Bone health and heart health

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Bone health and heart health

Understanding osteoporosis

- Osteoporosis is a disease that causes your bones to become weak and brittle
- It is a common disease, and can result in fractures from even simple trauma.
- In fact, it is estimated that a 50 year-old woman has a 40% chance of having an osteoporotic fracture during her remaining lifetime
- Osteoporosis is important because of the problems resulting from these fractures- disability, loss of independence, and even death

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How Bones Change Throughout Life

Key Messages

- The bony skeleton - serves both a structural function, providing mobility, support, and protection for the body, and a reservoir function, as the storehouse for essential minerals.
- It undergoes a continual self-regeneration process called remodeling.
- Remodeling removes old bone and replaces it with new bone.
- Remodeling continues throughout life so that most of the adult skeleton is replaced about every 10 years.

Systemic hormones regulating bone

Calcium Regulating Hormones
Parathyroid Hormone
Calcitriol (Active Vitamin D)
Calcitonin
Sex Hormones
Estrogen
Testosterone
Other Systemic Hormones
Growth Hormone/Insulin-Like Growth Factor
Thyroid Hormone

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Osteoporosis: a global health crisis

- Osteoporosis is a global health epidemic.
- Globally more than 200 million people struggle with bone loss.
- By 2050 the globally there will be up to 21.3 million hip fractures each year.
- The prevalence of osteoporosis varies greatly depending on different studies, geographical regions, and races.
- The highest fracture risks are in the Scandinavian countries (Denmark, Norway, Sweden Finland, Iceland).
- By 2050 globally there will be up to 21.3 million hip fractures each year.

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Osteoporosis burden UK

Burden of disease in the UK

- In the UK over 3,775,000 people are estimated to have osteoporosis[1].
- Over 500,000 fragility fractures that occur in the UK each year[1].
- 21.9% of women and 6.7% of men aged 50 years or more were estimated to have osteoporosis[1].
- In the UK it is estimated that one in two women and one in five men aged over 50 will have an osteoporotic fracture in their lifetime[2].
- Hip fracture is the most serious consequence of osteo- porosis in terms of morbidity, mortality and health care expenditure

1. Willers C, et al. Osteoporosis in Europe: A compendium of coun- try-specific reports, Arch Osteoporos, 2022
2. Van Staa TP, Dennison EM, Leufkens HA, Cooper C. Epidemiology of fractures in England and Wales. Bone. 2001 Dec 1;29(6):517-22.

Why are women more likely than men to get osteoporosis?

- Women tend to have smaller, thinner bones than men.
- Men have more bone mass during growth and develop more muscle mass.
- Women are at greater risk of osteoporosis due to the decrease in oestrogen production at the menopause.

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Secondary osteoporosis

Causes of secondary osteoporosis

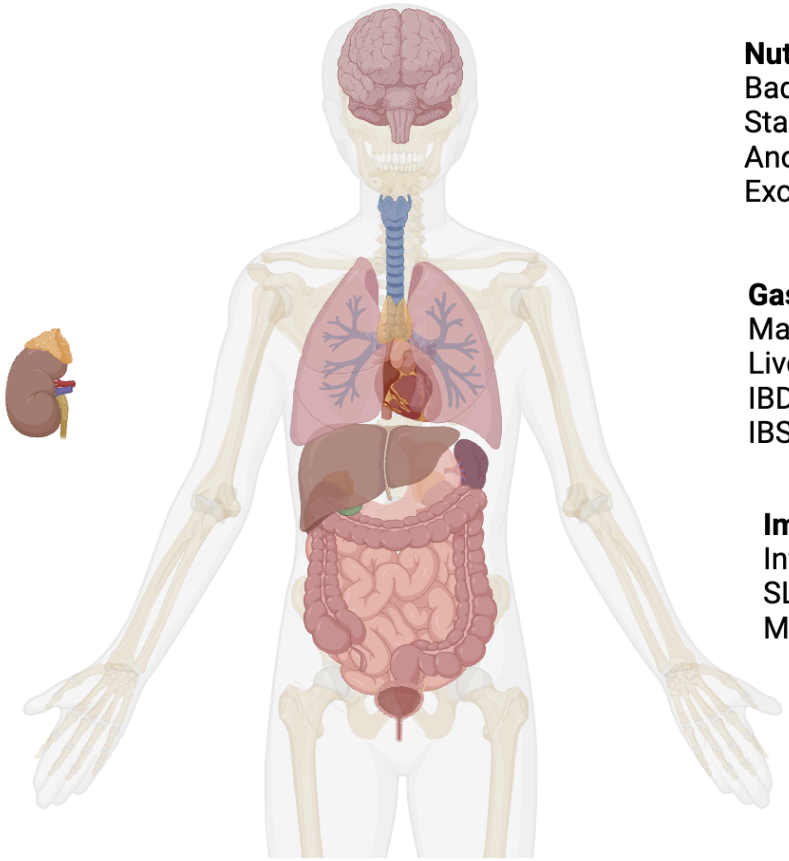
Drug-induced
Steroids
PPI
Anti-epileptics
Anticoagulants

Renal
Hyperparathyroidism
Adynamic bone disease
Osteomalacia
Mixed ROD

Endocrinological
DM
Hypogonadism
Thyroid/PTH disorders

Others
Smoking

Genetic causes



Nutritional
Bad dietary habits
Starvation
Anorexia/Bulemia
Excessive alcohol

Gastro-intestinal
Malabsorption
Liver disease
IBD
IBS

Immunological
Inflammatory arthritis
SLE
Multiple sclerosis

Hemato-oncological
Haemolytic anaemia
Malignancies

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Risk factors for osteoporosis

General

- Age: women 65 and older, men older than 70
- Caucasian or Asian ethnicity
- Family history of osteoporosis
- Has experienced a low-impact fracture
- Maternal or parental hip fracture
- Postmenopausal status

Lifestyle

- Cannot rise from a chair for extended time
- Cigarette smoking (active or passive)
- High alcohol intake (three or more drinks per day)
- Sedentary lifestyle; low physical activity

Nutrition

- High caffeine consumption
- Low calcium intake
- Vitamin D deficiency
- Thin: weight less than 127 lbs; BMI lower than 19

Medications (Long-Term Therapy)

- Aluminum (in antacids)
- Anticonvulsant therapy (phenobarbital, phenytoin)
- Aromatase inhibitor for breast cancer
- GnRH analog for prostate cancer
- Immunosuppressant agents
- Long-term corticosteroid use (5 mg prednisone per day for three months or longer)
- Long-term heparin use
- Parenteral progesterone
- Proton pump inhibitors
- Supraphysiologic doses of thyroxine
- Tamoxifen (premenopausal women)
- Total parenteral nutrition

Medical Conditions

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Diagnosis

DEXA

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Menopause and bone health

Menopause definition: The World Health Organisation (WHO) defines menopause as the complete cessation of menstruation in a woman for one year or more[1]. In the UK, the mean age of natural menopause is 51 years, although this can vary between different ethnic groups.

Bone implication of menopause:

Menopause significantly speeds bone loss and increases the risk of osteoporosis.

During the menopausal transition period, the average reduction in BMD is about 10%.

Approximately half of women are losing bone even more rapidly - 10%–20% in those 5–6 years around menopause.

Estrogen role:

Estrogen affects bone through the following mechanisms:

1. lowering the sensitivity of bone mass to PTH (parathyroid hormone), thus reducing bone resorption
2. increasing the production of calcitonin, thus inhibiting bone resorption
3. accelerating calcium resorption by the intestine
4. reducing the calcium excretion from the kidney

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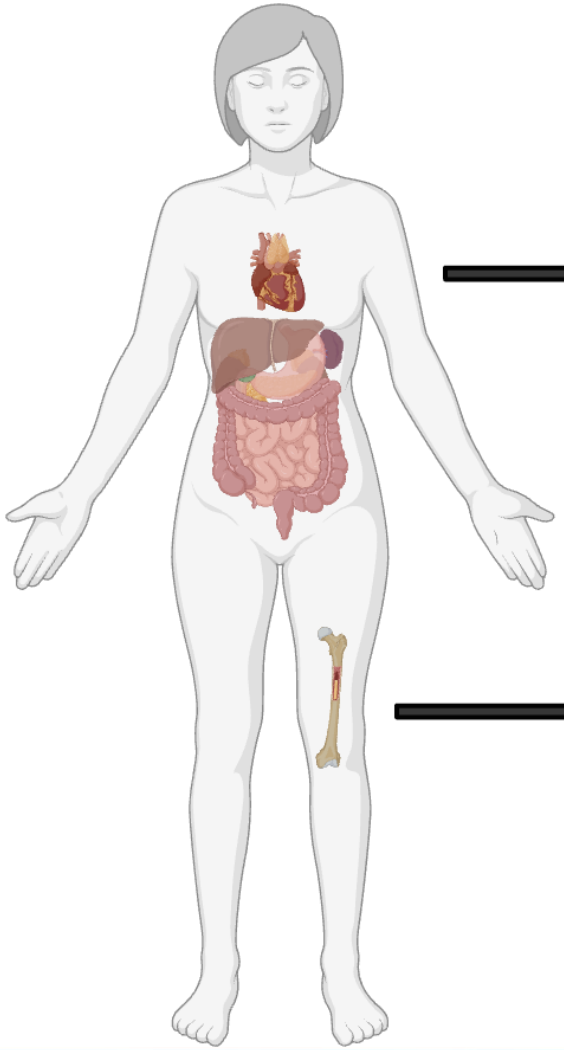
Estrogen deficiency



Estrogen and the heart:

- positive effect on the inner layer of the artery walls
- maintains healthy cholesterol levels

Estrogen and bones:
Estrogen helps to preserve bone density and prevents osteoporosis.

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Shared risk factors

- Aging
- Sedentary lifestyle
- Excess alcohol
- Obesity
- High blood pressure

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Systemic inflammation

- systemic inflammation has been implicated in both atherosclerosis and bone loss.
- ’’Low-grade inflammation’’ and inflammatory mediators—plays an important role in the pathogenesis of both atherosclerosis and osteoporosis[1].
- chronic inflammatory conditions like RA and lupus accelerate these risks to bone and heart health[2].

1. Agca R, Heslinga SC, Rollefstad S, Heslinga M, McInnes IB, Peters MJ, et al. EULAR recommendations for cardiovascular disease risk management in patients with rheumatoid arthritis and other forms of inflammatory joint disorders: 2015/2016 update. Ann Rheum Dis. 2017;76:17–28.
2. Salman-Monte TC, Torrente-Segarra V, Vega-Vidal AL, Corzo P, Castro-Dominguez F, Ojeda F, et al. Bone mineral density and vitamin D status in systemic lupus erythematosus (SLE): A systematic review. Autoimmun Rev. 2017;16:1155–9.

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Vitamin deficiency

Role of vitamin D:

- Helps with calcium absorption from food in the intestine
- Ensures the correct renewal and mineralization of bone
- Helps to keep muscles strong and so reduces the risk of falling

Bone and vitamin D: The consequences of vitamin D deficiency are bone loss, leading to osteoporosis and fractures.

Heart and vitamin D:

- Low vitamin D levels have been shown to be an independent risk factor for development of arterial hypertension, diabetes mellitus, heart failure, stroke, peripheral artery disease, ischemic heart disease, and mortality associated to these conditions [Brewer et al].

L.C. Brewer, E.D. Michos, J.P. Reis. Vitamin D in atherosclerosis, vascular disease, and endothelial function. Curr Drug Targets, 12 (2011), pp. 54-60

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Studies on links between bone health and heart health

Studies on CV mortality: Females with a low bone mass have increased cardiovascular mortality ranging from 22% to 40% per each decrease by one standard deviation (SD) in bone mineral density (BMD) [Kado et al, Van et al].

Studies on cardiovascular disease and bone mass:

- Bone mass is decreased in patients with cardiovascular disease regardless of age [Farhat et al].
- and presence of peripheral artery disease and/or ischemic heart disease is associated to an increased risk of hip fracture [Sennerby et al].
- A significant association has also been reported between the presence of myocardial infarction and low BMD [Magnus et al].
- between the presence of osteoporosis/osteopenia and an increased risk of obstructive coronary disease in both sexes [Perez et al, Varma et al].
- women with osteoporosis have a 3.9-fold increased risk for experiencing a cardiovascular event [Tanko et al].

1. D.M. Kado, W.S. Browner, T. Blackwell, R. Gore, S.R. Cummings. Rate of bone loss is associated with mortality in older women: a prospective study. J Bone Miner Res, 15 (2000), pp. 1974-1980
2. M. Van Der Klift, H.A. Pols, J.M. Geleijnse, D.A. Van Der Kuip, A. Hofman, C.E. De Laet. Bone mineral density and mortality in elderly men and women: the Rotterdam Study. Bone, 30 (2002), pp. 643-648
3. G.N. Farhat, A.B. Newman, K. Sutton-Tyrrell, K.A. Matthews, R. Boudreau, A.V. Schwartz, *et al*.The association of bone mineral density measures with incident cardiovascular disease in older adults. Osteoporos Int, 18 (2007), pp. 999-1008.
4. U. Sennerby, B. Farahmand, A. Ahlbom, S. Ljunghall, K. Michaëlsson. Cardiovascular diseases and future risk of hip fracture in women. Osteoporos Int, 18 (2007), pp. 1355-1362.
5. H. Magnus, D.L. Broussard. Relationship between bone mineral density and myocardial infarction in US adults. Osteoporos Int, 16 (2005), pp. 2053-2062
6. J.L. Pérez-Castrillón, G. Vega, L. Abad, A. Sanz, J. Chaves, G. Hernández, *et al*. Effects of atorvastatin on vitamin D levels in patients with acute ischemic heart disease. Am J Cardiol, 99 (2007), pp. 903-905
7. R. Varma, W.S. Aronow, Y. Basis, T. Singh, K. Kalapatapu, M.B. Weiss, *et al*. Relation of bone mineral density to frequency of coronary heart disease. Am J Cardiol, 101 (2008), pp. 1103-1104

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Poor bone quality is linked to poor heart health

New research by Queen Mary University of London and the University of Southampton's Medical Research Council Lifecourse Epidemiology Unit has found associations between lower bone mineral density and worse cardiovascular health in both men and women [1].

Lower bone density (the amount of bone mineral in bone tissue) is linked to stiffer arteries (a sign of poor heart health).

People with poor bone quality have a higher risk of dying from coronary heart disease– when the arteries supplying the heart with blood get clogged up with fatty deposits.

1. Poor Bone Quality is Associated With Greater Arterial Stiffness: Insights From the UK Biobank'. Zahra Raisi-Estabragh Luca Biasiolli Jackie Cooper Nay Aung Kenneth Fung José M Paiva Mihir M Sanghvi Ross J Thomson Elizabeth Curtis Julien Paccou Jennifer J Rayner Konrad Werys Henrike Puchta Katharine E Thomas Aaron M Lee Stefan K Piechnik Stefan Neubauer Patricia B Munroe Cyrus Cooper Steffen E Petersen Nicholas C Harvey. *Journal of Bone and Mineral Research*

Study: Bone health, cardiovascular disease and imaging outcomes in UK Biobank: a causal analysis

Aims: Our study involving 485,257 participants (55% women, mean age 56.5±8.1 years) examined the relationship between bone health and cardiovascular health in the UK Biobank.

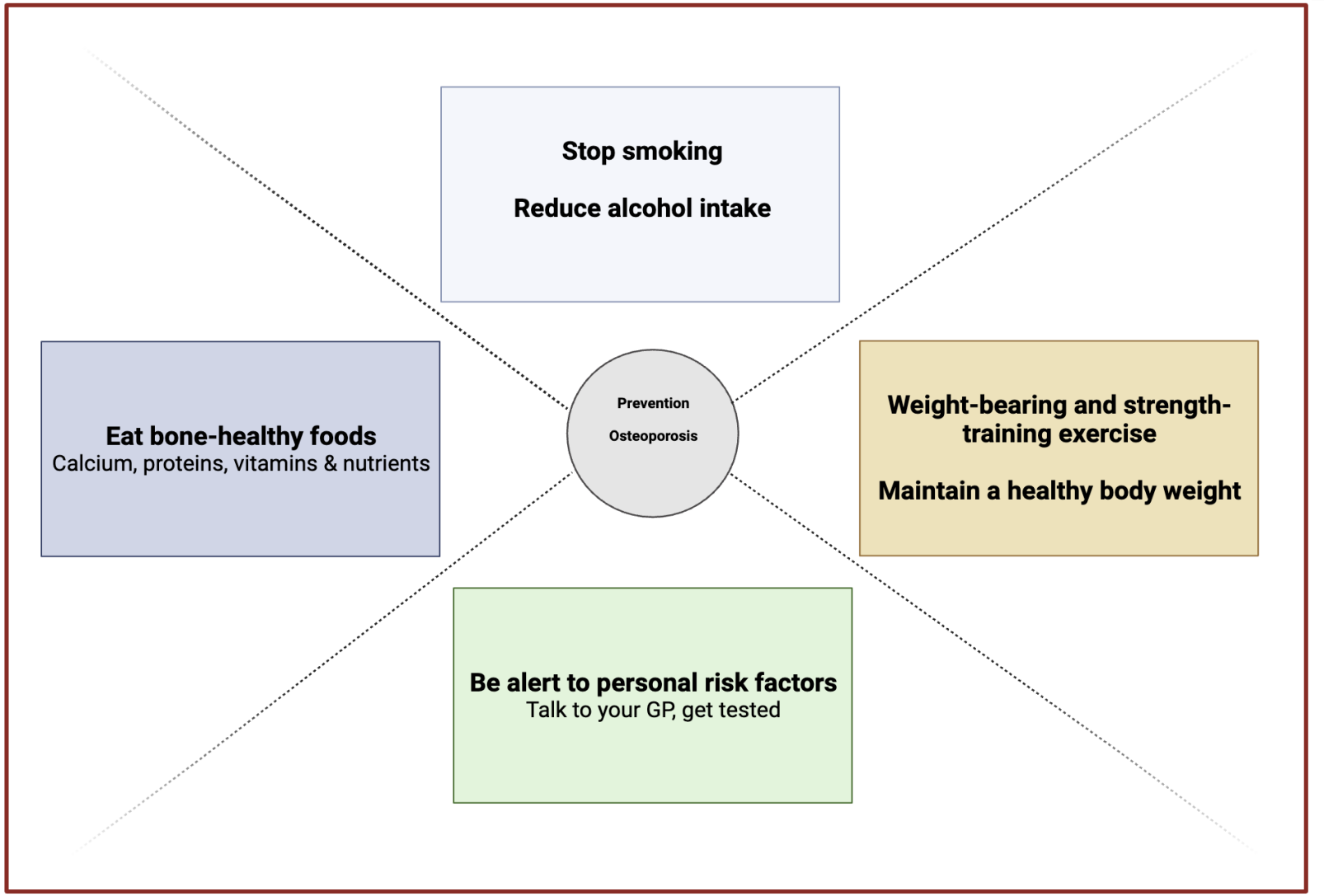
biobank uk
Improving the health of future generations

UK Biobank is a large-scale biomedical database and research resource, containing in-depth genetic and health information from half a million UK participants.

Results

1. Better bone quality associated with decreased odds of all prevalent and incident CVDs considered.
2. Better bone quality associated with better arterial health as reflected by higher aortic distensibility.
3. These findings support the notion that bone-cardiovascular associations reflect shared risk factors/mechanisms rather than direct causal pathways.

Osteoporosis
Prevention



Treatment of osteoporosis

Bisphosphonate Medications for Osteoporosis (OP)		
Generic drug name	**Approved uses for OP**	**Dosing and form**
Alendronate	**Prevention and treatment** of postmenopausal OP in women Treatment of OP due to use of glucocorticoid medicines	Once-daily or once-weekly pills
Risedronate	**Prevention and treatment** of postmenopausal OP in women **Prevention and treatment of OP** due to use of glucocorticoid medicines	Once-daily, once-weekly or once-monthly pills
Ibandronate	**Prevention and treatment** of postmenopausal OP in women	Once-monthly pills, or every three months by intravenous infusion (often called IV) given through a vein
Zoledronic acid	Same as for risedronate	Once a year by IV

Treatment of osteoporosis

Calcitonin

- Approved for the management of postmenopausal osteoporosis and helps prevent vertebral (spine) fractures.
- It also is helpful in controlling pain after an osteoporotic vertebral fracture.

Estrogen or hormone replacement therapy

- Estrogen treatment alone or combined with another hormone, progestin, has been shown to decrease the risk of osteoporosis and osteoporotic fractures in women.
- Consult with your doctor about whether hormone replacement therapy is right for you.

Selective estrogen receptor modulators

- These medications, often referred to as SERMs, mimic estrogen's good effects on bones without some of the serious side effects such as breast cancer.

Teriparatide

Teriparatide is a form of parathyroid hormone that helps stimulate bone formation.

Living with osteoporosis

- If you have osteoporosis, it is important to help prevent not just further bone loss but also a fracture.
- Here are some ways to decrease your chance of falls:
  - **Use a walking aid**. If you are unsteady, use a cane or walker.
  - **Remove hazards in the home**. Remove throw rugs. Also, remove or secure loose wires or cables that may make you trip. Add nightlights in the hallways leading to the bathroom. Install grab bars in the bathroom and nonskid mats near sinks and the tub.
  - **Get help carrying or lifting heavy items.** If you are not careful, you could fall, or even suffer a spine fracture without falling.
  - **Wear sturdy shoes.** This is above all true in winter or when it rains.

Thank you!