Use of content and disclaimer

Use of notes and media: Please read this carefully before using the Nutritional Medicine Institute ("NMI") speaker ("speaker") presentation notes ("notes") audio and video ("media") at www.nmi.health ("website"). The notes and media provided on the website are the copyright and/ or intellectual property of the speaker. NMI has been granted a non-exclusive worldwide right to reproduce and distribute the presentation notes and media. You may not reuse, republish, or reprint such content without written consent.

Disclaimer: The contents of lectures such as this are for educational purposes and intended for health professionals. This information is not a substitution for standard medical care. Health professionals are solely responsible for the care and treatment provided to their own patients.

Nutritional Medicine Institute

1

Longevity and Biological Ageing: Enhancing Health into Advanced Age



SESSION 5

Dr. Sally Moorcroft

Supporting Cardiometabolic Resilience in Menopause and Beyond

2:45-3:30pm

An event by: Nutritional Medicine Institute

Platinum sponsors: DDI Doctor's Data Science+Insight, pure encapsulations, regenerus labs

2

Nutritional Medicine Institute



LONGEVITY AND BIOLOGICAL AGEING:
Enhancing Health into Advanced Age

SUPPORTING CARDIOMETABOLIC RESILIENCE IN MENOPAUSE AND BEYOND



Dr Sally Moorcroft
Functional and Integrative Medicine Doctor
MBChB, BSc (Hons), IFMCP, MCPP, MFHom (Med)
www.drsallysclinic.com

DR SALLY'S CLINIC



3

AFFILIATIONS AND DECLARATIONS OF INTEREST

Affiliations

- Founder & Clinical Director, Dr Sally's Clinic
- Founder & Director, Dr Sally's Botanicals
- Functional Medicine Certified Professional – Medical (FMCP-M)
- Module Lead/ Educator - National Centre for Integrative Medicine (NCIM)

Declaration of Interest

- Owner/shareholder of Dr Sally's Clinic and Dr Sally's Botanicals
- Has received fees for educational, speaking and/or consultancy work from Pure Encapsulations, Invivo/Microba, Regenerus, Fagron, Lamberts Healthcare, Genova Diagnostics and IHCAN
- No commercial organisation has influenced the content or conclusions of this presentation

4

CONTENT

Learning Objectives:

- **1. Review the physiological and biochemical changes associated with menopause that contribute to increased cardiometabolic risk.**
- **2. Explain the mechanistic links between oestrogen decline and changes in key metabolic processes, including mitochondrial function, insulin sensitivity, inflammation, and metabolic flexibility.**
- **3. Critically evaluate current evidence for therapeutic strategies, including dietary and lifestyle interventions, selected nutraceuticals and botanical medicines, and hormone-based approaches.**
- **4. Apply personalised intervention strategies to support cardiometabolic resilience and promote healthy ageing in postmenopausal women.**

5

AGEING AND WOMEN'S HEALTH



6

Cardiovascular disease (CVD) continues to be the leading cause of death in women worldwide, with a notable increase in risk for CVD after menopause.

Dastmalchi, L, Gulati, M, Thurston, R. et al. Improving Cardiovascular Clinical Competencies for the Menopausal Transition: A Focus on Cardiometabolic Health in Midlife. JACC Adv. 2025 Jun, 4 (6_Part_2) .https://doi.org/10.1016/j.jacadv.2025.101791

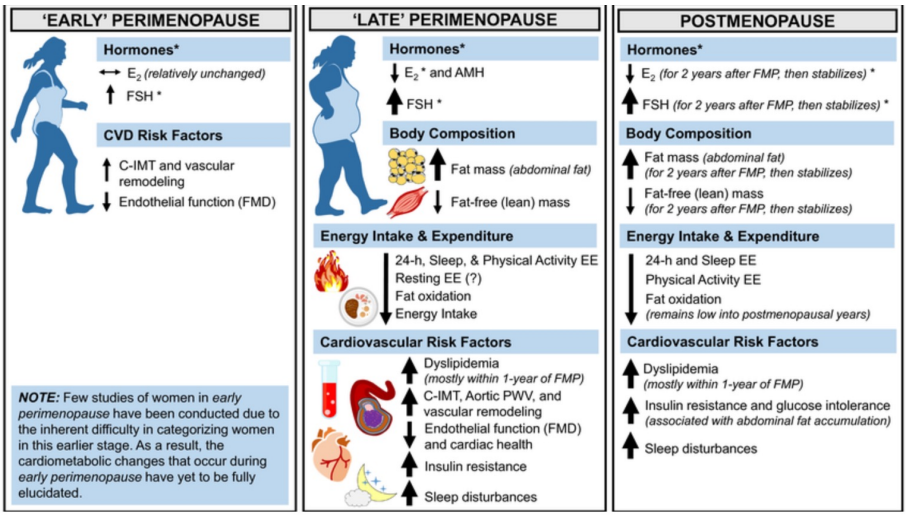
7

The menopause is associated with changes in cardiometabolic health, including changes in lipid profiles, body composition, and vascular function, leading to elevated CVD risk.

Symptoms of anxiety, depression, sleep disturbances and vasomotor symptoms (VMSs) during this time, can also independently contribute to CVD risk.

Dastmalchi, L, Gulati, M, Thurston, R. et al. Improving Cardiovascular Clinical Competencies for the Menopausal Transition: A Focus on Cardiometabolic Health in Midlife. JACC Adv. 2025 Jun, 4 (6_Part_2) .https://doi.org/10.1016/j.jacadv.2025.101791

8



Changes in cardiometabolic risk factors occur during the menopause transition, which is separated into two subcategories (early perimenopause and late perimenopause) and into the postmenopausal years. Horizontal arrows (↔) indicate stability, and smaller or larger/thicker directional arrows (↑ or ↓) indicate smaller or larger changes that occur. *Although E2 concentrations are lower at menopause onset compared with premenopausal concentrations, the patterns of E2 decline and FSH rise during perimenopause are heterogenous across women. AMH, anti-Müllerian hormone; C-IMT, carotid intima-media thickness; E2, estradiol; EE, energy expenditure; FSH, follicle-stimulating hormone; FMP, final menstrual period; PWV, pulse wave velocity

Marlatt, Kara & Pitynski-Miller, Dori & Gavin, Kathleen & Moreau, Kerrie & Melanson, Edward & Santoro, Nanette & Kohrt, Wendy. (2021). Body composition and cardiometabolic health across the menopause transition. Obesity. 30. 14-27. 10.1002/oby.23289.

9

Thyroid dysfunction commonly arises during menopause.

A link has been established between aging and thyroid dysfunction, with **postmenopausal women being at increased risk due to age-related shifts in thyroid function.**

Soares Junior JM, Albayrak M, Sengul D, Sengul I. Thyroid function after menopause: is there any concern in thyroidology? Rev Assoc Med Bras (1992). 2024 Dec 16;70(12):e7012EDI. doi: 10.1590/1806-9282.7012EDI. PMID: 39699486; PMCID: PMC11656532.

10

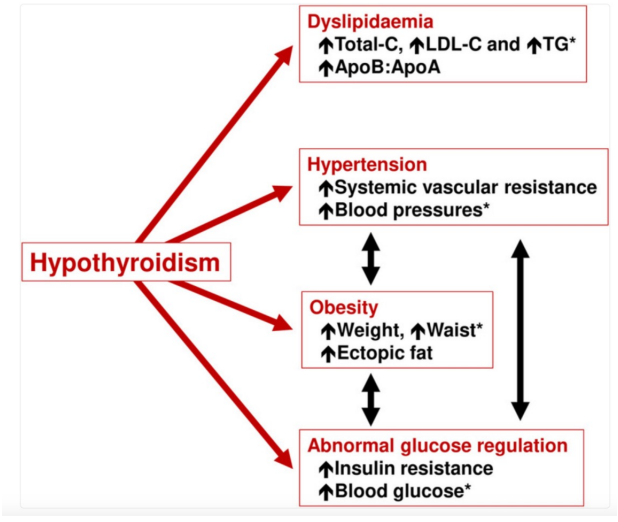
Thyroid dysfunction and cardiovascular risk.

Studies show a significant association between **Sub-Clinical Hypothyroidism (SCH) and Hypothyrodism (OH) and adverse cardiovascular outcomes.**

Higher FT4 and lower TSH, consistent with **hyperthyroidism, were also associated with increased risk of cardiovascular mortality in a large observational study.**

Kahaly GJ, Liu Y, Persani L. Hypothyroidism: playing the cardiometabolic risk concerto. Thyroid Res. 2025 May 20;18(1):20. doi: 10.1186/s13044-025-00233-y. PMID: 40390147; PMCID: PMC12090691.

11



Hypothyroidism

Overview of the effects of hypothyroidism on classical cardiometabolic risk factors: note that all of these are often improved by treatment with levothyroxine.

Kahaly GJ, Liu Y, Persani L. Hypothyroidism: playing the cardiometabolic risk concerto. Thyroid Res. 2025 May 20;18(1):20. doi: 10.1186/s13044-025-00233-y. PMID: 40390147; PMCID: PMC12090691.

12



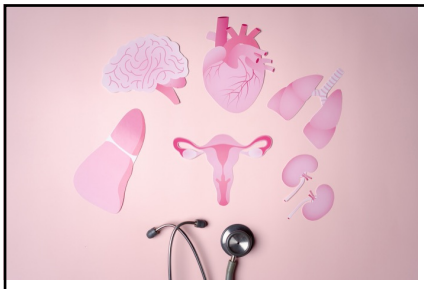
PMOS-
Polyendocrine metabolic ovarian syndrome

(was PCOS)

- **Insulin resistance** is a key pathophysiological feature, with **increased risk of dysglycaemia, type 2 diabetes and cardiovascular risk factors.**
- **Cardiovascular disease risk is increased**, including **ischaemic heart disease, myocardial infarction and stroke.**
- **Obstructive sleep apnoea is substantially more prevalent** - pooled prevalence ~35% **; increased risk persists** compared with women without PMOS **independent of BMI.**

Teede, H at al International PCOS Network, Recommendations From the 2023 International Evidence-based Guideline for the Assessment and Management of Polycystic Ovary Syndrome, The Journal of Clinical Endocrinology & Metabolism, Volume 108, Issue 10, October 2023, Pages 2447–2469, https://doi.org/10.1210/clinem/dgad463

13



Thyroid disease is approximately 2.5× more common in women with PMOS.

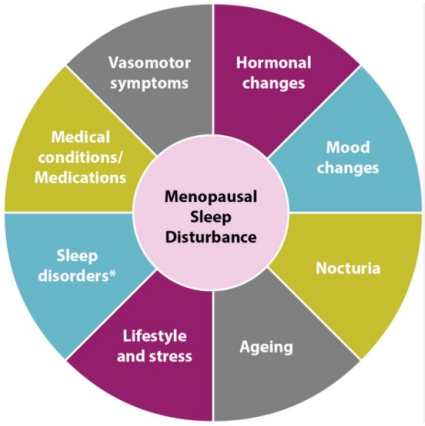
Hypothyroidism in PMOS:

- **Can worsen metabolic and reproductive issues.**
- Associated with increased metabolic syndrome and glucose abnormalities.
- Women with PMOS and hypothyroidism tend to have a **higher BMI with a corresponding increase in metabolic disease burden.**

Fan Huanhuan et al; The role of the thyroid in polycystic ovary syndrome. Frontiers in Endocrinology, Volume 14, 2023

14

Sleep Disturbance, Menopause and Cardiovascular Risk



Sleep disruption drives insulin resistance, appetite signalling, BP, inflammation and vasomotor symptom burden.

Schaedel Z. Managing sleep disturbance during the menopause transition. Post Reproductive Health. 2025;31(4):284-293. doi:10.1177/20533691251378872

15

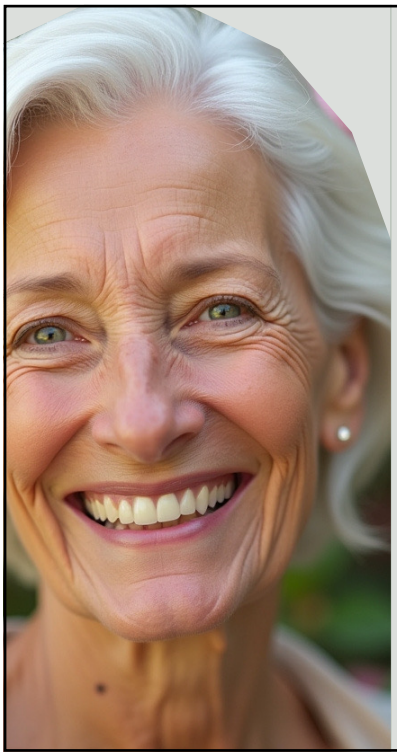
Risk of obstructive sleep apnea (OSA) increases during menopause.

Severe vasomotor symptoms have been linked with risk for OSA.

Poor sleep quality, short sleep duration, and OSA are linked to greater incidence of **cardiometabolic dysfunction** such as **insulin resistance, obesity and hypertension, and worse CVD outcomes.**

Schaedel Z. Managing sleep disturbance during the menopause transition. Post Reproductive Health. 2025;31(4):284-293. doi:10.1177/20533691251378872

16



MENOPAUSE AS A KEY TRANSITION IN AGEING

HORMONE CHANGES AND THEIR IMPACT ON:

- BODY COMPOSITION
- INSULIN SENSITIVITY
- LIPID METABOLISM
- VASCULAR FUNCTION

17

BODY COMPOSITION CHANGES



18

Declining Oestradiol and ↑ FSH lead to:

Reduction in skeletal muscle mass and strength

Skeletal muscle contains oestrogen receptors that regulate:

- Muscle maintenance; repair, regeneration and growth

Declining oestrogen therefore impairs:

- Muscle protein synthesis
- Mitochondrial function
- Muscle regeneration

Meaning postmenopausal women may experience **reduced muscle mass, muscle strength, slower recovery from exercise & sarcopenic obesity** (loss of muscle mass with increased adiposity**).**

Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740. PMID: 41598677; PMCID: PMC12842199.

19

Sarcopenia

- degenerative loss of skeletal muscle that occurs at a rate of 3%–8% every 10 years after the age of 30 years, and accelerates with age and declining oestrogen.

Metabolic Consequences of Sarcopenic Obesity:

- ↓ **Muscle mass**
- ↓ **Resting energy expenditure**
- ↓ **Glucose uptake and disposal**
- ↑ **Visceral adiposity**
- ↑ **TNF-α and IL-6**
- ↑ **Leptin**
- ↓ **Adiponectin and IGF-1**



Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740. PMID: 41598677; PMCID: PMC12842199.

20

Retrospective cross-sectional study of 325 women:

Postmenopausal women demonstrated significantly **lower** lean body mass, soft lean mass, **skeletal muscle mass,** total body water, **protein, and mineral content compared with premenopausal and perimenopausal women.**

Total and visceral fat area (VFA), body fat percentage (BF), and waist-to-hip ratio were significantly higher, indicating a **shift toward central adiposity.**

Fat distribution shifted from gluteofemoral to visceral depots.

These changes were most pronounced in normal-weight women.

Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740. PMID: 41598677; PMCID: PMC12842199.

21

Visceral obesity triggers chronic inflammation via immune activation, raising TNF, IL-6, and leptin while IGF-1 declines, **promoting insulin resistance, muscle catabolism, and fat gain.**

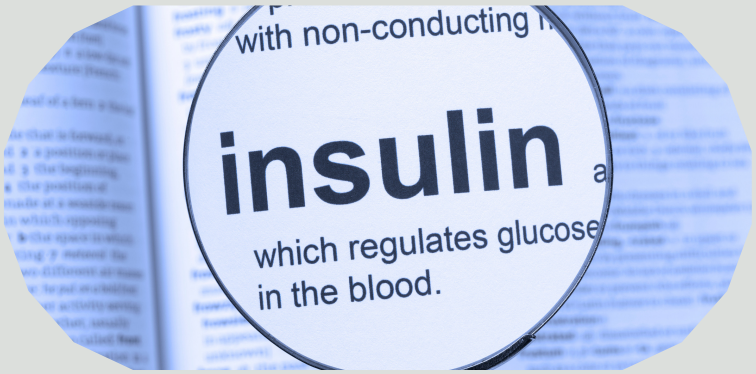
Increased leptin and reduced adiponectin further impair muscle growth and fat oxidation, **driving sarcopenic obesity.**

These interconnected mechanisms create **a vicious cycle that magnifies menopause-related body composition changes.**

Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740. PMID: 41598677; PMCID: PMC12842199.

22

INSULIN SENSITIVITY CHANGES



23



Declining oestrogen levels alter insulin signalling and glucose metabolism, causing:

- **Reduced glucose uptake**
- **Impaired insulin sensitivity**
- **Increased risk of insulin resistance and type 2 diabetes**

Postmenopausal women are twice as likely to develop T2DM compared with men and younger women.

Vieira-Potter, Vicki & Mishra, Gargi & Townsend, Kristy. (2025). Health of adipose tissue: oestrogen matters. Nature Reviews Endocrinology. 22. 76-91. 10.1038/s41574-025-01180-2.

24

Menopause is associated with postprandial metabolism, metabolic health and lifestyle: The ZOE PREDICT study.

Post-menopausal females had higher fasting blood measures (glucose, HbA1c and inflammation (GlycA), [.....] compared with pre-menopausal females.

Postprandial metabolic responses for glucose and insulin were higher (42% and 4% respectively) and CGM measures (glycaemic variability and time in range) were unfavourable post- versus pre-menopause.

In age-matched subgroups, postprandial glucose responses remained higher post- menopause.

Bermingham KM, et al. Menopause is associated with postprandial metabolism, metabolic health and lifestyle: The ZOE PREDICT study. EBioMedicine. 2022 Nov;85:104303. doi: 10.1016/j.ebiom.2022.104303. Epub 2022 Oct 18. PMID: 36270905; PMCID: PMC9669773.

25

Insulin Sensitivity Decline in Menopause - Mechanisms:

↓ Oestrogen Signalling
- Impaired insulin signalling / GLUT4-mediated glucose uptake in skeletal muscle
- ↓ insulin sensitivity

↑ Visceral Adiposity
- ↑ FFA delivery to liver
- Hepatic lipid accumulation / insulin resistance
- ↑ hepatic glucose production

Adipose Tissue Dysfunction
- ↓ adiponectin
- ↑ inflammatory signalling
- ↓ insulin sensitivity

Metabolic Changes
- Mitochondrial dysfunction / ↓ metabolic flexibility
- Inflammageing & oxidative stress
- ↓ skeletal muscle mass

Menopause may amplify age-related insulin resistance through converging effects on adipose tissue, liver and skeletal muscle.

26

LIPID METABOLISM CHANGES



27

The menopausal transition is associated with:

- ↑ **Total cholesterol**
- ↑ **LDL cholesterol**
- ↑ **Triglycerides**
- ↑ **Apolipoprotein B (ApoB)**
- ↑ **Total cholesterol : HDL ratio**

The SWAN study found that **total cholesterol, LDL-C, triglycerides and Lp(a) peaked during late perimenopause and early postmenopause.**

Lower premenopausal E2 and/or greater declines in E2 were associated with a more atherogenic lipid/lipoprotein profile.

↑ **proportion of small, dense LDL particles***

***Small, dense LDL particles are more atherogenic and associated with increased cardiovascular risk.**

Derby CA, et al. Am J Epidemiol. 2009;169:1352–1361. I El Khoudary SR, et al. J Clin Lipidol. 2023;17:157–167.

28

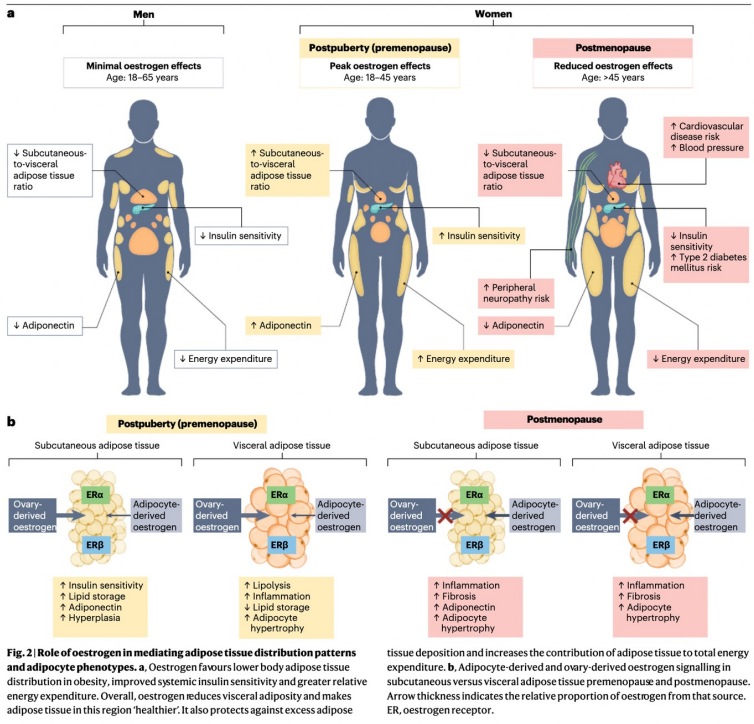


Fig. 2 | Role of oestrogen in mediating adipose tissue distribution patterns and adipocyte phenotypes. a, Oestrogen favours lower body adipose tissue distribution in obesity, improved systemic insulin sensitivity and greater relative energy expenditure. Overall, oestrogen reduces visceral adiposity and makes adipose tissue in this region 'healthier'. It also protects against excess adipose tissue deposition and increases the contribution of adipose tissue to total energy expenditure. **b**, Adipocyte-derived and ovary-derived oestrogen signalling in subcutaneous versus visceral adipose tissue premenopause and postmenopause. Arrow thickness indicates the relative proportion of oestrogen from that source. ER, oestrogen receptor.

Role of oestrogen in mediating adipose tissue distribution patterns and adipocyte phenotypes.

Vieira-Potter, Vicki & Mishra, Gargi & Townsend, Kristy. (2025). Health of adipose tissue: oestrogen matters. Nature Reviews Endocrinology. 22. 76-91. 10.1038/s41574-025-01180-2.

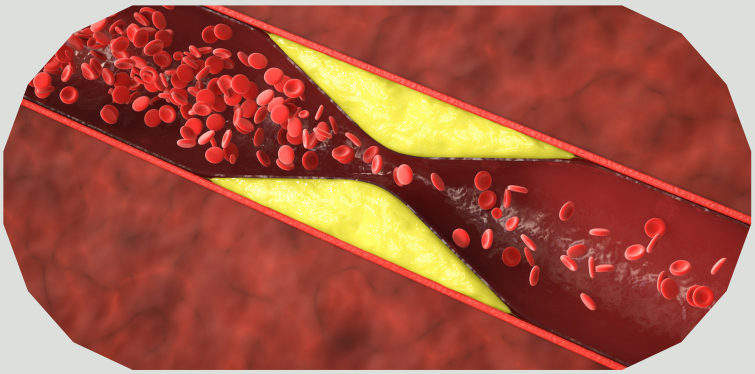
29

- Oestrogens have **protective effects on adipocyte metabolism,** affecting each component of the '**triad of adipocyte health' — insulin sensitivity, inflammatory state and mitochondrial activity.**
- Adipose tissue **stored viscerally is less insulin sensitive and more prone to dysregulation of lipolysis, which is a trigger for inflammation.**
- **Adipocytes** in this depot also tend to be **larger and secrete less adiponectin.**

Vieira-Potter, Vicki & Mishra, Gargi & Townsend, Kristy. (2025). Health of adipose tissue: oestrogen matters. Nature Reviews Endocrinology. 22. 76-91. 10.1038/s41574-025-01180-2.

30

VASCULAR CHANGES



31

A progressive reduction in endothelial function and elevation in arterial stiffness [is found] across the menopause transition**, beginning in early perimenopause** and becoming more pronounced in the late perimenopause to early postmenopausal period.

VMS have been linked to adverse CVD risk factors, including **hypertension, insulin resistance, and poorer lipid profiles, poorer endothelial function and greater carotid atherosclerosis,** as well as **greater risk for myocardial infarction, stroke, and CVD mortality** later in life.

SWAN findings have indicated that VMS, particularly when experienced frequently, **were associated with elevated HOMA score.**

Hildreth KL, et al . Vascular dysfunction across the stages of the menopausal transition is associated with menopausal symptoms and quality of life. Menopause. 2018 Sep;25(9):1011-1019.

Thurston RC. Vasomotor symptoms and cardiovascular health: findings from the SWAN and the MsHeart/MsBrain studies. Climacteric. 2024 Feb;27(1):75-80.

32

Oestrogen gives antioxidant protection:

Increased oxidative stress (↑ ROS) is observed in postmenopausal women

↑Oxidative stress decreases nitric oxide (NO) bioavailability

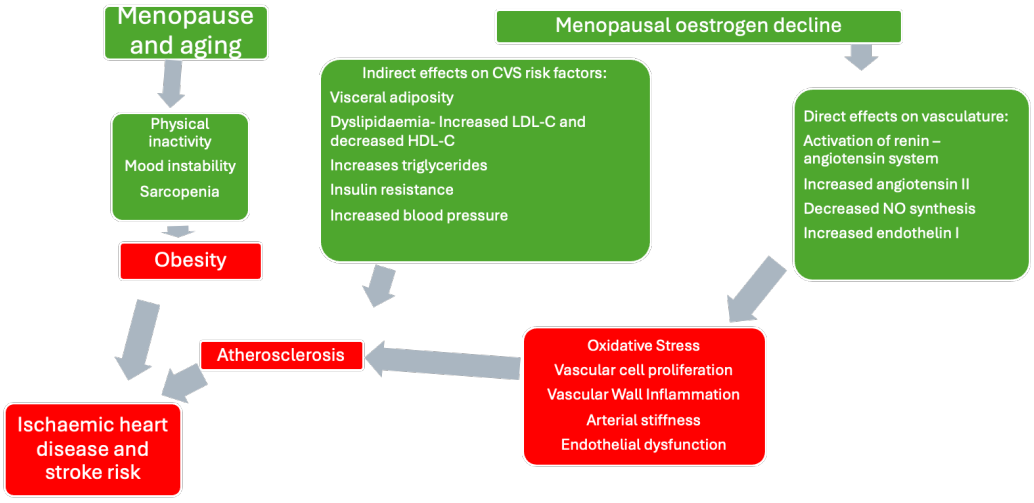
↓ NO contributes to:

- **Endothelial dysfunction**
- **Increased arterial stiffness**
- **Accelerated vascular aging**

Hildreth KL, Ozemek C, Kohrt WM, Blatchford PJ, Moreau KL. Vascular dysfunction across the stages of the menopausal transition is associated with menopausal symptoms and quality of life. Menopause. 2018 Sep;25(9):1011-1019.

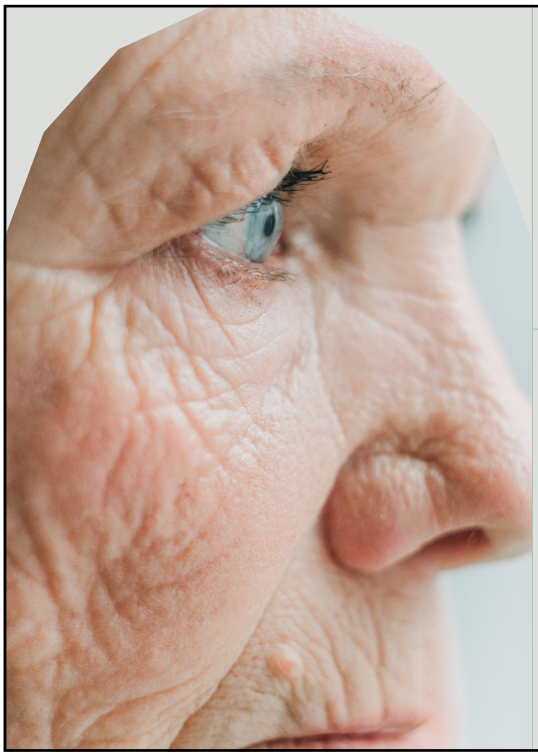
33

Summary of changes in the cardiovascular system in menopause.



Susan R Davis et al. Menopause. Nature Reviews Disease Primers Volume 1, Article number: 15004 (2015)

34

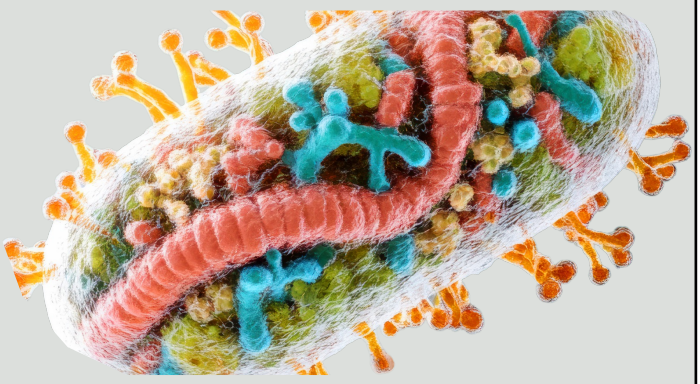


MECHANISMS OF CARDIOMETABOLIC AGEING

- MITOCHONDRIAL FUNCTION AND ENERGY METABOLISM
- METABOLIC FLEXIBILITY
- INFLAMMATORY PATHWAYS (“INFLAMMAGING”)

35

MITOCHONDRIAL FUNCTION AND ENERGY METABOLISM



36

Oestradiol (E_2) supports mitochondrial health through**:**

- ↑ **Mitochondrial biogenesis**
- ↑ **ATP production and oxidative phosphorylation**
- ↑ **Fatty acid oxidation**
- ↑ **Mitochondrial quality control (mitophagy)**
- ↓ **Oxidative stress (ROS)**

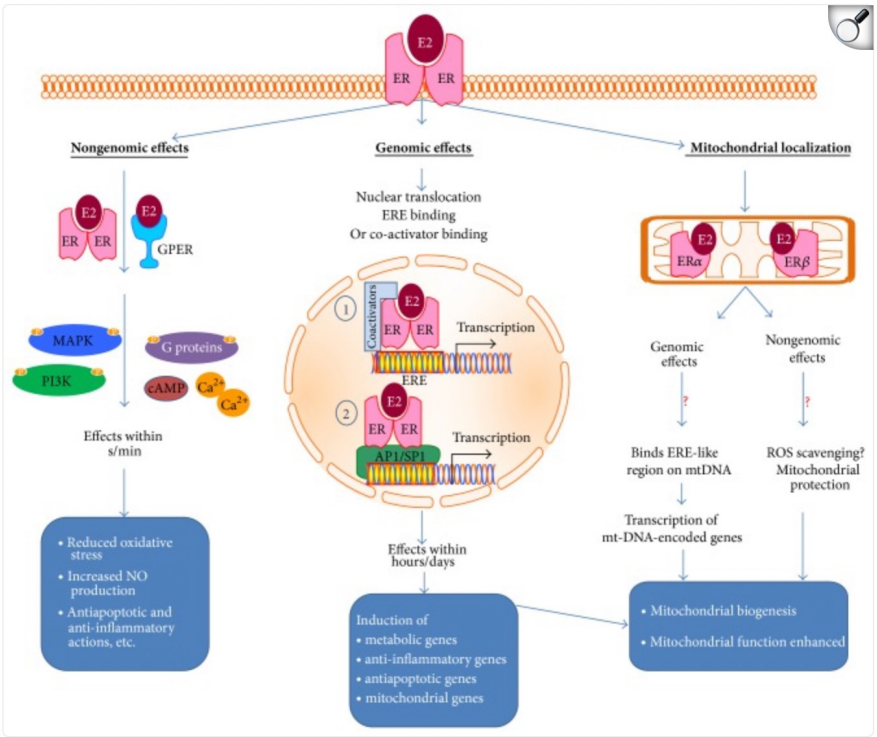
Oestrogen deficiency can contribute to mitochondrial dysfunction during menopause.

Consequences of mitochondrial dysfunction:

- ↓ Fatty acid oxidation
- ↑ Stress kinase activation
- Impaired insulin signalling - leading to↑**Insulin resistance**

Gupte AA, Pownall HJ, Hamilton DJ. Estrogen: an emerging regulator of insulin action and mitochondrial function. J Diabetes Res. 2015;2015:916585. doi: 10.1155/2015/916585. Epub 2015 Mar 26. PMID: 25883987; PMCID: PMC4391691.

37



Gupte AA, Pownall HJ, Hamilton DJ. Estrogen: an emerging regulator of insulin action and mitochondrial function. J Diabetes Res. 2015;2015:916585. doi: 10.1155/2015/916585. Epub 2015 Mar 26. PMID: 25883987; PMCID: PMC4391691

38

METABOLIC FLEXIBILITY



39

Metabolic Flexibility

-the ability to adapt fuel utilisation in response to changes in fuel availability and energy demand, helping to maintain **energy homeostasis.**

Metabolic flexibility aids:

- **Efficient switching between glucose and fatty acid oxidation**
- **Insulin sensitivity and effective glucose uptake**
- **Mitochondrial content and respiratory capacity**
- **Ability to increase fuel oxidation in response to energetic demand**

Metabolic inflexibility leads to:

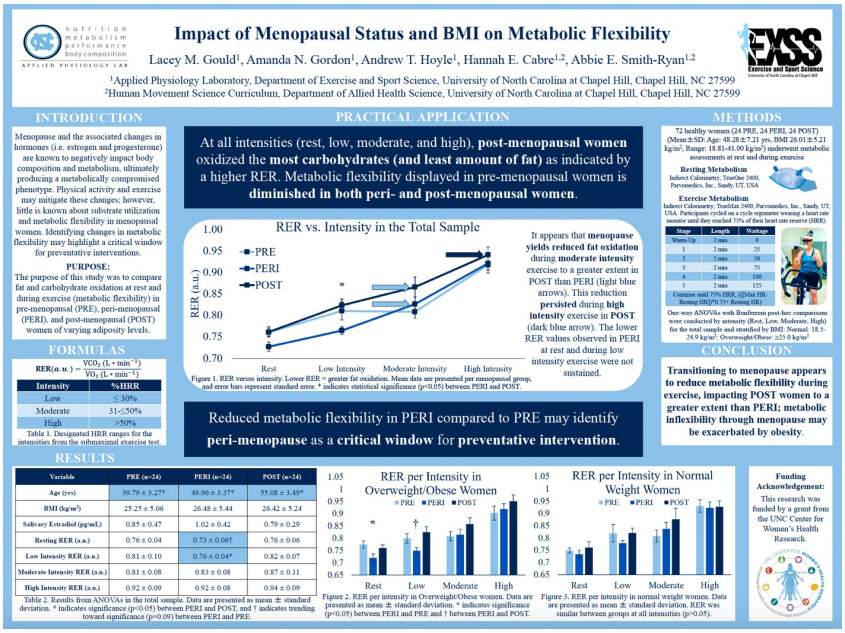
- **Impaired ability to switch appropriately between fuel sources**
- **Insulin resistance, obesity and type 2 diabetes**

Kleis-Olsen AS, et al Metabolic flexibility in postmenopausal women: Hormone replacement therapy is associated with higher mitochondrial content, respiratory capacity, and lower total fat mass. Acta Physiol (Oxf). 2024 Jun;240(6):e14117. doi: 10.1111/apha.14117. Epub 2024 Feb 25. PMID: 38404156.

Goodpaster BH, Sparks LM. Metabolic Flexibility in Health and Disease. Cell Metab. 2017 May 2;25(5):1027-1036. doi: 10.1016/j.cmet.2017.04.015. PMID: 28467922; PMCID: PMC5513193.

40

Peri- and postmenopausal women demonstrated reduced metabolic flexibility during exercise, characterised by greater reliance on carbohydrate oxidation and reduced fat oxidation compared with premenopausal women.



Impact of Menopausal Status and BMI on Metabolic Flexibility

Lacey M. Gould[1], Amanda N. Gordon[1], Andrew T. Hoyle[1], Hannah E. Cabre[1,2], Abbie E. Smith-Ryan[1,2]

[1]Applied Physiology Laboratory, Department of Exercise and Sport Science, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599
[2]Human Movement Science Curriculum, Department of Allied Health Science, University of North Carolina at Chapel Hill, Chapel Hill, NC 27599

INTRODUCTION

Menopause and the associated changes in hormones (i.e. estrogen and progesterone) are known to negatively impact body composition and metabolism, ultimately producing a metabolically compromised phenotype. Physical activity and exercise may mitigate these changes; however, little is known about substrate utilization and metabolic flexibility in menopausal women. Identifying changes in metabolic flexibility may highlight a critical window for preventative interventions.

PURPOSE:
The purpose of this study was to compare fat and carbohydrate oxidation at rest and during exercise (metabolic flexibility) in pre-menopausal (PRE), peri-menopausal (PERI), and post-menopausal (POST) women of varying adiposity levels.

FORMULAS

$$\mathbf{RER}(a.u.) = \frac{VCO_2\,(L \cdot min^{-1})}{VO_2\,(L \cdot min^{-1})}$$

Intensity	%HRR
Low	≤ 30%
Moderate	31–≤50%
High	>50%

Table 1. Designated HRR ranges for the intensities from the submaximal exercise test.

PRACTICAL APPLICATION

At all intensities (rest, low, moderate, and high), **post-menopausal women** oxidized the **most carbohydrates (and least amount of fat)** as indicated by a higher RER. Metabolic flexibility displayed in pre-menopausal women is **diminished in both peri- and post-menopausal women**.

Figure 1. RER versus intensity. Lower RER = greater fat oxidation. Mean data are presented per menopausal group, and error bars represent standard error. * indicates statistical significance ($p<0.05$) between PERI and POST.

It appears that **menopause yields reduced fat oxidation** during **moderate intensity** exercise to a greater extent in POST than PERI (light blue arrows). This reduction **persisted** during **high intensity** exercise in **POST** (dark blue arrow). The lower RER values observed in PERI at rest and during low intensity exercise were not sustained.

Reduced metabolic flexibility in PERI compared to PRE may identify **peri-menopause** as a **critical window** for **preventative intervention**.

METHODS

72 healthy women (24 PRE, 24 PERI, 24 POST) (Mean±SD: Age: 48.28±7.21 yrs, BMI 26.01±5.21 kg/m², Range: 18.81-41.00 kg/m²) underwent metabolic assessments at rest and during exercise

Resting Metabolism
Indirect Calorimetry: TrueOne 2400, Parvomedics, Inc., Sandy, UT, USA.

Exercise Metabolism
Indirect Calorimetry: TrueMax 2400, Parvomedics, Inc., Sandy, UT, USA. Participants cycled on a cycle ergometer wearing a heart rate monitor until they reached 75% of their heart rate reserve (HRR).

Stage	Length	Wattage
Warm-Up	2 min	0
1	2 min	25
2	2 min	50
3	2 min	75
4	2 min	100
5	2 min	125
Continue until 75% HRR. ((Max HR - Resting HR)*0.75+ Resting HR)		

One-way ANOVAs with Bonferroni post-hoc comparisons were conducted by intensity (Rest, Low, Moderate, High) for the total sample and stratified by BMI: Normal: 18.5-24.9 kg/m², Overweight/Obese: ≥25.0 kg/m²

CONCLUSION

Transitioning to menopause appears to reduce metabolic flexibility during exercise, impacting POST women to a greater extent than PERI; metabolic inflexibility through menopause may be exacerbated by obesity.

RESULTS

Variable	PRE (n=24)	PERI (n=24)	POST (n=24)
Age (yrs)	39.79 ± 3.27*	49.96 ± 3.37*	55.08 ± 3.49*
BMI (kg/m²)	25.25 ± 5.06	26.48 ± 5.44	26.42 ± 5.24
Salivary Estradiol (pg/mL)	0.85 ± 0.47	1.02 ± 0.42	0.79 ± 0.29
Resting RER (a.u.)	0.76 ± 0.04	0.73 ± 0.06†	0.76 ± 0.06
Low Intensity RER (a.u.)	0.81 ± 0.10	0.76 ± 0.04*	0.82 ± 0.07
Moderate Intensity RER (a.u.)	0.81 ± 0.08	0.83 ± 0.08	0.87 ± 0.11
High Intensity RER (a.u.)	0.92 ± 0.09	0.92 ± 0.08	0.94 ± 0.09

Table 2. Results from ANOVAs in the total sample. Data are presented as mean ± standard deviation. * indicates significance ($p<0.05$) between PERI and POST; and † indicates trending toward significance ($p=0.09$) between PERI and PRE.

Figure 2. RER per intensity in Overweight/Obese women. Data are presented as mean ± standard deviation. * indicates significance ($p<0.05$) between PERI and PRE and † between PERI and POST.

Figure 3. RER per intensity in normal weight women. Data are presented as mean ± standard deviation. RER was similar between groups at all intensities ($p>0.05$).

Funding Acknowledgement:
This research was funded by a grant from the UNC Center for Women's Health Research.

Metabolic inflexibility appears to emerge during perimenopause and may be exacerbated by higher BMI, suggesting a potential window for early intervention.

Gould LM et al. Impact of Menopausal Status and BMI on Metabolic Flexibility. University of North Carolina at Chapel Hill.

41

INFLAMMATORY PATHWAYS ("INFLAMMAGING")



42

Inflammaging - chronic, low-grade systemic inflammation associated with ageing.

Menopause may amplify inflammageing through several pathways:

↓ **Oestrogen → loss of anti-inflammatory effects**

↑ **Visceral adiposity → increased cytokine productio**n (IL-6, TNF-α)

↑ **Oxidative stress and ROS generation**

• **Mitochondrial dysfunction**

• **Immune dysregulation**

• **Accumulation of senescent cells (SASP)**

The menopause transition may therefore intersect with established mechanisms of inflammageing, potentially amplifying age-related metabolic and cardiovascular risk.

Hage FG, Oparil S. Ovarian hormones and vascular disease. CurrOpinCardiol. 2013 Jul;28(4):411-6. doi: 10.1097/HCO.0b013e32836205e7. Review.
Xing D et al. Estrogen and Mechanisms of Vascular Protection. Arteriosclerosis, thrombosis, and vascular biology. 2009;29(3):289-295. doi:10.1161/ATVBAHA.108.182279.
McCarthy M, Raval AP. The peri-menopause in a woman's life: a systemic inflammatory phase that enables later neurodegenerative disease. J Neuroinflammation. 2020 Oct 23;17(1):317. doi: 10.1186/s12974-020-01998-9. PMID: 33097048; PMCID: PMC7585188.

43



ROLE OF SEX HORMONES IN THE CARDIOVASCULAR-GUT MICROBIOME AXIS

44

Oestrogen Decline, Gut Barrier Dysfunction & Metabolic Risk

Menopause-associated ↓ oestrogen

↓

Impaired intestinal barrier integrity

↑ intestinal epithelial damage

Altered tight-junction integrity

↓

↑ LPS exposure

↓

Metabolic endotoxaemia

Promotes systemic low-grade inflammation

Associated with insulin resistance

and risk of diabetes progression

Pussinen PJ, et al Endotoxemia is associated with an increased risk of incident diabetes. Diabetes Care. 2011 Feb;34(2):392-7.
Shieh A, et al . Markers of compromised gut epithelial barrier integrity increase during the menopause transition. J Clin Invest. 2026 Jul 9;136(17)
Shieh A, et al Gut permeability, inflammation, and bone density across the menopause transition. JCI Insight. 2020 Jan 30;

45



WHAT WE HAVE COVERED SO FAR.....

- Menopause is a major metabolic transition.
- Cardiometabolic risk increases during and after the menopausal transition.
- Declining oestrogen drives changes in body composition, mitochondrial function, metabolic flexibility, insulin sensitivity and gut microbiome health.
- Skeletal muscle and mitochondrial health are central to healthy ageing.
- Menopause offers a key opportunity to improve long-term healthspan for women and reduce future disease burden.

46



SO, WHAT CAN WE DO ? .....

LET'S EXPLORE SOME KEY PERSONALISED INTERVENTION STRATEGIES:

- Nutritional Therapy
- Nutraceuticals & Botanicals
- Lifestyle Changes/ Exercise
- Hormone Therapy

47

NUTRITION: KEY STRATEGIES



48



Address:

- Nutritional deficiencies

Optimise:

- Protein intake: 1.2-1.6g/kg body weight
- Omega 3/6 balance
- Omega 9
- Hydration to support healthy blood pressure
- Hip to Waist ratio
- Blood sugar balance

Support:

- Adrenal function and HPA axis
- Healthy gut microbiome and barrier integrity
- Mitochondrial and vascular health

Reduce:

- Saturated fats/ stimulants/ alcohol/ processed food and refined carbohydrates
- Inflammation

49

Mediterranean Diet Adherence & Risk of All-Cause Mortality in Women.

25,315 US women followed up for 25 years, **higher adherence to the Mediterranean diet associated with a 23% relative risk reduction in all-cause mortality.**

Biomarkers of small molecule metabolites, inflammation, triglyceride-rich lipoproteins, insulin resistance, and body mass index contributed most to explaining this lower risk.

Another meta-analysis of 883,878 participants, reported that **higher Mediterranean diet adherence was associated with 21% reduced risk of CVD mortality.**

Ahmad S, Moorthy MV, Lee IM, Ridker PM, Manson JE, Buring JE, Demler OV, Mora S. Mediterranean Diet Adherence and Risk of All-Cause Mortality in Women. JAMA Netw Open. 2024 May 1;7(5):e2414322. doi: 10.1001/jamanetworkopen.2024.14322. PMID: 38819819; PMCID: PMC11143458.

50

Shorter-term studies show **Mediterranean diet has beneficial effects on cardiometabolic, inflammatory, & lipid biomarkers.**

- lower levels of CRP, interleukin 6 (IL-6) & improved endothelial function.

In a 3-month dietary clinical trial, **Mediterranean diet consumption showed reduced oxidized LDL levels** in comparison with low-fat diet.

Mediterranean diet was associated with better glycemic control and improved cardiovascular risk factors than control diets, including those characterized by lower fat content, **in menopausal women.**

Ahmad S, Moorthy MV, Lee IM, Ridker PM, Manson JE, Buring JE, Demler OV, Mora S. Mediterranean Diet Adherence and Risk of All-Cause Mortality in Women. JAMA Netw Open. 2024 May 1;7(5):e2414322. doi: 10.1001/jamanetworkopen.2024.14322. PMID: 38819819; PMCID: PMC11143458.
Gonçalves C, Moreira H, Santos R. Systematic review of mediterranean diet interventions in menopausal women. AIMS Public Health. 2024 Jan 10;11(1):110-129. doi: 10.3934/publichealth.2024005. PMID: 38617417; PMCID: PMC11007410.

51

Effects of timing and eating duration of time restricted eating on metabolic outcomes: systematic review and network meta-analysis

41 RCTsl 2287 participants
42% womenl mean participant age 37.2 years

Time restricted eating overall improved metabolic health outcomes compared with usual diets, and **early time restricted eating was superior to late time restricted eating.**

The association between duration of eating (<8 hours, 8 hours & >8 hours) and metabolic health outcomes was inconsistent.

Time restricted eating was associated with **significant improvements in body weight, body mass index, fat mass, waist circumference, systolic blood pressure, and levels of fasting blood glucose, fasting insulin, and triglycerides.**

Chen Y, Tsai H, Tu Y, Chen L. Effects of timing and eating duration of time restricted eating on metabolic outcomes: systematic review and network meta-analysis. BMJ Medicine. 2026;5:e001071. https://doi.org/10.1136/bmjmed-2024-001071

52



For early time restricted eating the last meal was eaten before 1700



For mid-time restricted eating, the last meal ended between 1700 & 1900



For late time restricted eating, eating was concluded after 1900

Early and mid-time restricted eating in general had better efficacy than late, for anthropometric measurements and glycaemic parameters.

Late time restricted eating, especially when combined with a longer eating duration, was generally least effective for most metabolic outcomes.

Menopause-specific data remain limited.

Chen Y, Tsai H, Tu Y, Chen L. Timing and eating duration of time restricted eating on metabolic outcomes: systematic review and network meta-analysis. BMJ Medicine. 2026;5:e001071. https://doi.org/10.1136/bmjmed-2024-001071

53

Gut microbiome

Clinical and experimental evidence indicates that **menopause-related hormonal changes are associated with gut microbiota dysbiosis.**

Contributing to adverse lipid profiles through **mechanisms involving bile acid metabolism, short-chain fatty acid production, and low-grade systemic inflammation.**

Nutritional interventions aimed at modulating the gut microbiota—**including Mediterranean, plant-based, increased dietary fiber intake, and supplementation with prebiotics, probiotics, polyphenols, phytoestrogens, and omega-3 fatty acids—have shown potential to improve lipid profiles and cardiometabolic risk markers.**

Summary: **The gut microbiota emerges as a relevant contributor to menopause-associated dyslipidemia and cardiovascular risk.**

Reytor-González C, et al. The Role of Gut Microbiota in Postmenopausal Women: Implications for Lipid Metabolism and Targeted Nutritional Interventions. Curr Nutr Rep. 2026 Mar 28;15(1):32. doi: 10.1007/s13668-026-00752-6. PMID: 41903028; PMCID: PMC13032950.

54

NUTRACEUTICALS

- Creatine
- Berberine
- Phytoestrogens
- Omega 3
- Myo-inositol
- Melatonin



55

Creatine monohydrate for lean mass, strength, and bone density in postmenopausal women: a systematic review and meta-analysis

Seven RCTs (n = 608 randomized; duration 12–104 weeks, median 38 weeks) enrolled postmenopausal women (mean age ≈ 62 y).

Lean mass (k = 5; n = 338) favored creatine

Leg-press 1RM (k = 3; n = 111) improved with creatine.

Benefits were evident when creatine ≥ 5 g·day^{-1} was combined with RT.

Trials using ≤ 3 g·day^{-1} without RT showed no measurable effect.

Bone density was unchanged overall.

Adverse events were mild and similar to placebo; renal indices were unchanged.

Naddafha S, Antonio J, Kreider RB, Stout JR. Creatine monohydrate for lean mass, strength, and bone density in postmenopausal women: a systematic review and meta-analysis. J Int Soc Sports Nutr. 2026 Dec 31;23(1):2668435. doi: 10.1080/15502783.2026.2668435. Epub 2026 May 16. PMID: 42141930; PMCID: PMC13182165.

56

In clinic.....

- **Recommend creatine supplementation as part of a comprehensive training program for postmenopausal women aiming to improve strength or muscle mass.**
- **Typical regimen is a 5–7-day loading phase of ~20 g/day (split into four doses) followed by 3–5 g/day maintenance.**
- **If loading is contraindicated because of GI discomfort, starting at 3–5 g/day is effective, reaching saturation over several weeks.**
- **Encourage resistance training at least 2–3 times per week - the benefits of creatine manifest when combined with progressive overload (e.g. weightlifting or resistance band exercises).**

Naddafha S, Antonio J, Kreider RB, Stout JR. Creatine monohydrate for lean mass, strength, and bone density in postmenopausal women: a systematic review and meta-analysis. J Int Soc Sports Nutr. 2026 Dec 31;23(1):2668435. doi: 10.1080/15502783.2026.2668435. Epub 2026 May 16. PMID: 42141930; PMCID: PMC13182165.

57

The Effect of Berberine Supplementation on Glycemic Control and Inflammatory Biomarkers in Metabolic Disorders: An Umbrella Meta-analysis of Randomized Controlled Trials

Berberine supplementation significantly reduced:

↓ Fasting blood glucose
↓ HbA1c
↓ insulin
↓ HOMA-IR
and inflammatory biomarkers:
↓ IL-6 ↓ TNF-α ↓ CRP

**** Be aware of the potential effect on the gut microbiome**

Nazari A, Ghotbabadi Z, Kazemi K ...
The Effect of Berberine Supplementation on Glycemic Control and Inflammatory Biomarkers in Metabolic Disorders: An Umbrella Meta-analysis of Randomized Controlled Trials
Clinical Therapeutics, 2023; 46, e64-e72

58



Phytoestrogens

Naturally occurring compounds found in many plants.

- **Structurally related to oestradiol.**
- **Modulating effect on oestrogen receptors.**
- **Found in:**

Soya beans, legumes, lentils, chickpeas, aduki beans, kidney beans, seeds, sprouted seeds, flax seeds.

59

Phytoestrogens & Cardiometabolic Health in Menopause:

2025 systematic review & meta-analysis
60 RCTs I 6,127 menopausal women
Phyoestrogens significantly reduced:
↓ Total cholesterol ↓ LDL-C ↓ Triglycerides
Phytoestrogens, particularly soy-derived interventions - showed especially favourable lipid effects.

Phytoestrogen-specific meta-analysis
56 RCTs I 4,039 postmenopausal women
Phytoestrogen supplementation was associated with:
↓ Total cholesterol ↓ LDL-C ↓ Triglycerides ↓ ApoB
↑ ApoA-I
and improvements in selected vascular biomarkers:
↓ ICAM-1 ↓ E-selectin

Wolters M, et al. Effects of phytoestrogen supplementation on intermediate cardiovascular disease risk factors among postmenopausal women: a meta-analysis of randomized controlled trials. Menopause. 2020 Sep;27(9):1081-1092. doi: 10.1097/GME.0000000000001566. PMID: 32852463.
Park, S.-H., M.-R. Oh, J. Lee, H.-K. Choi, and J.-T. Hwang. 2025. " Effects of Plant-Derived Dietary Supplements on Lipid Profiles in Menopausal Women: An Updated Systematic Review and Meta-Analysis of Randomized Placebo-Controlled Trials." Phytotherapy Research 39, no. 8: 3486–3507. https://doi.org/10.1002/ptr.8511.

60

Does Omega-3 Fatty Acid Supplementation Have Favorable Effects on the Lipid Profile in Postmenopausal Women? A Systematic Review

Omega-3 fatty acid supplementation resulted in a **decrease in triglyceride concentrations** particularly in the RCTs that lasted ≤16 weeks, when the baseline triglyceride concentrations were ≥150 mg/dL in individuals with a body mass index ≥30 kg/m2 , and when the dose of omega-3 fatty acids was ≥1 g/d.

LDL-C* and HDL-C values increased.

Total cholesterol levels remained unchanged after administration of omega-3 fatty acids.

Conclusion:
In postmenopausal women, supplementation with omega-3 fatty acid resulted in a significant reduction in triglyceride concentrations and a modest elevation in HDL-C and LDL-C levels, whereas this intervention did not affect total cholesterol values.

***The modest rise in LDL-C may partly reflect a shift towards larger, buoyant LDL particles; effects on ApoB/particle number are important when interpreting this change.**

Wang J, Gaman M, Albadawi N ...Does Omega-3 Fatty Acid Supplementation Have Favorable Effects on the Lipid Profile in Postmenopausal Women? A Systematic Review and Dose–response Meta-analysis of Randomized Controlled Trials Clinical Therapeutics, 2023; 45, e74-e87

61

Effects of omega-3 on metabolic markers in postmenopausal women with metabolic syndrome

RCT of 87 Brazilian women.

Significant reductions in body mass index and waist circumference in both groups without significant changes in body fat or muscle mass.

Intervention with diet plus omega-3 was associated with significant reduction in systolic and diastolic blood pressure, serum triglyceride concentration, and insulin resistance, as well as a reduction in serum IL-6 concentration.

In postmenopausal women with metabolic syndrome, dietary intervention plus supplementation of omega-3 resulted in a **further decrease in triglycerides and blood pressure** and also in an improvement in **insulin resistance and inflammatory markers,** important components of metabolic syndrome.

Tardivo AP, Nahas-Neto J, Orsatti CL, Dias FB, Poloni PF, Schmitt EB, Nahas EA. Effects of omega-3 on metabolic markers in postmenopausal women with metabolic syndrome. Climacteric. 2015 Apr;18(2):290-8. doi: 10.3109/13697137.2014.981521. Epub 2014 Dec 26. PMID: 25394692.

62

Effects of myo-inositol supplementation in postmenopausal women with metabolic syndrome: a perspective, randomized, placebo-controlled study.

80 postmenopausal women with metabolic syndrome were treated with **diet plus supplementation of myo-inositol (2 g BID plus diet: intervention group**) or with diet plus placebo (control group) **for 6 months.**

Results: **Myo-inositol plus diet improved systolic and diastolic blood pressure, HOMA index, cholesterol, and triglyceride serum levels with highly significant differences**, compared with the groups treated only with diet and placebo.

In the group treated with myo-inositol, a decrease in diastolic blood pressure (-11%), HOMA index (-75%), and serum triglycerides (-20%) and an improvement in high-density lipoprotein cholesterol (22%) were shown.

Conclusions: **Supplementation with myo-inositol may be considered a reliable option in the treatment of metabolic syndrome in postmenopausal women.**

Giordano D, et al Effects of myo-inositol supplementation in postmenopausal women with metabolic syndrome: a perspective, randomized, placebo-controlled study. Menopause. 2011 Jan;18(1):102-4. doi: 10.1097/gme.0b013e3181e8e1b1. PMID: 20811299.

63

Melatonin

Mechanistic studies suggest potential relevance to healthy ageing through melatonin's actions on:

- **Circadian regulation & sleep**
- **Mitochondrial function**
- **Antioxidant defence & redox homeostasis**
- **↓ Oxidative stress**
- **Immune & inflammatory modulation of NF-κB, TNF-α and IL-6**
- **Potential cardiometabolic effects — including blood pressure and lipid regulation.**

Minich DM, Henning M, Darley C, Fahoum M, Schuler CB, Frame J. Is Melatonin the "Next Vitamin D"?: A Review of Emerging Science, Clinical Uses, Safety, and Dietary Supplements. Nutrients. 2022 Sep 22;14(19):3934. doi: 10.3390/nu14193934. PMID: 36235587; PMCID: PMC9571539.

64

Other Tools in our Cardiometabolic Support Toolkit.....

Mitochondrial / Cellular energy & Methylation

- CoQ10
- α-Lipoic acid (ALA)
- L-Carnitine
- Creatine
- B vitamins
- Magnesium
- Trimethylglycine (TMG/Betaine)
- Phosphatidylcholine
- Selenium
- Green Tea

Metabolic regulation

- Myo-inositol (inositol)
- Berberine
- α-Lipoic acid (ALA)
- Plant sterols
- Magnesium
- Zinc
- Chromium
- Green Tea

Inflammation / oxidative stress

- Omega-3 fatty acids (EPA/DHA)
- Turmeric / curcumin
- Resveratrol
- Pycnogenol
- Vitamin C
- Vitamin E
- Selenium
- Green Tea

Vascular / endothelial support

- Omega-3 fatty acids (EPA/DHA)
- Polyphenols
- Vitamin K
- Beetroot / nitrate-rich foods
- Aged garlic extract
- Nattokinase
- Green Tea

Gut microbiome

- Probiotics (strain- and context-specific)
- Prebiotics
- Dietary fibre
- Polyphenols
- Omega-3 fatty acids
- Fermented foods

Bone / musculoskeletal health

- Vitamin D
- Vitamin K
- Magnesium
- Boron

65

- Chodari L, Dilsiz Aytemir M, Vahedi P, et al. Targeting mitochondrial biogenesis with polyphenol compounds. Oxid Med Cell Longev. 2021;2021:4946711. doi:10.1155/2021/4946711
- Mthembu SXH, Dludla PV, Ziqubu K, et al. The potential role of polyphenols in modulating mitochondrial bioenergetics within the skeletal muscle: a systematic review of preclinical models. Molecules. 2021;26(9):2791. doi:10.3390/molecules26092791
- Pollicino F, Veronese N, Dominguez LJ, Barbagallo M. Mediterranean diet and mitochondria: new findings. Exp Gerontol. 2023;176:112165. doi:10.1016/j.exger.2023.112165
- Du J, Zhu M, Bao H, et al. The role of nutrients in protecting mitochondrial function and neurotransmitter signaling: implications for the treatment of depression, PTSD, and suicidal behaviors. Crit Rev Food Sci Nutr. 2016;56(15):2560-2578. doi:10.1080/10408398.2013.876960
- Di Lorenzo A, Iannuzzo G, Parlato A, et al. Clinical evidence for Q10 coenzyme supplementation in heart failure: from energetics to functional improvement. J Clin Med. 2020;9(5):1266. doi:10.3390/jcm9051266
- Virmani MA, Cirulli M. The role of L-carnitine in mitochondria, prevention of metabolic inflexibility and disease initiation. Int J Mol Sci. 2022;23(5):2717. doi:10.3390/ijms23052717
- Mantle D, Hargreaves IP, Domingo JC, Castro-Marrero J. Mitochondrial dysfunction and coenzyme q10 supplementation in post-viral fatigue syndrome: an overview. Int J Mol Sci. 2024;25(1):574. doi:10.3390/ijms25010574
- National Institutes of Health Office of Dietary Supplements. Dietary supplements for primary mitochondrial disorders: fact sheet for health professionals. Updated June 30, 2020. Accessed April 4, 2025. https://ods.od.nih.gov/factsheets/PrimaryMitochondrialDisorders-HealthProfessional/

66

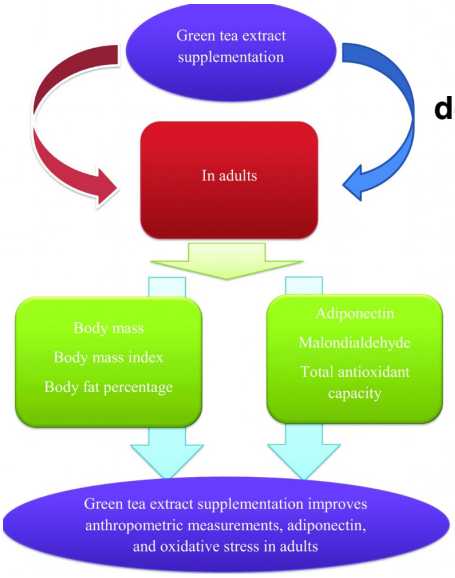
FUNCTIONAL FOODS:

- Green tea/ Matcha
- Cinnamon
- Cocoa
- Soya - edamame, tofu, tempeh
- Berries & other polyphenol-rich plants
- Pomegranate juice
- Ground Flax/ Linseeds
- Extra virgin olive oil
- Oily fish
- Garlic
- Beetroot
- Oats



67

Green Tea Extract & Metabolic Health
Systematic review & dose-response meta-analysis of RCTs



GTE supplementation significantly
decreased Body Mass, BMI, Body Fat Percentage, and MDA (oxidative stress marker).
while increasing Total Antioxidant Capacity and adiponectin.

It had no significant effect on Fat Mass, Waist Circumference, leptin and ghrelin.

59 studies I n = 3,802

Asbaghi O, Rezaei Kelishadi M, Larky DA, et al. The effects of green tea extract supplementation on body composition, obesity-related hormones and oxidative stress markers: a grade-assessed systematic review and dose–response meta-analysis of randomised controlled trials. British Journal of Nutrition. 2024;131(7):1125-1157. doi:10.1017/S000711452300260X

68

The effect of cinnamon supplementation on cardiovascular risk factors in adults: a GRADE assessed systematic review, dose–response and meta-analysis of randomized controlled trials.

The review included 49 RCTs with a total of **3,038 participants.**

Cinnamon **improved WC, blood pressure, glycemic indices, CRP, lipid profile, and MDA (oxidative stress marker) in adults.**

Cinnamon supplementation selectively reduced WC without significantly affecting overall body weight, BMI, or body fat.



Jafari A, et al. The effect of cinnamon supplementation on cardiovascular risk factors in adults: a GRADE assessed systematic review, dose-response and meta-analysis of randomized controlled trials. J Health Popul Nutr. 2025 Jul 3;44(1):233. doi: 10.1186/s41043-025-00967-3. PMID: 40611215; PMCID: PMC12224812

69

Effects of Cocoa Consumption on Cardiometabolic Risk Markers: Meta-Analysis of Randomized Controlled Trials.

The eligible studies were randomized clinical trials (RCTs) involving adults undergoing cocoa consumption **(cocoa extract or ≥70% cocoa dark chocolate) for ≥4 weeks**.

Thirty-one studies were included, totaling **1986 participants.**

Cocoa consumption showed no effects on body weight, BMI, WC, triglycerides, HDL-c and HbA1c. **Reduction in total cholesterol, LDL-c, fasting blood glucose, SBP, and DBP was shown.**



Conclusions: The consumption of cocoa showed **protective effects on major cardiometabolic risk markers that have a clinical impact in terms of cardiovascular risk reduction.**

Arisi, T. O. P., da Silva, et al (2024). Effects of Cocoa Consumption on Cardiometabolic Risk Markers: Meta-Analysis of Randomized Controlled Trials. Nutrients, 16(12), 1919. https://doi.org/10.3390/nu16121919

70



Extra Virgin Olive Oil

Extra virgin olive oil (EVOO) is rich in bioactive phenolic compounds with **antioxidant and anti-inflammatory activity.**

Hyperlipidemic patients exhibited **significant improvements in endothelial function, with increased reperfusion rate and oxygen consumption rate compared to controls. Diastolic blood pressure and heart rate decreased significantly.**

The clinical trial compared two EVOOs with different phenolic concentrations at different dosages; the lower-phenolic EVOO at 20g daily, and the higher-phenolic EVOO at 8g daily.

Conclusions: **EVOO consumption improved endothelial function and hemodynamic parameters in hyperlipidemic patients, with high-phenolic EVOO demonstrating superior vascular benefits at lower doses.**

Kourek C, at al Extra Virgin Olive Oil (EVOO) Improves Vascular Endothelial Function and Hemodynamic Parameters in Patients with Hyperlipidemia: A Post Hoc Analysis of a Randomized Controlled Trial. Nutrients. 2025 Nov 21;17(23):3650. doi: 10.3390/nu17233650. PMID: 41373940; PMCID: PMC12693667.

71

The aim of this systematic review and meta-analysis was to evaluate the effect of EVOO consumption on cardiometabolic risk factors and inflammatory mediators.

Thirty-three trials involving 2020 participants were included.

EVOO consumption was associated with a **significant decrease in insulin and insulin resistance levels (HOMA-IR).**

This meta-analysis indicated no significant effect of consuming EVOO on fasting blood glucose, triglycerides, total cholesterol, low density lipoproteins, very low density lipoproteins, high density lipoproteins, Apolipoprotein (Apo) A-I and B, lipoprotein a, blood pressure, body mass index, waist circumference, waist to hip ratio, C-reactive protein, interleukin-6, interleukin-10, and tumor necrosis factor α levels.

In conclusion, the current systematic review and meta-analysis offers compelling evidence suggesting **potential benefits associated with the consumption of EVOO on insulin sensitivity.**

Mojgan Morvaridzadeh, et al
Effect of Extra Virgin Olive Oil on Anthropometric Indices, Inflammatory and Cardiometabolic Markers: a Systematic Review and Meta-Analysis of Randomized Clinical Trials,
The Journal of Nutrition, Volume 154, Issue 1,2024, Pages 95-120, https://doi.org/10.1016/j.tjnut.2023.10.028.

72



Fibre and Polyphenols

DIETARY FIBRE

↓ Fasting glucose & insulin
↓ HOMA-IR & HbA1c
↓ LDL-C & total cholesterol
↓ TNF-α & blood pressure

Umbrella review: 52 meta-analyses I n = 47,197
Fu et al., 2022

POLYPHENOL-RICH FOODS

↓ Oxidative stress & inflammatory signalling
↑ Nrf2 signalling I ↓ NF-κB activity
Support for insulin sensitivity, mitochondrial & metabolic health

Mechanistic / clinical review
Tauil et al., 2024

Fu L, Zhang G, Qian S, Zhang Q and Tan M (2022) Associations between dietary fiber intake and cardiovascular risk factors: An umbrella review of meta-analyses of randomized controlled trials. Front. Nutr. 9:972399. doi: 10.3389/fnut.2022.972399
Tauil RB, et al. Metabolic-Associated Fatty Liver Disease: The Influence of Oxidative Stress, Inflammation, Mitochondrial Dysfunctions, and the Role of Polyphenols. *Pharmaceuticals.* 2024; 17(10):1354. https://doi.org/10.3390/ph17101354

73

Quick Wins

DAILY:
1 1/2 tsp ground Ceylon cinnamon powder
2-3 cups green tea
2 tbsp freshly ground flaxseeds
2-4 tbsp EVOO onto meals/ salads

WEEKLY
2-3 portions of oily fish
Aim for 30 different plant foods



74

BOTANICALS/ HERBS :

- Ashwaganda
- Shatavari
- Turmeric
- Hawthorn



75

Ashwagandha and Shatavari Extracts Dose-Dependently Reduce Menopause Symptoms, Vascular Dysfunction, and Bone Resorption in Postmenopausal Women

24-week prospective, randomized, double-blind, placebo-controlled, parallel-group intervention study
127 postmenopausal women; 123 completed
Standardised aqueous extracts of Withania somnifera or Asparagus racemosus (250 or 500 mg/day), alone or in combination.
Improvements were dose-dependent, lacking synergism, and favouring the Ashwaganda extract.

Key findings
Compared with placebo, supplementation produced dose-dependent improvements in:
Menopausal symptoms — ↓ MENQOL scores
Vascular function — ↓ reflection index; ↑ nitric oxide
Inflammation — ↓ hs-CRP
Oxidative stress — ↑ glutathione

This study shows promising evidence that Withania and Asparagus may influence biological pathways relevant to healthy ageing following menopause.

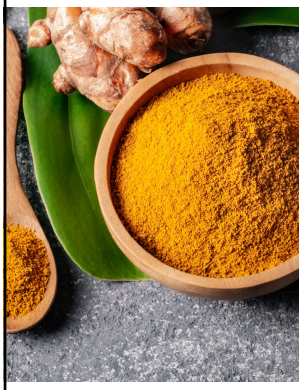
Pingali U, et al. Ashwagandha and Shatavari Extracts Dose-Dependently Reduce Menopause Symptoms, Vascular Dysfunction, and Bone Resorption in Postmenopausal Women: A Randomized, Double-Blind, Placebo-Controlled Study. J Menopausal Med. 2025 Apr;31(1)

76

Curcumin and Postmenopausal Women's Health

2025 systematic review & meta-analysis

14 RCTs | n=982 postmenopausal women



↓ **Systolic BP**

↓ **Diastolic BP**

↑ **Total antioxidant capacity**

↑ **Superoxide dismutase**

↓ **Vasomotor symptoms**

Additional systematic-review evidence:

↓ **fasting glucose | ↓ insulin | ↓ HOMA-IR | improved lipid parameters**

Akyakar B, et al. Int J Mol Sci. 2025;26:8260. and Jin D, et al. Phytother Res. 2025;39:2202–2216.

77

Hawthorn Clinically Significantly Reduces Blood Pressure in Hypertension: A Meta-Analysis of Randomized Placebo-Controlled Clinical Trials

- **Hawthorn showed statistically significantly decrease in SBP and non-significant reduced DBP after 2–6 months of treatment.**
- Variations in dosage (250–1200 mg/day) and study protocols contributed to this heterogeneity.
- The **flavonoids, anthocyanidins, proanthocyanidins**, & **condensed polyphenolic tannins (PCOs)** have **anti-inflammatory, anti-oxidant, and protective cardiac effects.**
- **Plus stabilizing effect on capillaries, reducing vascular permeability and fragility.**



Tassell MC, Kingston R, Gilroy D, Lehane M, Furey A. Hawthorn (Crataegus spp.) in the treatment of cardiovascular disease. Pharmacogn Rev. 2010 Jan;4(7):32-41. doi: 10.4103/0973-7847.65324. PMID: 22228939; PMCID: PMC3249900.

Szikora Z, Tóth N, Iványi RO, Szabó BV, Csupor D, Tóth B. Hawthorn (Crataegus spp.) Clinically Significantly Reduces Blood Pressure in Hypertension: A Meta-Analysis of Randomized Placebo-Controlled Clinical Trials. Pharmaceuticals (Basel). 2025 Jul 10;18(7):1027. doi: 10.3390/ph18071027. PMID: 40732315; PMCID: PMC12298042.

78



79

Targeted preventive strategies should include lifestyle interventions such as **regular resistance and weight-bearing exercise, optimization of protein intake, and promotion of physical activity aimed at preserving muscle mass and limiting visceral fat accumulation.**

Early implementation of **these measures may help mitigate cardiometabolic risk**, **reduce the development of sarcopenic obesity** in women who develop obesity, and preserve functional capacity and quality of life in midlife women.

Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740. PMID: 41598677; PMCID: PMC12842199.

80

Other focus areas include:

- Sleep optimisation
- Stress reduction - mindfulness, meditation, yoga
- Reducing alcohol
- Smoking cessation
- Maintaining healthy weight
- Social support



Ghodeshwar GK, Dube A, Khobragade D. Impact of Lifestyle Modifications on Cardiovascular Health: A Narrative Review. Cureus. 2023 Jul 28;15(7):e42616. doi: 10.7759/cureus.42616. PMID: 37641769; PMCID: PMC10460604.

81

Resistance Training:
Systematic reviews & meta-analyses of RCTs

Body composition & cardiometabolic health
↓ Adiposity
↓ Cardiometabolic risk factors
↓ Inflammation

Musculoskeletal health & healthy ageing
↑ Muscle strength
↑ Physical function

Supports bone health & sarcopenia prevention



Clinical translation
Resistance training 2–3 days/week
Continue for >12 weeks — and ideally long-term

Nunes PRP et al. J Sport Health Sci. 2024;13:145–159. and González-Gálvez N et al. Climacteric. 2024.

82

Aging is associated with altered estrogen receptor expression and alters redox protein balance in human female skeletal muscle.

107 women from 19 to 70 years l Samples taken from skeletal muscle in vastus lateralis

None of the included subjects were using hormonal treatments in any form (oral contraceptives, intra uterine devices, or menopause hormone therapy)

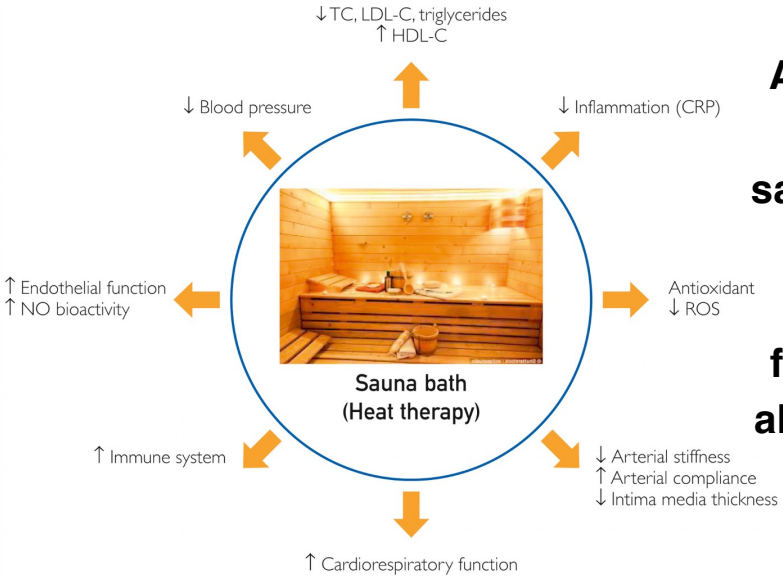
Skeletal muscle expression of oestrogen receptors differed with age, with lower ERα and GPER1 expression in older women.

<u>Lifelong-trained late-postmenopausal women had higher ERα and ERβ expression than age- and menopause-stage-matched sedentary women.</u>



Tamariz-Ellemann, A., Nørregaard, L.B., Oxfeldt, M. et al. Aging is associated with altered estrogen receptor expression and alters redox protein balance in human female skeletal muscle. GeroScience (2026). https://doi.org/10.1007/s11357-026-02432-3

83

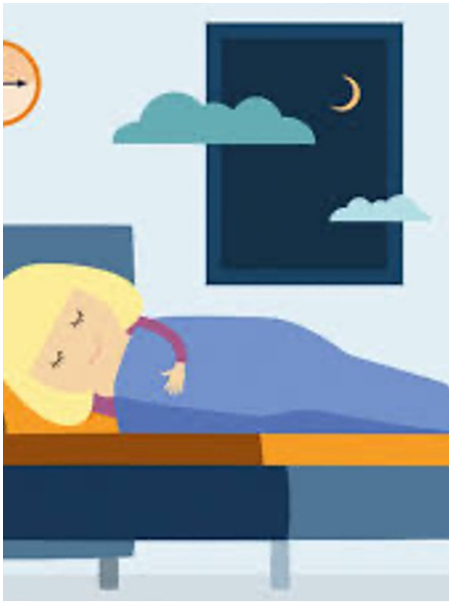


A combination of regular physical activity and sauna baths is associated with a substantial reduction in the risk of fatal cardiovascular and all-cause mortality events compared with each modality alone.

Figure 2 Pleiotropic effects (proposed mechanistic pathways) of Finnish sauna baths. CRP = C-reactive protein; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; NO = nitric oxide; ROS = reactive oxygen species; TC = total cholesterol.

Laukkanen J, Laukkanen T, Kunutsor S. 2018 Cardiovascular and Other Health Benefits of Sauna Bathing: A Review of the EvidenceMayo Clinic Proceedings,

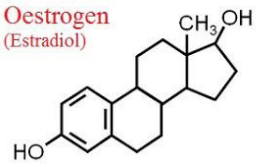
84



Summary of Lifestyle Advice

- Quick win – 5 mins of walking after a meal helps support glucose regulation.
- Focus on sleep hygiene and sleep support.
- Focus on resistance training.
- Reduce stress.
- Try sauna therapy.

85



HRT

Cardiovascular Effects of HRT: Timing Matters

Cardiovascular benefit–risk is most favourable when HRT is initiated before age 60 or within 10 years of menopause.

Early initiation is associated with:
- **Reduced coronary heart disease risk**
- **Reduced all-cause mortality**
- **Lower coronary artery calcification**

- Oral HRT is associated with a small increase in ischemic stroke risk.

- **Transdermal HRT has a more favourable cardiovascular risk profile.**

Current evidence supports a "**window of opportunity**" in which HRT initiated close to menopause may confer cardiovascular benefits, whereas later initiation appears less favorable. The timing hypothesis relates primarily to initiation — it does not imply that HRT should routinely be discontinued after age 60.

Stevenson JC, British Menopause Society Medical Advisory Council. Primary prevention of coronary heart disease in women. BMS Consensus Statement. Reviewed March 2026.

86

Cardiovascular and Metabolic Effects of HRT:



Initiation <60 years or within 10 years of menopause:
• Improved endothelial function and vasodilation
• Increased nitric oxide (NO) bioavailability
• Reduced vascular inflammation and platelet activation
• Reduced LDL cholesterol
• Improved insulin sensitivity and body fat distribution
• More favourable cardiovascular benefit-risk profile

Initiation >60 years or >10 years after menopause
• Benefit–risk profile becomes less favourable and requires individualised assessment
•Absolute cardiovascular and thrombotic risks increase with age and baseline risk
•Oral oestrogen increases VTE risk and has a less favourable thrombotic profile
•Transdermal estradiol has a more favourable VTE/stroke risk profile

British Menopause Society Guidelines

87

Early Menopause / POI

• Associated with increased:
  • Cardiovascular disease risk
  • Insulin resistance and type 2 diabetes
  • All-cause mortality
• Prolonged oestrogen deficiency is a key contributing factor.
• **Current BMS guidance recommends HRT until the average age of natural menopause (~51 years), unless contraindicated.**

British Menopause Society Guidelines

88

HRT and Metabolic Health

Body composition & mitochondrial function

A 2024 case–control study of postmenopausal women found that **HRT use was associated with lower total and visceral fat mass, together with higher skeletal-muscle mitochondrial content and respiratory capacity.** Resting energy expenditure and fat oxidation were unchanged.

Insulin sensitivity

A **2025 meta-analysis of 17 RCTs (n=5,772)** found that menopausal hormone therapy significantly **reduced insulin resistance (HOMA-IR) in healthy postmenopausal women.**
The effect was greater in oestrogen-only trials than with combined oestrogen–progestogen therapy.*

Type 2 diabetes

Large RCTs also suggest a **reduction in incident T2D**. In the WHI oestrogen–progestin trial:
3.5% HRT vs 4.2% placebo I HR 0.79
with evidence of reduced insulin resistance independent of changes in body size.

Kleis-Olsen AS et al. Acta Physiol. 2024;240:e14117 I I Margolis KL et al. Diabetologia. 2004;47:1175–87 I
Casper RF et al. Effects of micronized progesterone added to non-oral estradiol on lipids and cardiovascular risk factors in early postmenopause: a clinical trial. Lipids Health Dis. 2012;11:133. PMID: 23046709.
Li T, Jiang NS, Kaskey J, Schnatz PF, Nudy M. Hormone therapy and insulin resistance in non-diabetic postmenopausal women: a systematic review and meta-analysis. Climacteric. 2025;28(6):673–681. doi:10.1080/13697137.2025.2509844.

89



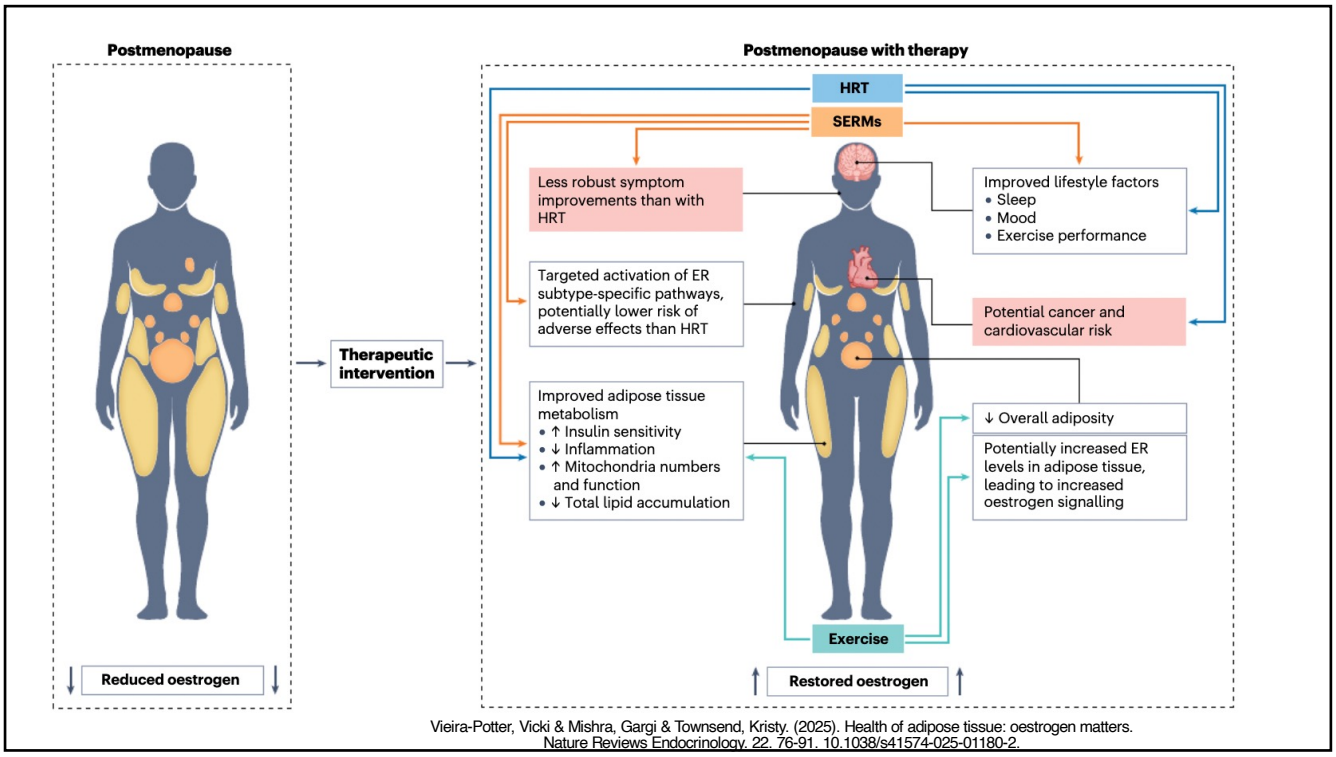
2025 meta-analysis of 17 RCTs (n=5,772)

*Oestrogens used - oral conjugated equine estrogens, oral 17β-estradiol, transdermal 17β-estradiol.
Oral conjugated equine estrogen and 17β-estradiol (oral or transdermal) most common in studies.

*Progestogen/ Progesterone used - medroxyprogesterone acetate, micronized progesterone, dydrogesterone, drospirenone, and norethisterone acetate.
Medroxyprogesterone acetate (MPA) and norethisterone acetate (NETA) most common progestogen therapies .

Li T, Jiang NS, Kaskey J, Schnatz PF, Nudy M. Hormone therapy and insulin resistance in non-diabetic postmenopausal women: a systematic review and meta-analysis. Climacteric. 2025;28(6):673–681. doi:10.1080/13697137.2025.2509844.

90



Vieira-Potter, Vicki & Mishra, Gargi & Townsend, Kristy. (2025). Health of adipose tissue: oestrogen matters. Nature Reviews Endocrinology. 22. 76-91. 10.1038/s41574-025-01180-2.

91

TAKE HOME:

DR SALLY'S CLINIC

- Menopause represents a critical window for intervention in supporting cardiovascular health for women.
- Integrating **personalised** exercise, nutrition & stress management, alongside appropriate therapeutics can improve metabolic health, reduce cardiometabolic risk, and support healthy longevity.
- When using HRT, key FM approaches are still very relevant. In particular, supporting vasculature, nutrient optimisation, antioxidant and inflammatory state, & mitochondrial and gut health.



92

Reference

Arisi, T. O. S., da Silva, et al (2024). Effects of Cocoa Consumption on Cardiometabolic Risk Markers: Meta-Analysis of Randomized Controlled Trials. Nutrients, 16(12), 1919. https://doi.org/10.3390/nu16121919

Ahmad S, Moorthy MV, Lee IM, Ridker PM, Manson JE, Buring JE, Demler OV, Mora S. Mediterranean Diet Adherence and Risk of All-Cause Mortality in Women. JAMA Netw Open. 2024 May 1;7(5):e2414322. doi: 10.1001/jamanetworkopen.2024.14322. PMID: 38819819; PMCID: PMC11143458.

Argano C, Mirarchi L, Amodeo S, Orlando V, Torres A, Corrao S. The Role of Vitamin D and Its Molecular Bases in Insulin Resistance, Diabetes, Metabolic Syndrome, and Cardiovascular Disease: State of the Art. Int J Mol Sci. 2023 Oct 23;24(20):15485. doi: 10.3390/ijms242015485. PMID: 37895163; PMCID: PMC10607188.

Asbaghi O, Rezaei Kelishadi M, Larky DA, et al. The effects of green tea extract supplementation on body composition, obesity-related hormones and oxidative stress markers: a grade-assessed systematic review and dose–response meta-analysis of randomised controlled trials. British Journal of Nutrition. 2024;131(7):1125-1157. doi:10.1017/S000711452300260X

Akyakar B, Şahin İN, Ağagündüz D, Szép D, Budán F. The Effect of Curcumin on Postmenopausal Symptoms: A Systematic Review Based on Randomized Controlled Trials. Int J Mol Sci. 2025 Aug 26;26(17):8260.

Bermingham KM, et al. Menopause is associated with postprandial metabolism, metabolic health and lifestyle: The ZOE PREDICT study. EBioMedicine. 2022 Nov;85:104303. doi: 10.1016/j.ebiom.2022.104303.

Bird SR, Hawley JA. Update on the effects of physical activity on insulin sensitivity in humans. BMJ Open Sport Exerc Med. 2017 Mar 1;2(1):e000143. doi: 10.1136/bmjsem-2016-000143. PMID: 28879026; PMCID: PMC5569266.

Casanova G, Spritzer PM. Effects of micronized progesterone added to non-oral estradiol on lipids and cardiovascular risk factors in early postmenopause: a clinical trial. Lipids Health Dis. 2012 Oct 9;11:133. doi: 10.1186/1476-511X-11-133. PMID: 23046709; PMCID: PMC3508911.

Casper RF et al./the study indexed as: Effects of micronized progesterone added to non-oral estradiol on lipids and cardiovascular risk factors in early postmenopause: a clinical trial. Lipids Health Dis. 2012;11:133. PMID: 23046709.

Chen Y, Tsai H, Tu Y, Chen L. Effects of timing and eating duration of time restricted eating on metabolic outcomes: systematic review and network meta-analysis. BMJ Medicine. 2026;5:e001071.

Chodari L, Dilsiz Aytemir M, Vahedi P, et al. Targeting mitochondrial biogenesis with polyphenol compounds. Oxid Med Cell Longev. 2021;2021:4946711. doi:10.1155/2021/4946711

Dastmalchi, L, Gulati, M, Thurston, R. et al. Improving Cardiovascular Clinical Competencies for the Menopausal Transition: A Focus on Cardiometabolic Health in Midlife. JACC Adv. 2025 Jun, 4 (6_Part_2) .https://doi.org/10.1016/j.jacadv.2025.101791

Derby CA,et al. Lipid changes during the menopause transition in relation to age and weight: The Study of Women's Health Across the Nation. Am J Epidemiol. 2009;169(11):1352–1361.

Di Lorenzo A, Iannuzzo G, Parlato A, et al. Clinical evidence for Q10 coenzyme supplementation in heart failure: from energetics to functional improvement. J Clin Med. 2020;9(5):1266. doi:10.3390/jcm9051266

Drăgoi CM, Dumitrescu IB, Nicolae AC. Rhythms of life: melatonin, nutrition, sleep, and antioxidant strategies for healthy aging. Front Neurosci. 2026 Mar 4;20:1736978. doi: 10.3389/fnins.2026.1736978.

Du J, Zhu M, Bao H, et al. The role of nutrients in protecting mitochondrial function and neurotransmitter signaling: implications for the treatment of depression, PTSD, and suicidal behaviors. Crit Rev Food Sci Nutr. 2016;56(15):2560-2578. doi:10.1080/10408398.2013.876960

Ehrhardt N, Al Zaghal E. Continuous Glucose Monitoring As a Behavior Modification Tool. Clin Diabetes. 2020 Apr;38(2):126-131. doi: 10.2337/cd19-0037. PMID: 32327884; PMCID: PMC7164990

El Khoudary SR, et al. The independent associations of anti-Müllerian hormone and estradiol levels over the menopause transition with lipids/lipoproteins: The Study of Women's Health Across the Nation. J Clin Lipidol. 2022;17(4):457-467. doi: 10.1016/j.jacl.2023.11.008. PMID: 38547448

93

Ghodeshwar GK, Dube A, Khobragade D. Impact of Lifestyle Modifications on Cardiovascular Health: A Narrative Review. Cureus. 2023 Jul 28;15(7):e42616. doi: 10.7759/cureus.42616.

Gonçalves C, Moreira H, Santos R. Systematic review of mediterranean diet interventions in menopausal women. AIMS Public Health. 2024 Jan 10;11(1):110-129. doi: 10.3934/publichealth.2024005. PMID: 38617417; PMCID: PMC11007410.

Gulati A, Banker H, Muhammad AA, Anamika F, Jain R. Unlocking the Potential: Phytoestrogens and Cardiovascular Health. Curr Cardiol Rev. 2025;21(3):e1573403X333952. doi: 10.2174/011573403X333952241203050033. PMID: 39757642; PMCID: PMC12172217.

Gupte AA, Pownall HJ, Hamilton DJ. Estrogen: an emerging regulator of insulin action and mitochondrial function. J Diabetes Res. 2015;2015:916585. doi: 10.1155/2015/916585. Epub 2015 Mar 26.

Goodpaster BH, Sparks LM. Metabolic Flexibility in Health and Disease. Cell Metab. 2017 May 2;25(5):1027-1036. doi: 10.1016/j.cmet.2017.04.015. PMID: 28467922; PMCID: PMC5513193.

Hage FG, Oparil S. Ovarian hormones and vascular disease. CurrOpinCardiol. 2013 Jul;28(4):411-6. doi: 10.1097/HCO.0b013e32836205e7. Review.

Hevener AL, Zhou Z, Moore TM, Drew BG, Ribas V. The impact of ERα action on muscle metabolism and insulin sensitivity - Strong enough for a man, made for a woman. Mol Metab. 2018 Sep;15:20-34.

Hildreth KL, Ozemek C, Kohrt WM, Blatchford PJ, Moreau KL. Vascular dysfunction across the stages of the menopausal transition is associated with menopausal symptoms and quality of life. Menopause. 2018 Sep;25(9):1011-1019. doi: 10.1097/GME.0000000000001112. PMID: 29634636; PMCID: PMC6103796.

Hyvarinen, M et al. Metabolic health, menopause, and physical activity—a 4-year follow-up study. International Journal of Obesity. Volume 46, pages 544–554 (2022)

Jafari A, et al. The effect of cinnamon supplementation on cardiovascular risk factors in adults: a GRADE assessed systematic review, dose-response and meta-analysis of randomized controlled trials. J Health Popul Nutr. 2025 Jul 3;44(1):233. doi: 10.1186/s41043-025-00967-3. PMID: 40611215; PMCID: PMC12224812

Jin, D., Jin, S., Sheng, G., Cui, Z., Gao, P. and Li, G. (2025), Effects of Curcumin on Postmenopausal Women's Health: A Systematic Review and Meta-Analysis. Phytotherapy Research, 39: 2202-2216. https://doi.org/10.1002/ptr.8467

Laukkanen J, Laukkanen T, Kunutsor S. 2018 Cardiovascular and Other Health Benefits of Sauna Bathing: A Review of the EvidenceMayo Clinic Proceedings, 93, 1111-1121

Li T, Jiang NS, Kaskey J, Schnatz PF, Nudy M. Hormone therapy and insulin resistance in non-diabetic postmenopausal women: a systematic review and meta-analysis. Climacteric. 2025;28(6):673–681. doi:10.1080/13697137.2025.2509844.

Kahaly GJ, Liu Y, Persani L. Hypothyroidism: playing the cardiometabolic risk concerto. Thyroid Res. 2025 May 20;18(1):20. doi: 10.1186/s13044-025-00233-y. PMID: 40390147; PMCID: PMC12090691.

Kleis-Olsen AS, et al Metabolic flexibility in postmenopausal women: Hormone replacement therapy is associated with higher mitochondrial content, respiratory capacity, and lower total fat mass. Acta Physiol (Oxf). 2024 Jun;240(6):e14117. doi: 10.1111/apha.14117. Epub 2024 Feb 25. PMID: 38404156.

Kourek C, at al Extra Virgin Olive Oil (EVOO) Improves Vascular Endothelial Function and Hemodynamic Parameters in Patients with Hyperlipidemia: A Post Hoc Analysis of a Randomized Controlled Trial. Nutrients. 2025 Nov 21;17(23):3650. doi: 10.3390/nu17233650. PMID: 41373940; PMCID: PMC12693667.

Mantle D, Hargreaves IP, Domingo JC, Castro-Marrero J. Mitochondrial dysfunction and coenzyme q10 supplementation in post-viral fatigue syndrome: an overview. Int J Mol Sci. 2024;25(1):574. doi:10.3390/ijms25010574

Marlatt, Kara & Pitynski-Miller, Dori & Gavin, Kathleen & Moreau, Kerrie & Melanson, Edward & Santoro, Nanette & Kohrt, Wendy. (2021). Body composition and cardiometabolic health across the menopause transition. Obesity. 30. 14-27. 10.1002/oby.23289.

Manson JE, Aragaki AK, Rossouw JE, Anderson GL, Prentice RL, LaCroix AZ, Chlebowski RT, Howard BV, Thomson CA, Margolis KL, Johnson KC, Kuller LH, Oberman A, Lasser NL, Ko MG, Sattari M, Lewis CE, Expert T, Limacher M, Hays J. Menopausal hormone therapy and long-term all-cause and cause-specific mortality: the Women's Health Initiative randomized trials. JAMA. 2017 Feb 14;318(10):927-938. doi: 10.1001/jama.2017.11217. PMID: 28898378; PMCID: PMC5728370.

94

McCarthy M, Raval AP. The peri-menopause in a woman's life: a systemic inflammatory phase that enables later neurodegenerative disease. J Neuroinflammation. 2020 Oct 23;17(1):317.

Mojgan Morvaridzadeh, et al Effect of Extra Virgin Olive Oil on Anthropometric Indices, Inflammatory and Cardiometabolic Markers: a Systematic Review and Meta-Analysis of Randomized Clinical Trials, The Journal of Nutrition, Volume 154, Issue 1,2024, Pages 95-120, https://doi.org/10.1016/j.tjnut.2023.10.028.

Mthembu SXH, Dludla PV, Ziqubu K, et al. The potential role of polyphenols in modulating mitochondrial bioenergetics within the skeletal muscle: a systematic review of preclinical models. Molecules. 2021;26(9):2791. doi:10.3390/molecules26092791

Minich DM, Henning M, Darley C, Fahoum M, Schuler CB, Frame J. Is Melatonin the "Next Vitamin D"?: A Review of Emerging Science, Clinical Uses, Safety, and Dietary Supplements. Nutrients. 2022 Sep 22;14(19):3934. doi: 10.3390/nu14193934. PMID: 36235587; PMCID: PMC9571539.

Nazari A, Ghotbabadi Z, Kazemi K . The Effect of Berberine Supplementation on Glycemic Control and Inflammatory Biomarkers in Metabolic Disorders: An Umbrella Meta-analysis of Randomized Controlled Trials Clinical Therapeutics, 2023; 46, e64-e72

Nappi R, Chedraui P, Lambrinoudaki I et al. Menopause: a cardiometabolic transition, The Lancet Diabetes & Endocrinology, 2022; 10, 442-4

Naddafha S, Antonio J, Kreider RB, Stout JR. Creatine monohydrate for lean mass, strength, and bone density in postmenopausal women: a systematic review and meta-analysis. J Int Soc Sports Nutr. 2026 Dec 31;23(1):2668435. doi: 10.1080/15502783.2026.2668435. Epub 2026 May 16. PMID: 42141930; PMCID: PMC13182165.

National Institutes of Health Office of Dietary Supplements. Dietary supplements for primary mitochondrial disorders: fact sheet for health professionals. Updated June 30, 2020. Accessed April 4, 2025. https://ods.od.nih.gov/factsheets/PrimaryMitochondrialDisorders-HealthProfessional/

N. González-Gálvez, J. M. Moreno-Torres & R. Vaquero-Cristóbal (14 Feb 2024): Resistance training effects on healthy postmenopausal women: a systematic review with meta-analysis, Climacteric, DOI: 10.1080/13697137.2024.2310521

Nunes PRP, M, et al. Effect of resistance training volume on body adiposity, metabolic risk, and inflammation in postmenopausal and older females: Systematic review and meta-analysis of randomized controlled trials. J Sport Health Sci. 2024 Mar;13(2):145-159. doi: 10.1016/j.jshs.2023.09.012. Epub 2023 Oct 1. PMID: 37788790; PMCID: PMC10980902.

Paulo Ricardo Prado Nunes, et al, Effect of resistance training volume on body adiposity, metabolic risk, and inflammation in postmenopausal and older females: Systematic review and meta-analysis of randomized controlled trials, Journal of Sport and Health Science, Volume 13, Issue 2, 2024, Pages 145-159, ISSN 2095-2546,

Park YM, Pereira RI, Erickson CB, Swibas TA, Kang C, Van Pelt RE. Time since menopause and skeletal muscle estrogen receptors, PGC-1α, and AMPK. Menopause. 2017 Jul;24(7):815-823. doi: 10.1097/GME.0000000000000829. PMID: 28195989; PMCID: PMC5484730.

Park, S.-H., M.-R. Oh, J. Lee, H.-K. Choi, and J.-T. Hwang. 2025. " Effects of Plant-Derived Dietary Supplements on Lipid Profiles in Menopausal Women: An Updated Systematic Review and Meta-Analysis of Randomized Placebo-Controlled Trials." Phytotherapy Research 39, no. 8: 3486–3507. https://doi.org/10.1002/ptr.8511.

Pingali U, et al. Ashwagandha and Shatavari Extracts Dose-Dependently Reduce Menopause Symptoms, Vascular Dysfunction, and Bone Resorption in Postmenopausal Women: A Randomized, Double-Blind, Placebo-Controlled Study. J Menopausal Med. 2025 Apr;31(1)

Pollicino F, Veronese N, Dominguez LJ, Barbagallo M. Mediterranean diet and mitochondria: new findings. Exp Gerontol. 2023;176:112165. doi:10.1016/j.exger.2023.112165

Pussinen PJ, et al Endotoxemia is associated with an increased risk of incident diabetes. Diabetes Care. 2011 Feb;34(2):392-7.

Roudsari NM, et al Ginger: A complementary approach for management of cardiovascular diseases. Biofactors. 2021 Nov;47(6):

95

Schaedel Z. Managing sleep disturbance during the menopause transition. Post Reproductive Health. 2025;31(4):284-293. doi:10.1177/2053369125137887

Semnani-Azad Z et al. Intermittent fasting strategies and their effects on body weight and other cardiometabolic risk factors: systematic review and network meta-analysis of randomised clinical trials BMJ 2025; 389 :e082007 doi:10.1136/bmj-2024-082007

Shieh A, et al . Markers of compromised gut epithelial barrier integrity increase during the menopause transition. J Clin Invest. 2026 Jul 9;136(17)

Shieh A, et al Gut permeability, inflammation, and bone density across the menopause transition. JCI Insight. 2020 Jan 30;

Soares Junior JM, Albayrak M, Sengul D, Sengul I. Thyroid function after menopause: is there any concern in thyroidology? Rev Assoc Med Bras (1992). 2024 Dec 16;70(12):e7012EDI.

Susan R Davis et al. Menopause. Nature Reviews Disease Primers Volume 1, Article number: 15004 (2015)

Stevenson JC, British Menopause Society Medical Advisory Council. Primary prevention of coronary heart disease in women. BMS Consensus Statement. Reviewed March 2026.

Szeliga A, Chedraui P, Meczekalski B. The Impact of the Menopausal Transition on Body Composition and Abdominal Fat Redistribution. J Clin Med. 2026 Jan 16;15(2):740. doi: 10.3390/jcm15020740.

Szikora Z, Mátyus RO, Szabó BV, Csupor D, Tóth B. Hawthorn (Crataegus spp.) Clinically Significantly Reduces Blood Pressure in Hypertension: A Meta-Analysis of Randomized Placebo-Controlled Clinical Trials. Pharmaceuticals (Basel). 2025 Jul 10;18(7):1027. doi: 10.3390/ph18071027. PMID: 40732315; PMCID: PMC12298042.

Tauil RB, et al. Metabolic-Associated Fatty Liver Disease: The Influence of Oxidative Stress, Inflammation, Mitochondrial Dysfunctions, and the Role of Polyphenols. Pharmaceuticals. 2024; 17(10):1354. https://doi.org/10.3390/ph17101354

Tamariz-Ellemann, A., Nørregaard, L.B., Oxfeldt, M. et al. Aging is associated with altered estrogen receptor expression and alters redox protein balance in human female skeletal muscle. GeroScience (2026). h

Tassell MC, Kingston R, Gilroy D, Lehane M, Furey A. Hawthorn (Crataegus spp.) in the treatment of cardiovascular disease. Pharmacogn Rev. 2010 Jan;4(7):32-41. doi: 10.4103/0973-7847.65324.

Tardivo AP, Nahas-Neto J, Orsatti CL, Dias FB, Poloni PF, Schmitt EB, Nahas EA. Effects of omega-3 on metabolic markers in postmenopausal women with metabolic syndrome. Climacteric. 2015 Apr;18(2):290-8.

Teede, H at al International PCOS Network, Recommendations From the 2023 International Evidence-based Guideline for the Assessment and Management of Polycystic Ovary Syndrome, The Journal of Clinical Endocrinology & Metabolism, Volume 108, Issue 10, October 2023, Pages 2447–2469, https://doi.org/10.1210/clinem/dgad463.

Thurston RC. Vasomotor symptoms and cardiovascular health: findings from the SWAN and the MsHeart/MsBrain studies. Climacteric. 2024 Feb;27(1):75-80. doi: 10.1080/13697137.2023.2196001. Epub 2023 Aug 14.

Virmani MA, Cirulli M. The role of L-carnitine in mitochondria, prevention of metabolic inflexibility and disease initiation. Int J Mol Sci. 2022;23(5):2717. doi:10.3390/ijms23052717

Vieira-Potter, Vicki & Mishra, Gargi & Townsend, Kristy. (2025). Health of adipose tissue: oestrogen matters. Nature Reviews Endocrinology. 22. 76-91. 10.1038/s41574-025-01180-2.

Wang J, Gaman M, Albadawi N. Does Omega-3 Fatty Acid Supplementation Have Favorable Effects on the Lipid Profile in Postmenopausal Women? A Systematic Review and Dose–response Meta-analysis of Randomized Controlled Trials. Clinical Therapeutics, 2023; 45, e74-e87

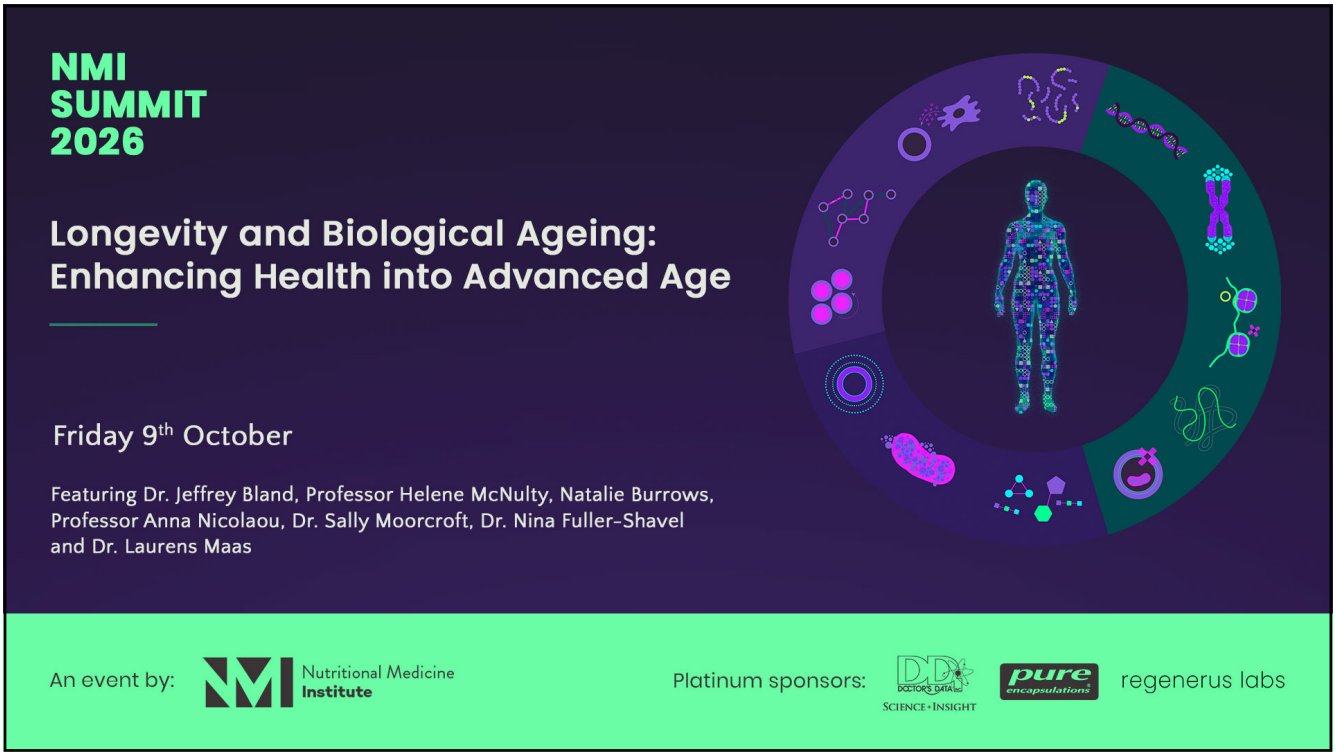
Wolters M, et al. Effects of phytoestrogen supplementation on intermediate cardiovascular disease risk factors among postmenopausal women: a meta-analysis of randomized controlled trials. Menopause. 2020 Sep;27(9):1081

Wylenzek F, Bühling KJ, Laakmann E. A systematic review on the impact of nutrition and possible supplementation on the deficiency of vitamin complexes, iron, omega-3-fatty acids, and lycopene in relation to increased morbidity in women after menopause. Arch Gynecol Obstet. 2024 Oct;310(4):2235-2245. doi: 10.1007/s00404-024-07555-6. Epub 2024 Jun 27. PMID: 38935105; PMCID: PMC11393286.

Xing D et al. Estrogen and Mechanisms of Vascular Protection. Arteriosclerosis, thrombosis, and vascular biology. 2009;29(3):289-295. doi:10.1161/ATVBAHA.108.182279.

Zhipeng Tao, Zhiyong Cheng; Hormonal regulation of metabolism—recent lessons learned from insulin and estrogen. Clin Sci (Lond) 31 March 2023; 137 (6): 415–434. doi: https://doi.org/10.1042/CS20210519

96


NMI
SUMMIT
2026
Longevity and Biological Ageing:
Enhancing Health into Advanced Age
Friday 9th October
Featuring Dr. Jeffrey Bland, Professor Helene McNulty, Natalie Burrows,
Professor Anna Nicolaou, Dr. Sally Moorcroft, Dr. Nina Fuller-Shavel
and Dr. Laurens Maas
An event by:
Nutritional Medicine
Institute
Platinum sponsors:
DOCTOR'S DATA
SCIENCE+INSIGHT
pure
encapsulations
regenerus labs

97