# Independent research & further reading

**Guest**: Dr Vonda Wright

**Disclaimer 1:** The literature presented here, directly (or as closely as possible) looks at statements made by the guest. In order to fully understand each topic mentioned, an extensive literature review (beyond the scope of this document) would be required.

**Disclaimer 2:** The information provided in this podcast and any associated materials is not intended to replace professional medical advice. For any medical concerns, it is essential to consult a qualified health professional.

## Contents

## Fatmax

*"And I can tell exactly what, when your mitochondria, the little energy storehouses in your cells, go from burning fat to burning carbohydrates and that place is called the fat max and that is when your mitochondria, your energy organelles are most efficient and that's where we want to work out 80 percent of the time."*

Research suggests that exercising at an intensity that maximises fat oxidation (Fatmax) may be beneficial for weight loss, health, and endurance training. Fat oxidation increases from low to moderate exercise intensities and decreases at higher intensities. Fatmax is generally found at around 60-65% of VO2max, but this can vary between individuals. The significant variability is influenced by factors such as gender, physical activity level, and VO2max. However, these factors only explain a small portion of the variability.

References 1-5.

## Peak bone mass

*"We build, build, build bones until, in women, we're about 28, and, uh, men, 30, we reach peak bone mass. We then reach a plateau where we keep our bone density, and then in women, it begins to plummet due to hormonal, um, Influences. For men, men usually maintain their bone density until their 70s when they plummet."*

Peak bone mass development varies by sex and skeletal site. In females, it is generally attained between ages 18-22 for the total body and hip, while the lumbar spine continues developing until around 33-40 years. In males, peak bone mass occurs later, typically between 19-27 for the total body and hip and 19-33 for the lumbar spine. After reaching peak bone mass, women experience a gradual decline, which accelerates as menopause approaches. In men, bone loss occurs more slowly, as they have compensatory mechanisms that help preserve bone strength.

References 6-17.

## Bone density in senior athletes

*"So we did a study looking at their bone density across time. And the first thing, the first [00:12:00] study we found was that with chronic Exercise, such as these people did, you can maintain your bone density at a very high proportion into your 80s."*

Reference 18.

## Hip fractures

*"Women have 70 percent of all hip fractures"*

Women account for 70-80% of hip fracture patients, with those over 85 being at the highest risk.

References 19-21.

*"If you break your hip, 50 percent of the time"*

Hip fractures significantly impact functional outcomes in older adults. Studies show that 4 months post-fracture, only about half of patients regain their ability to walk outdoors, with two-thirds requiring walking aids. One year after fracture, 57% of patients do not regain their prefracture ambulatory ability, and 13% of previously ambulatory patients become unable to walk.

References 22, 23.

Hip fractures in elderly patients are associated with significant mortality risk, with 30-day mortality rates ranging from 3% to 6%. The one-year mortality rate ranges from 16.6% to 33%, with men generally experiencing higher mortality than women.

References 24-33.

## Osteocalcin

*“When bone releases a protein called osteocalcin, it talks to the muscle. But in the case of bone, osteocalcin, if we just stick with that protein. It talks to the whole body when your osteoblasts, the bone building cells in your bones, release osteocalcin. It goes to your brain and has a neuroprotective effect by decreasing inflammation. It goes to your brain and causes the synthesis of neurons in the hippocampus. It goes to the pancreas and helps with insulin insensitivity. It goes to the muscle and helps the muscles scoop up.”*

Recent research suggests that osteocalcin (OCN), a hormone secreted by osteoblasts, plays a protective role in brain function and inflammation. It crosses the blood-brain barrier, binds to neurones in various brain regions, and enhances monoamine neurotransmitter synthesis while inhibiting GABA production. Studies also suggest that osteocalcin plays a significant role in improving insulin resistance and glucose metabolism.

References 34-40.

*“it stimulates The release of something called brain derived neuro traffic, neurotrophic, uh, protein BDNF”*

While osteocalcin does not directly stimulate BDNF, both molecules share common effects in regulating energy, bone mass, and neuronal functions (41).

## High-impact activities: effect on bones

*“That is borne out by looking out of the University of Wisconsin. Orthopedic researchers there studied which women's sports build the best bone. And it's gymnastics. It is the pounding and the feeding of those athletes that builds the best bone.”*

*“If we're not active in our youth, we don't have the anabolic stimulus as much to make as much mitochondria. If we are sedentary children, We will make bone, but we will not build bone to the extent we do if we're bashing it every day”*

Studies examining bone health in athletes have found that those involved in impact-loading sports—also known as high-impact or weight-bearing sports, such as gymnastics—tend to have higher bone mineral density (BMD) than those in non-weight-bearing sports like swimming. A long-term, 27-year follow-up study further supports this, showing that men who participated in high-impact sports during both adolescence and adulthood had significantly higher lumbar spine BMD at age 40 compared to those who did not.

Several studies indicate that sedentary behaviour is negatively associated with bone health, particularly in the lower extremities, such as reduced bone mineral density at the femoral neck. This negative impact is generally small and independent of physical activity levels. However, some studies found no significant association between sedentary behaviour and bone health when considering total body outcomes.

References 42-58.

## Breastfeeding and bone density

*"A woman breastfeeding will lose 20 percent of her bone density in the first six months of breastfeeding"*

Breastfeeding is associated with a temporary loss of bone mineral density (BMD), particularly in the lumbar spine and femoral neck. During the first six months of lactation, BMD can decrease by 3.9–6.5% in the lumbar spine and around 4.8% in the femoral neck. This loss is not observed in non-lactating women or those who breastfeed for shorter durations. However, BMD generally recovers after weaning, with most studies indicating a return to baseline levels within 6–12 months.

References 59-64.

*"for breastfeeding mothers, you will lose about 500 milligrams of calcium a day"*

Breastfeeding mothers experience significant calcium demands, with daily losses ranging from 200-400 mg through breast milk. Some sources suggest even higher losses of up to 500 mg per day.

References 65-67.

## Low bone density and cognitive dysfunction

*“people that have low bone density. They also have higher brain cognitive dysfunction with age and vice versa. There's an association in the literature with osteoporosis and cognitive decline and vice versa.”*

*“I don't believe we worked out the causation, but there's a correlation. We see people with Alzheimer's. And people with, uh, dangerous osteoporosis are sometimes the same group, 30 percent of the time”*

Research indicates a strong link between low bone mineral density (BMD) and cognitive impairment. Individuals with osteopenia or osteoporosis are more likely to experience cognitive decline than those with normal BMD. Lower BMD is associated with greater white matter hyperintensity burden and poorer performance in memory and executive function tasks. Additionally, those in the lowest BMD quartile face twice the risk of progressing from mild cognitive impairment to Alzheimer’s disease. In the early stages of Alzheimer’s disease, reduced BMD correlates with brain atrophy and memory decline, independent of other influencing factors.

References 68-71.

<u>Osteoporosis</u>

Recent research highlights a strong connection between osteoporosis and cognitive impairment. Individuals with osteoporosis have a twofold increased risk of cognitive decline, while those with cognitive impairment are 1.56 times more likely to develop osteoporosis. Additionally, osteoporosis is associated with lower cognitive scores, particularly in declarative memory and processing speed.

References 72-74.

## Osteoporosis prevalence

*“2 million men have osteoporosis”*

The worldwide prevalence of osteoporosis is approximately 18.3%, with a higher prevalence in women (23.1%) compared to men (11.7%). Over 200 million people globally are affected by osteoporosis, and its prevalence is increasing due to the ageing population. In a study published in 2021, it was estimated that 10.2 million people aged 50 and over had osteoporosis in the United States, with an additional 43.3 million having low bone mass. An article from 1997 (75) reported 1-2 million men in the United States had osteoporosis.

References 75-79.

## Fasting glucose levels and diabetes

*“If it's staying up 110 consistently, We know from the literature that you have a 70 to 100 percent chance of developing full blown diabetes within 10 years”*

A fasting glucose level of 110 mg/dL is considered impaired fasting glucose and is associated with an increased risk of developing type 2 diabetes over time. The likelihood of progression to diabetes for individuals with impaired fasting glucose varies across studies but is generally significant.

References 80-82.

## Diabetes prevalence

*“96 million people in the United States have pre diabetes according to the American Diabetes Association”*

Reference 83.

## Muscle mass and longevity

*“some people still might not be aware of the link between longevity and, muscle”*

Research suggests that muscle mass and strength are important predictors of longevity in older adults. Higher muscle mass index is associated with lower all-cause mortality risk, while greater muscle strength is predictive of increased lifespan regardless of other metabolic factors.

References 84, 85.

## Klotho

*“mice who are born without the ability to make klotho die old, very young.”*

Studies have shown that Klotho deficiency leads to premature ageing, while its overexpression seems to extend lifespan. Interestingly, in older adults, lower plasma Klotho levels were independently associated with an increased risk of mortality.

References 86-92.

## Galanin

*“Another protein that's released with skeletal muscle contraction, um, called galanin. is released, it is transcribed, goes to the brain, works at a place called the Nucleus Cerullus, which is critical for resilience. It makes you more resilient. It helps you able to problem solve.”*

Exercise-induced galanin release plays a significant role in glucose metabolism and stress resilience. In type 2 diabetic rats, exercise-induced galanin facilitates GLUT4 translocation in adipocytes, improving insulin sensitivity. In rats, exercise increases galanin levels in the locus coeruleus, enhancing resilience to stress by preventing dopamine overflow and dendritic spine loss in the medial prefrontal cortex. In humans, a 20-minute exercise test significantly increases plasma galanin levels in middle-aged individuals, with peak concentrations observed 15 minutes post-exercise.

References 93-95.

## Protein

*"So, is there a range of protein people need? Yes, there is. But people can remember one gram per ideal pound"*

Protein intake recommendations for athletes and active individuals vary depending on specific goals and circumstances. For muscle building and maintenance, a daily intake of 1.4-2.0 g/kg of body weight is typically sufficient. However, higher intakes (greater than 3.0 g/kg/day) may support fat loss in resistance-trained individuals. For older adults, the recommended intake is at least 1.0-1.2 g/kg/day, with a higher range of 1.2-1.5 g/kg/day for those at risk of malnutrition.

References 96, 97.

## Creatine

*"it's good for like, cognitive performance, skin, hair, um, muscle, bone, et cetera"*

Creatine supplementation is well-known for its benefits in enhancing exercise performance and overall health. It boosts muscle strength, increases fat-free mass, and improves high-intensity exercise outcomes. Research also suggests that creatine has antioxidant properties, helps reduce mental fatigue, and protects the brain from neurotoxicity. Additionally, consistently maintaining a low dietary intake of about 3 g/day of creatine throughout life may provide notable health benefits.

References 98-106.

<u>Skin</u>

Research suggests that creatine may have beneficial effects on skin health. Creatine supplementation can increase cellular energy levels, enhance mitochondrial function, and protect against oxidative and UV damage in skin cells (107).

Hair

While creatine is an important component of hair structure, its supplementation has raised concerns about potential hair loss. However, the effects of supplementation on hair growth remain unclear, indicating a need for further research.

References 108-111.

## Estrogen and bone health

*“there is a significant link between menopause and bone density because you lose some of those critical Hormones like testosterone? Like estrogen and testosterone. So estrogen on bones acts to control the cell that breaks down bones. We talked about in bone health, there's a cell that breaks down bones called the osteoclast with a C and a cell that builds bones with, called an osteoblast. Estrogen helps control the osteoclast. So even in menopause, when there is no estrogen, we're still building bone. Breaking down bone outstrips building bone. So replacing hormones helps rebalance bone, uh, breakdown and bone rebuilding.”*

Estrogen plays a crucial role in bone health for both males and females throughout life. It regulates bone growth, maturation, and turnover by inhibiting osteoclast differentiation and enhancing osteoblast activity. Estrogen deficiency, such as during menopause, leads to increased bone resorption, decreased bone mass, and altered bone architecture, potentially resulting in osteoporosis.

References 112, 113.

## Musculoskeletal syndrome of menopause (MSM)

*“This paper on the musculoskeletal syndrome of menopause has currently been downloaded almost 300, 000 times”*

Reference 114.

## Estrogen receptors in musculoskeletal tissue

*“Every musculoskeletal tissue has alpha and beta estrogen receptors”*

Research has shown that both estrogen receptor alpha (ERα) and beta (ERβ) are expressed in human skeletal muscle at the mRNA and protein levels (115).

## Estrogen and bone and muscle mass loss

*“What I'm telling you is that estrogen sitting in those receptors can prevent bone loss, can prevent muscle loss”*

Estrogen plays a crucial role in maintaining muscle mass and function, particularly in women. Research indicates that estrogen deficiency, such as during menopause, can lead to muscle atrophy and reduced strength. Estrogen also plays a role in preventing bone loss and osteoporosis. Studies have shown that estrogen use can reduce fracture risk by 50% and prevent further bone loss in established osteoporosis.

References 116-122.

## Low back pain prevalence

*“lower back pain is the single leading cause of disability globally”*

Low back pain is recognised as the single leading cause of disability worldwide.

References 123-125.

*“lower back pain affected 619 million people globally”*

Reference 126.

## Learning while moving

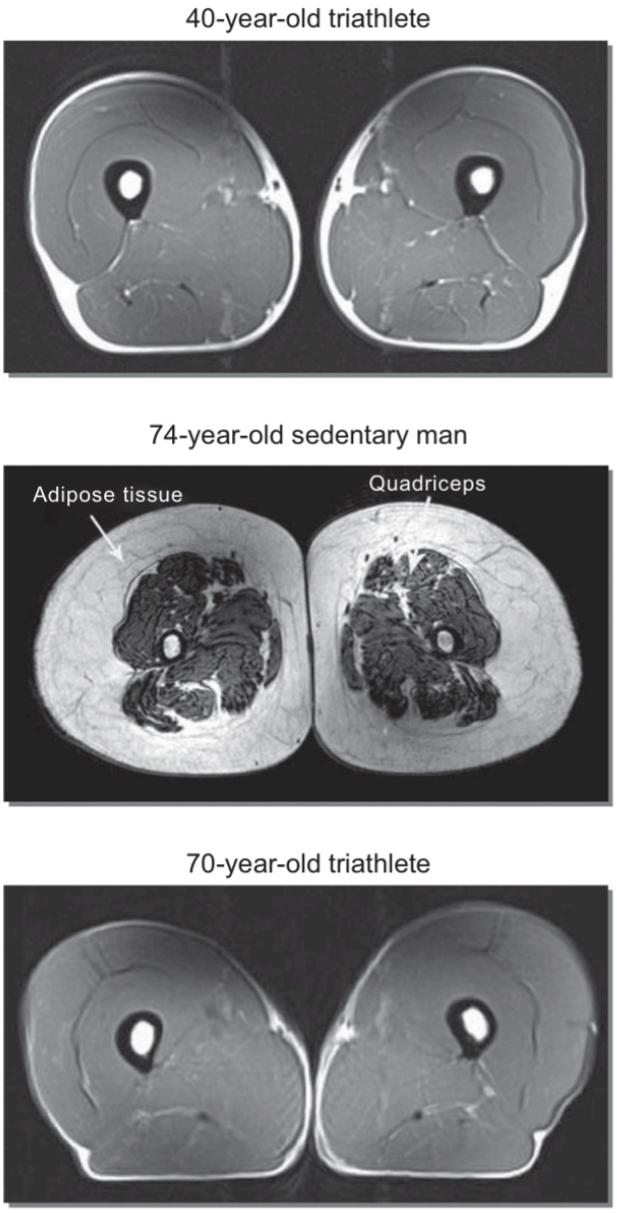
*“studies have shown that if we're trying to learn something, it's better to be moving as we learn because the kinetic energy of learning is better for our brains.”*

Some studies suggest that combining physical activity with learning may enhance cognitive performance, although the timing and intensity of physical activity may play a crucial role in its impact on learning outcomes. For instance, multitasking while walking can increase cognitive load and potentially impair performance on concurrent tasks.

References 127-131.

## Guest’s favourite studies

*“You've done a lot of studies. [01:42:00] They're so fascinating. Have you got a favorite? You know, my favorite study, uh, I have two favorite studies. One which, which has taken on a life of its own on the internet, and it's the muscle study where we did MRIs of the thighs of athletes from 40 to 80. And in that image we have a 40 year old Exerciser, not a pro exerciser, who has beautiful quad muscle architecture, beautiful ham, hamstring architecture, very little rind of peripheral fat, very thick bone cortex, and when I studied those people, they were very strong. The adjacent picture is what happens if we sit around getting low back pain for 35 years.”*




**Abbreviations:** IMAT, intramuscular adipose tissue; MRI, magnetic resonance imaging; SCAT, subcutaneous adipose tissue.

Reference 132.

*"The other favorite study of mine was the very first one we did on masters athletes answering the question, at what age do we really slow down?:*

Reference 133.

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