difference in the prevalence of fractures at different sites as people age. Younger people who fall may put a hand out to try to break the fall and thus wrist fractures are more common in younger people. In older people, perhaps as result of slower reactions, hip fractures are more prevalent. Hip fractures are associated with increased mortality and morbidity - 20% of people die within a year of a hip fracture, 30% have permanent disability, 40% are unable to walk independently and 80% are unable to carry out activities of daily living (ADLs) one year after the fracture. \(^1\)

Falls: causes and risk factors

Risk factors for falls include: having had a fall in the last year; poor strength; poor balance; poor posture; bad eyesight; poor foot health; continence and health issues such as Parkinson’s disease; having had a stroke; and dementia). In an ageing body, fear of falling and concerns about comorbidities can lead to a vicious spiral of inactivity. This in turn leads to a reduction in the ability to maintain an independent lifestyle and the potential for increased risk of injury. \(^{70}\)

Gait problems and use of walking aids, along with difficulties in everyday tasks and fear of falling almost double the risk of a fall. \(^{71}\) Furthermore, people with vertebral fractures are more likely to have kyphosis or forward-flexed posture, which is associated with impaired balance \(^{72}\) - 64% of people with kyphosis had had a fall in the previous year. \(^{73}\)
Integrating specific exercises to prevent falls

Falls risk, including problems with gait, muscle strength and balance, is modifiable with exercise. Weight-bearing activities will help muscle strength and balance to some extent, although this can become more difficult in older age. Falls services should provide an assessment for multiple risk factors for falls, and advice on appropriate interventions, including a specialist falls exercise programme (with balance training) where available. A multi-factorial approach should include medication review and general health assessment (e.g. eyesight). Environmental factors may need to be considered to address other risk factors.

Balance training is defined as the transfer of bodyweight from one part of the body to another or challenges specific aspects of the balance systems (e.g. vestibular systems) and balance retraining is defined as the re-education of basic functional movement patterns to a wide variety of dynamic activities that target more sophisticated aspects of balance.

How professionals communicate the benefits of falls prevention exercise is important. Most people do not perceive themselves as fallers or as frail. People need to be motivated to take part in strength and balance exercise to prevent falls by using appropriate language. Terms such as ‘maintaining independence’ and ‘reducing the risk of fractures’ (rather than ‘fall prevention’) are helpful. Emphasising the importance of balance to feel confident and be able to enjoy other activities may also be useful.

Research Evidence

- Those who meet the UK Government physical activity guidelines for health are less likely to fall or injure themselves.
- Exercise reduces fear of falling to some extent - at least immediately after the intervention.

Types of intervention

- Not all exercise modalities reduce falls. Interventions that do not challenge balance sufficiently (e.g. seated programmes) have shown little or no effect on falls rates in people who are already falling, despite improvements in known risk factors, such as strength.
- Individualised and supervised strength and balance interventions are most effective for those at risk of falls, including those with significant risk of fracture. Most research studies had an instructor to participant ratio of <10 in the supervised sessions.
- Highly challenging balance training and muscle strengthening at least 3x per week reduces falls and possibly fracture risk.
- Two UK programmes, the Otago exercise programme and the FaME (PSI) programme are evidence-based and cost effective.

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Challenging balance exercise means attempting a level not yet mastered (i.e. the entire time, distance or activity cannot be completed without losing balance). Highly challenging balance exercise means that the person feels more than wobbly whilst doing the activity, they may need to take a compensatory step or temporarily hold on to a support to retain their balance.
Tai Chi has been shown to reduce risk of falls in people with mild deficits of strength and balance. However, if it has to be significantly modified to allow those with poor balance to participate (e.g. seated versions or versions without weight transfer) then Tai Chi loses its ability to improve lower limb strength, balance and falls risk.

There is currently not enough evidence to recommend *dancing* as a falls prevention activity, though it may have the potential to reduce future falls risk.

**Frequency & amount of intervention**

- For someone with a history of falls, 3 hours a week for at least 4 months (>50 hours total) is needed to effectively reduce falls. The effect is optimised if the exercise is ongoing, as the fall risk reduction quickly diminishes if exercise stops.
- Interventions that do not provide a sufficient dose have shown little or no effect on falls rates in people who are already falling. Trials that have shown a reduction in falls rate and risk include highly challenging balance exercise with a moderate to high intensity muscle strength training component.
- Walking alone does not reduce falls risk nor improve strength or balance and brisk walking may increase risk of falls and fractures in those with a falls history. For the frailer adult or those with a history of injurious falls, gradual progression from strength and balance activities to brisk walking or activities that work on stamina or endurance, may avoid an increase in falls risk.

**Evidence specifically concerning people with osteoporosis**

- A qualitative study, involving women with osteoporosis who had completed balance training, found that they perceived improved empowerment and self-efficacy after participation in balance training, resuming activities they had stopped and becoming more active and independent in daily life using safety precautions and fall-prevention strategies.
- One study in people with osteoporosis, showed that strength and balance exercise reduced pain and improved balance and co-ordination, without any adverse events.
- In people with vertebral fractures, improving back muscle strength may indirectly help reduce falls risk by reducing kyphosis, although the research evidence is limited.
- Integrating a falls screening programme into routine osteoporosis care is justified and feasible given the proportion of people with osteoporosis who screen positive for being at risk of falling.
Recommendations on strength and balance exercise to reduce falls and fractures

For all people with osteoporosis (particularly those aged 65 or who have poor balance)

- Physical activity or exercise to improve balance and muscle strength is recommended [E]
- Balance and muscle strength exercise (including activities such as Tai Chi, Dance, Yoga and Pilates) are recommended at least twice a week to reduce the risk of falls especially in older age [C]

For people with osteoporosis who are already having falls

- People who fall repeatedly or have started to avoiding activity as a result of concern about falling, should be referred to a local falls service [C]
- Exercise interventions to prevent falls should be tailored to suit the individual to ensure that they challenge balance without increasing falls risk [E]
- Specific and highly challenging balance and muscle strengthening exercises, supervised by a trained health or exercise professional, are recommended [E]
- Highly challenging balance and muscle strength training for 3 hours a week over at least 4 months is recommended – this could be around 25 mins/day or 3x 1hr sessions a week [E]
- The Otago or FaME (PSI) exercise programmes are recommended [E]
- Gradual progression from strength and balance exercises to higher impact exercise (such as brisk walking) is recommended for the frailer older adult to prevent an increase in falls risk [C]
- Exercise to strengthen back muscles and improve posture should be considered to reduce falls risk [C]
- Advice about reducing falls risk should be communicated in a positive way to be relevant and effective [E]
The ‘spine caring’ approach

This section addresses the need for people with osteoporosis to work on good posture (keeping the upper back straight) while lifting and moving. Strengthening back muscles should improve posture and reduce the pain and other symptoms of vertebral fractures and may help reduce the risk of vertebral fractures. These two principles of ‘good posture’ and ‘strong back muscles’ can work together in a cycle to promote positive outcomes [Figure 7].

![Diagram showing the relationship between good posture and strong back muscles](image)

*Figure 7*

Many people experience fear about simply moving, lifting and everyday living after a diagnosis of osteoporosis. They have heard that they could cause a vertebral fracture by stretching, bending (‘flexion’), lifting or twisting as part of everyday living moving, or during exercise practices such as Pilates or Yoga. Consequently, they limit what they do to reduce the perceived risk. As well as causing distress, this may be at the very time that they need to increase activity to maintain muscle and bone strength. These concerns particularly affect those with painful vertebral fractures who are worried that movements may exacerbate pain as well as precipitate further fractures.
Mechanics of spinal movement
Forward flexion of the spine puts increased force on the anterior surface of the vertebral bodies. This region of the vertebrae contains a lower composition of cortical bone than the posterior surfaces and may be at a higher risk of fracture. It is the arching or excessive curving of the spine that significantly increases force on the anterior vertebrae - not all ‘leaning forward’ movements.

As a result, other national guidance has recommended that people with vertebral fractures or diagnosed osteoporosis avoid rapid, repetitive, weighted, end-of-range-of-motion movements, rotation or flexion of the spine during exercise, such as lifting weights with a flexed spine, sit-ups and end of range yoga and Pilates postures (see Appendix), rapid or loaded twisting in sports such as golf.

Day-to-day movements - bending forward and lifting, twisting and stretching
Some degree of flexion or forward bending is unavoidable in day-to-day living and assessing bone strength and risk of fracture in a meaningful way is difficult when providing advice about moving and lifting safely. Many older people will have undiagnosed vertebral fractures, low BMD (osteopenia or osteoporosis) and people who have very fragile bones may break them anyway, despite making modifications. The recommendations, below, are pragmatic and suitable for anyone seeking advice to reduce vertebral fractures. They will be most important for those who have a significant risk of further fractures, and for those with existing vertebral fractures or multiple other fragility fractures in particular.

Research evidence
Most vertebral fractures occur as part of everyday living. However the evidence in relation to particular day-to-day movements, or amending them to avoid fracture, is very limited.

Recommendations have been described in national guidance from the US, Canada, and Australia and are reflected in this statement.
Recommendations about moving, lifting and day to day activities to reduce vertebral fracture risk whilst maintaining activity levels

For all people with osteoporosis

➢ A positive and reassuring approach is recommended to reduce fear, enhance confidence and control - ‘how to’ rather than ‘don’t do’ especially as most people with osteoporosis are unlikely to experience a vertebral fracture during these activities [C]
➢ Exercises to improve muscle strength in the back are recommended to improve posture and support the spine. Repeated 3-5 times and held for 3-5 seconds at least twice a week [C]
➢ Safe techniques for day-to-day moving and lifting are recommended (see Appendix) [C]
  - ‘Think straight’ - a straight upper back (and keeping the neck in line with the spine) is the key principle for all movements that involve bending and lifting.
  - Flexibility and function remain important and should be encouraged.
  - Safe lifting techniques are recommended rather than instructions such as ‘don’t lift’ or to only lift up to a specific weight
  - The ‘hip hinge’ is a simple technique for safe bending that facilitates this and can be practised and integrated into all day-to-day movements.
  - Always move in a smooth, controlled way within a comfortable range.
  - Tighten core muscles during movements.

For people with painful vertebral fractures

➢ Prompt moving and lifting advice is recommended soon after painful vertebral fractures to reduce fear and maintain mobility [C]

End range or sustained flexion in exercise programmes including Yoga and Pilates

Exercise routines that involve sustained, repeated end range flexion or extension movements such as the ‘roll down’ in Pilates, some yoga positions and flexion exercises such as ‘sit ups’, are often considered contraindicated in people with osteoporosis 89 although there is some uncertainty and controversy about the need to modify exercises and for whom 90. Sometimes excessive curving or arching of the back, or excessive strain on back muscles occurs during other forms or exercise when an exercise is performed incorrectly.

The evidence confirming the precise group which is most at risk of fracture is limited although some strategies have been proposed. Therefore, the recommendations made are precautionary, and reflect the fact in many cases there are alternative moves or exercises that can provide similar benefits in terms of flexibility and muscle strength. [see Appendix 2].
Research evidence

- In one study, increased risk of vertebral fracture during flexion exercise was in a group with radiographic osteopenia - diagnosed on X-Ray; reports of vertebral fracture linked with flexion in yoga were in women with osteopenia. The numbers of harms reported were very low. [see page 13-14]

Recommendations about flexion in exercise (such as Yoga & Pilates)

**For all people with osteoporosis**

- Movements or exercise that involve sustained, repeated or end-range flexion should be amended or avoided [see Appendix] [C]
- Any exercise that either causes the back to curve or arch excessively or creates excessive strain on the back should be avoided or the technique corrected [C]

**In addition:**

**For people with osteoporosis without vertebral fractures**

- People who are experienced, demonstrate flexibility in the spine and can manage the moves comfortably and smoothly, should be advised that they can continue with these activities as long as they are fit enough to manage them with ease [C]

**For people with osteoporosis with vertebral fractures**

- People want to attend Yoga classes or Pilates classes should be advised to attend those designed for higher-risk or older adults, led by an instructor who has been trained to work with individuals with osteoporosis, who can amend exercises to their ability and range of movement [C]

**Exercise interventions to improve posture and reduce pain caused by vertebral fractures**

Vertebral fractures caused by osteoporosis can be symptomless, characterized only by a loss of height, but for some people cause acute or persistent pain. Pain that persists is usually due to postural changes and kyphosis resulting in muscle spasm, ligament strain and trapped nerves.

Postural changes can result in breathlessness, continence problems, and abdominal protrusion which affects body image and self-esteem, and causes practical problems such as getting clothing to fit.

Research evidence

- There is some limited evidence that advice about posture and both generalized exercise programmes and specific exercises such to strengthen the back extensor muscles can help with pain and symptoms of vertebral fracture.
- Exercise promotes well-being and helps relieve pain.
- Spinal extension exercises may improve posture and help to resist kyphosis.
Recommendations about exercise to help with pain and other symptoms of vertebral fracture (pain, height loss and kyphosis)

For people with symptomatic vertebral fractures

- **Daily exercises to strengthen back muscles (with a focus on endurance by exercising at low intensity), reduce muscle spasm, relieve pain, improve flexibility, and promote good posture** are recommended with a referral to a physiotherapist for tailored advice. Repeated 3-5 times and held for 3-5 seconds [C]

- **General advice about moving, exercise and physical activity** should be provided promptly without waiting for a referral to specialist services [C]

- **Maintaining physical activity and exercise is recommended** to address pain and improve well-being [C]

- **Professionals should explain how exercise interventions may help** with back pain as people are fearful that exercise will make pain worse [C]

- **Yoga and Pilates and similar exercise programmes should be considered** to help with posture and pain through teaching form, alignment and muscle strength and relaxation [C]

- **Breathing and pelvic floor exercises** are recommended to help with other symptoms that may be exacerbated by severe spinal kyphosis [C]
References:


52. Stattin K, Michaëllson K, Larsson SC, Wolk A, Byberg L. Leisure-time physical activity


60. Knutsnor S; Leyland S; Skelton D; James L; Cox M; Gibbons N; Clark E. Adverse events and safety issues associated with physical activity and exercise for adults with osteoporosis and osteoarthritis: A systematic review of observational studies and an updated review of interventional studies. J Frailty, Sarcopenia Falls (in Press. 2018).


87. Committee IOF, Advisors S, Minne HW, Iof C. Invest in Your Bones Move It or Lose It
https://www.iofbonehealth.org/sites/default/files/PDFs/WOD
Reports/move_it_or_lose_it_en.pdf.


Appendix 1

Glossary

**Bone Strength** is a composite term used to describe how resistant a bone is to fracture. The strength of a bone is dependent on how much mineral it contains as well as the shape size, internal architecture, and metabolism (turnover). Data are limited as to whether an intervention such as physical activity has reduced fractures because large studies with a long follow-up would be needed. Bone densitometry using dual energy X-ray absorptiometry (DXA) has been used instead as a surrogate measure. Other technologies such as ultrasound and quantitative computed tomography (QCT) may provide additional information about bone strength.

**Bone Mineral Density (BMD or 'bone density').** This was developed to measure how much mineral a bone contains. Bone densitometry, using dual energy X-ray absorptiometry (DXA), is the clinical gold standard for measuring bone and provides a ‘diagnosis of osteoporosis’ in older adults when BMD is significantly below the average young healthy normal range. This is a standardized WHO classification that has been used across intervention trials including those assessing osteoporosis drug therapies. Measures of BMD predict fracture relatively well although they provide a relative, rather than an absolute risk, and are unhelpful in stratifying people for exercise advice. DXA does have limitations including size dependence, being influenced by changes in body composition and being a two-dimensional technique. This means that separate bone compartments (trabecular [spongy] and cortical [shell] cannot be studied, nor the true cross section of the bone. As bone strength is made up of more than BMD, other measures, such as QCT, that overcome some of the limitations of DXA have been introduced.

**Fracture Risk Assessment:** based on fracture and mortality data- assessing the probability of a fragility fracture usually over the next 10 years using clinically proven risk factors, some independent of BMD. Online tools such as FRAX are available for health professionals to use to target those with the highest fracture risk with pharmacological therapies.

**Fragility Fractures** are fractures that result from mechanical forces that would not ordinarily result in fracture, known as low-level (or 'low-energy') trauma, as forces equivalent to a fall from a standing height or less. Vertebral fractures may occur without a fall. Not all fragility fractures are caused by osteoporosis but the term is used, in this document, as is common accepted, to denote osteoporotic fractures.

**Frailty** is a distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves. Older people living with frailty are at risk of adverse outcomes such as dramatic changes in their physical and mental wellbeing after an apparently minor event which challenges their health, such as an infection or a fall.

**Kyphosis** means that the normal curve in the middle section of vertebral column (the thoracic vertebrae) is more pronounced than normal. There are a number of...
reasons for this including postural changes caused by osteoporotic compression (wedge) fractures of the spine.

**Moderate intensity physical activity/exercise (aerobic)** requires a moderate amount of effort and noticeably accelerates the heart rate and makes you feel warmer. The level of activity will be relative to a person’s fitness, so an activity such as dancing may be moderate for a fitter person and vigorous for an unfit or frailer person. Examples include: brisk walking, dancing, water aerobics, heavier gardening and housework chores.

**Sarcopenia** is a syndrome characterised by progressive and generalised loss of skeletal muscle mass and strength with a risk of adverse outcomes such as physical disability, poor quality of life and death. The presence of both low muscle mass and low muscle function (strength or performance) need to be present for the diagnosis.

**Vigorous intensity physical activity/exercise (aerobic)** requires a large amount of effort and causes rapid breathing and a substantial increase in heart rate. Examples include: running, climbing or running up a hill, fast cycling, competition swimming. Generally you would not be able to hold a conversation whilst doing activities at this intensity.

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**Appendix 2 (to be completed)**

**Examples of correct lifting, hip hinging and back muscle strengthening exercises (see NOS website and publications for detailed information)**

How to Move a Box Safely

![Hip hinge - sitting](image_url)
Back strengthening exercises - examples

1. Shoulder Press into Floor

Back Extension exercises – spine muscle strengthening

2. Progression of hands to side rather than under head

3. Progression of hands to side of body

4. Seated alternatives for frail or those with distinct kyphosis that makes floor lying uncomfortable
Appendix 3

Methodology Summary

The Consensus statement was developed using existing systematic reviews, international guidance documents, updating systematic review evidence and gaining consensus through expert opinion. An overview of the process is outlined in Figure 1.

Expert Groups

Two groups were formed to support the different components of the development of the Consensus statement which are outlined below:

UK Expert Exercise Steering Group (EESG):

CHAIR: Professor Dawn Skelton, Professor in Ageing and Health, School of Health and Life Sciences, Glasgow Caledonian University.

Co-ordinator and project lead: Sarah Leyland, Osteoporosis Nurse Consultant NOS

Project officer: Virginia Wakefield NOS

Professor Karen Barker Professor of Physiotherapy at the Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences (NDORMS) at the University of Oxford.

Kate Bennett Clinical Lead Physiotherapist Solent NHS Trust. AGILE vice Chair, Southampton.

Dr Katherine Brook Wavell Physiology and Nutrition Learning and Teaching Discipline Group Lead, Senior Lecturer in Human Biology, School of Sport, Exercise and Health Sciences, Loughborough University.

Dr Emma Clark Consultant Senior Lecturer in Rheumatology at University of Bristol. Consultant Rheumatologist at North Bristol NHS Trust.

Rachel Lewis Clinical Specialist Physiotherapist in Rheumatology, North Bristol NHS Trust.

Dr Zoe Paskins Senior Lecturer and Honorary Consultant in Rheumatology, Arthritis Research UK Primary Care Centre, Research Institute for Primary Care & Health Sciences, Keele University.

Professor Jon Tobias Professor in Rheumatology at University of Bristol, Consultant Rheumatologist and Clinical Director, North Bristol NHS Trust.

Dr Kate Ward Associate Professor, MRC Lifecourse Epidemiology Unit, University of Southampton, Southampton General Hospital.

Dr Julie Whitney NIHR clinical lecturer (physiotherapy), Clinical Age Research Unit, Kings College Hospital, London.

Exercise Expert Working Group (EEWG):
Developing scope

Planned scope and content for the project was confirmed by evidence gathering from stakeholders. This consisted of an online survey completed by 600 people affected by the condition and interested health professionals providing 'free text' responses about what they felt were to key issues and confusions about exercise and osteoporosis. Stakeholder ‘discussion groups’, two for people affected and one for physiotherapists and other health or exercise professionals, were also convened to discuss their issues and questions.

Review and update of existing literature

A number of international osteoporosis guidance documents and reports have been published on exercise and physical activity to improve bone reduce fracture risk and help with symptomatic vertebral fractures. These have examined the published evidence, agreed key principles and have proposed what exercise interventions and physical activity is needed. The EESG agreed that existing international guidance would be used as a basis for this consensus process and a complete systematic review of all the scientific and clinical evidence was not necessary. Our statement would aim to ‘fill’ the gaps and explore new areas,
bringing existing recommendations up to date and making them relevant for the UK.

Members of the EESG supplemented the existing international published guidance by updating key review papers\(^8\)\(^9\)\(^10\) This update focused on effectiveness of exercise and potential ‘harms’ particularly exercise interventions causing fractures. A further review was completed of non-randomized controlled trials and case reports to provide more information about the potential hazards or harms\(^11\).

**Expert Consensus**

Expert Exercise Steering Group Teleconferences

Through teleconference and e-mail discussion the EESG formed the framework for the Consensus Statement. For each component of Strong, Straight and Steady the international guidance, systematic review and updated evidence review was synthesised to answer core questions and determine a set of draft key principles. It was agreed that, as there was limited evidence to answer some of the core questions, the Statement would need to base some recommendations for best practice on agreed principles using expert opinion.

Expert Exercise Working group face-face meetings

Two face-face meetings were held with the EESG and the wider EEWG gather a wider representation of expert views.

**Meeting One (September 2017):** The scope of the statement and evidence synthesis were presented to provide context to the group. The draft framework principles were presented and experts given opportunity to provide open feedback on:

- Whether any areas had not been explored
- The framework was appropriately constructed to be useful for the target audience
- Content of the draft principles

**Meeting Two (January 2018):** This involved a more focused discussion on the wording of the statement and draft principles.

Final agreement on principles and recommendations

After the two face-face meetings the wording of the principles was agreed through e-mail and teleconferences with the EESG. Each member of the EESG was then asked to confirm if they agreed with each of the final principles and recommendations. An external consultation including partnership organisations was conducted before completion of the final draft. (to be concluded)


Scope of consensus determined through stakeholder consultation

Review and update of existing systematic reviews and international guidance

EESG synthesis of evidence development of framework and first draft of principles

Joint EESG and EEWG group face-face meeting one
Presentation of evidence

Joint EESG and EEWG group face-face meeting two

Final agreement of principles and recommendations

Regular EESG teleconferences throughout process to provide advice and feedback