Independent Research & Further Reading

Guest: Dr Andy Galpin

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Undiagnosed Sleep Apnea Prevalence

> *"Somewhere in the neighborhood of 70 to 80% of people who have clinical sleep apnea will go undiagnosed. … 50%, depending on which study you look at, of athletes have a clinical sleep disorder. Half of them. For women, it's somewhere in the neighborhood of 90 to 95% of women that have clinical sleep apnea will go undiagnosed."*

The original estimate comes from the Wisconsin Sleep Cohort. A 1993 NEJM population study used overnight polysomnography in a random sample of middle-aged employed adults to show undiagnosed sleep-disordered breathing was common, including in women. The follow-up 1997 analysis combined questionnaire data from **4,925 adults** with in-lab polysomnography in **1,090 participants** and estimated that **82% of men and 93% of women with moderate-to-severe sleep apnea syndrome had not been clinically diagnosed**. Later reviews and epidemiology papers largely treat that cohort as the baseline evidence. Reviews in 2002, 2020, and 2021 all restate that undiagnosed obstructive sleep apnea (OSA) is common and that >80% or 80–90% of cases remain unrecognised, especially for moderate-to-severe disease. 2025 U.S. modelling estimated 83.7–85.6 million adults with OSA and about 68.5 million undiagnosed.

A 2026 review mentions **up to 75% of women with OSA remain undiagnosed** due to atypical symptoms (fatigue, insomnia, mood disturbance) and screening tools designed for men. Women with OSA present differently than men, which drives systematic underdiagnosis. Women report fatigue, insomnia, morning headaches, and mood disturbances rather than the classic male presentation of loud snoring and witnessed apneas. Despite milder severity scores, women face equal or worse cardiovascular consequences. OSA predicted ventricular hypertrophy, heart failure, and mortality only in women in the Sleep Heart Health Study. Women with OSA also show a 28% higher mortality risk compared to female controls, while men showed no significant excess.

In athletes, OSA prevalence ranges from 7% to 86.5% depending on sport, with collision-sport athletes at highest risk. A 2025 systematic review of 20 studies found frequencies from 7% in Brazilian Olympic athletes to 86.5% in rugby players. Athletic OSA research relies heavily on screening questionnaires rather than polysomnography, and no randomised controlled trials exist in this population. Studies are strongly male-dominated, limiting generalisability to female athletes whose risk profiles differ anatomically and hormonally. **Women are under-represented in OSA clinical trials, so sex-specific treatment outcomes remain poorly characterised**.

References 1-16.

Sleep Apnea Prevalence by Demographic Group

> *"It says men who are middle-aged have a 24 to 34% prevalence of apnea. Women, nine to 17%. … seniors … 30 to 60%. … post-menopausal women, 25%." Andy Galpin: "That's right. … you'll see a billion people across the globe [with apnea]."*

For context, the **apnea-hypopnea index, or AHI**, is the total number of apneas and hypopneas recorded during a sleep study divided by total sleep time in hours. An apnea is a complete airflow cessation lasting at least 10 seconds, and the AHI combines those events with hypopneas, which are partial breathing reductions. AHI is the most commonly used metric to diagnose obstructive sleep apnea and classify its severity, and it remains the best-studied single measure even though it is imperfect. Standard severity cutoffs:

- normal <5
- mild 5 to <15
- moderate 15 to <30
- severe ≥30 events/hour.

Sleep Apnea Prevalence

- The landmark Wisconsin Sleep Cohort Study found a **24% prevalence of sleep-disordered breathing (SDB) (AHI ≥ 5) in men aged 30–60**.
- A 2013 update to the same cohort estimated that **10% of men aged 30–49 and 17% of men aged 50–70 had moderate-to-severe SDB (AHI ≥ 15)**.
- The Busselton Healthy Ageing Study reported **moderate-to-severe OSA prevalence of 24.6% in males** in a matched age-group comparison from 2007, nearly identical to the 20.2% found in 2010–2015.

A systematic review of 24 studies found that **at AHI ≥ 5, the overall population prevalence ranged from 9% to 38%** and was consistently higher in men, with advancing age and higher BMI driving the upper end of that range. **At the moderate-to-severe threshold (AHI ≥15), prevalence ranged from 6% to 17%** in the general adult population but reached 49% in advanced age groups.

Additionally, a review of eleven epidemiological studies published between 1993 and 2013 reported a mean **OSA prevalence of 22%** (range 9–37%) in men at AHI ≥ 5.

Men bear a two- to three-fold higher prevalence of OSA than women across most adult populations. A US-based study estimated 2024 OSA prevalence at 39.1% in males versus 26.0% in females among adults aged ≥20. In Germany, polysomnography-confirmed prevalence at AHI ≥5 was 59% in men and 33% in women, while a Brazilian cohort found adjusted prevalence of 44.9% in men and 30.8% in women. The male-to-female ratio narrows considerably in population-based versus clinical samples, with early clinic-based studies exaggerating the disparity to 9:1 or 10:1, whereas community data suggest a ratio closer to 1.5:1.

OSA prevalence rises continuously with age in men, while women show a later onset linked to menopausal transition. In men, prevalence increases modestly with age even after BMI adjustment, with the highest rates observed in the 60–79 age range. In women, prevalence peaks around age 60–70 and then declines, an inverted U-shaped pattern driven primarily by menopause rather than chronological age. Postmenopausal women not on hormone replacement therapy had significantly higher OSA prevalence (2.7%) compared to premenopausal women (0.6%), approaching male rates.

References 17-27.

Central and Peripheral Apnea Subtypes

> *"What we're now finding is a whole series of other types of apnea. There are things called central apnea and peripheral apnea, and why this matters is. There's actually a paper published just … 2024 actually, where groups like ours … can actually start to identify more likely the cause of your apnea. … there are neural causes to it. There are environmental causes. Um, there are positional causes."*

It is uncertain which paper the guest is referring to. However, recent literature characterises obstructive sleep apnea (OSA) as a multifactorial disorder with substantial inter-individual variation in physiological endotypes, including anatomical and non-anatomical traits such as airway collapsibility, upper-airway muscle responsiveness, loop gain, and arousal threshold. Positional OSA also appears to have distinct physiological characteristics compared with non-positional OSA. In

particular, non-anatomical traits such as loop gain may contribute more strongly to OSA severity in positional cases, whereas anatomical factors appear to play a greater role in non-positional OSA. Supine-predominant OSA has also been associated with lower airway collapsibility and differences in upper-airway muscle compensation compared with non-positional OSA. More broadly, factors such as obesity and sex may influence OSA pathophysiology through different mechanisms, including effects on upper-airway mechanics and ventilatory control.

Neural and Environmental Drivers

Neural control of breathing, specifically elevated loop gain and a low arousal threshold, constitutes a major non-anatomical cause of OSA. Loop gain, a measure of ventilatory control instability, increases with age in both men and women, suggesting that neural respiratory control worsens over time and contributes to OSA in older adults. In central sleep apnea, chronic heart failure drives a nonhypercapnic phenotype through increased loop and controller gain, highlighting how environmental and comorbid factors interact with neural breathing regulation.

Environmental factors, primarily obesity, drive OSA severity by increasing upper airway collapsibility. However, the pathophysiological pathways linking obesity to OSA differ by sex; in men, higher BMI increases OSA severity partly by reducing upper airway stiffness and increasing arousal threshold, whereas in women, the effect is mediated primarily through reduced upper airway stiffness and circulatory delay.

References 28-32.

Wearables' Unreliability for Deep and REM Sleep

> *"They're really, really bad, and a major pitfall for wearables is predicting things like deep sleep and REM sleep. … we get paid to provide as close to perfect a sleep solutions as possible … and we do not pay attention to their deep or REM sleep on a wearable."*

Consumer wearables detect deep and REM sleep with moderate accuracy, but epoch-by-epoch agreement with polysomnography (PSG) remains limited and varies substantially across devices, algorithms, and populations. Multi-sensor wearables combining PPG and accelerometry achieve 60–80% accuracy for 4-stage sleep classification, with deep and REM sleep

generally detected more accurately than light sleep or wake. Device-confirmed epoch proportions for deep sleep range from 73–88% across Oura, Fitbit, and Apple Watch, with REM sleep confirmation between 73–79%.

Wearables incorporating photoplethysmography (PPG) alongside accelerometry consistently outperform accelerometer-only devices for multi-stage sleep classification. The Oura Ring Gen3 showed no significant difference from PSG for deep or REM sleep estimation, while the Apple Watch underestimated deep sleep by 43 minutes and Fitbit underestimated it by 15 minutes (Robbins et al. 2024). In a head-to-head comparison of six wearables, the Fitbit Sense and Fitbit Charge 5 showed no significant discrepancy for deep or REM sleep, whereas the Apple Watch significantly underestimated REM and WHOOP overestimated it (Schyvens et al. 2025).

Deep and REM sleep benefit from more distinct physiological signatures (reduced heart rate and minimal movement), making them easier for wearables to identify than light sleep or wake. However, conservative algorithms tend to default to light sleep classification when uncertain, suppressing deep and REM estimates.

Limitations

- Proprietary, black-box algorithms prevent independent evaluation of sensor-level performance and hinder reproducibility.
- Performance varies with individual factors, including age, BMI, skin tone, and sleep efficiency, raising equity concerns.
- Validation studies are limited to single device-firmware iterations, so results cannot be generalised across versions.
- Even trained human PSG scorers achieve only ~80% inter-rater agreement, particularly for REM transitions, setting a ceiling on wearable benchmarking.

References 33-39.

Global Decline in Sleep Duration Despite Rising Spend on Sleep

> *"If you look at some of the more recent papers, you're seeing annual spend on sleep is like 600 billion right now, but yet we have seen a 60-minute drop in total sleep time over the last 60 years."*

Consultancy firm Frost & Sullivan estimates that the global sleep economy will be worth $585 billion this year. However, this is a broad "sleep economy" estimate.

The evidence does not support a 60-minute population-level drop in objectively measured total sleep time over the last six decades, though small country-specific declines in self-reported sleep exist. A review of 168 studies (Youngstedt et al. 2015) with objectively recorded sleep (polysomnography or actigraphy) **from 1960 to 2013** found **no significant association of sleep duration with study year** across 6,052 healthy adults.

A systematic review (Bin et al. 2012) of 15 countries **from the 1960s to the 2000s** found self-reported sleep duration **increased in 7 countries** (changes of 0.1–1.7 minutes per night per year) and **decreased in 6** (changes of 0.1–0.6 minutes per night per year).

A **36-year Finnish longitudinal cohort** (Hublin et al. 2020) showed a mean **decrease of about 18 minutes in men** and **32 minutes in women** (roughly 0.5–0.9 minutes per year), though ageing was the probable main driver.

Objective data show no secular decline, and subjective declines where present are measured in single-digit minutes per year and partly attributable to ageing and methodology.

References 40-42.

NASA Satellite Data on Global Light Pollution

> *"There's data from NASA, satellite data, that can look and say the world is physically brighter now than it's ever been."*

Global satellite records of nighttime lights extend back to the early 1990s, but older and newer satellite instruments differ in sensitivity, resolution and calibration, making very long-term comparisons more difficult. A recent global analysis using NASA's Black Marble data found a net increase in satellite-measured artificial-light radiance from 2014 to 2022, alongside substantial simultaneous brightening and dimming.

NASA's Black Marble programme analyses nighttime observations from VIIRS instruments aboard the Suomi-NPP, NOAA-20 and NOAA-21 satellites. A 2026 analysis of about 1.16 million daily images from 2014–2022 found that:

- Areas that brightened produced a radiance increase equivalent to 34% of the 2014 baseline.
- Dimming elsewhere offset about 18% of that increase.
- The resulting net global increase was approximately 16% in artificial-light radiance.
- Brightening was prominent in parts of Asia and sub-Saharan Africa, associated with urbanisation, industrial development and electrification.
- Dimming occurred in places such as France, the UK and the Netherlands, associated with LED replacement, energy conservation and lighting policies. The UK's measured nighttime radiance fell by about 22% over the period.

Earth's inhabited land areas are, overall, more artificially illuminated at night than they were in the satellite record's 2014 baseline, but the change is highly uneven, and some regions are becoming darker.

References 43-46.

Urbanisation Linked to Higher Rates of Anxiety and Depression

> *"If you look at some of the studies … some of the studies have found things as high as, like, anxiety and depression are up 20-plus percent when you move into the city."*

The evidence does not show a single universal increase in anxiety when people move to urban areas. Large syntheses and multi-country studies often find higher urban anxiety on average, but several recent country-specific studies find the opposite pattern or no meaningful difference, especially outside very large cities or in lower- and middle-income settings.

A meta-analysis of 20 surveys (Mouly et al. 2023) found **21% higher anxiety disorder** prevalence in urban than rural populations, and review papers converge that anxiety and related stress disorders tend to be more common in cities.

A 191-country ecological analysis also reported a positive, non-linear association between urbanisation and common mental disorders, particularly anxiety, suggesting risk may rise more at higher levels of urbanisation rather than in a simple step from rural to urban living.

Mechanistic and environmental studies point to likely contributors within cities rather than "urban" being one uniform exposure: social deprivation, air pollution, dense street networks, and land-use density correlate with affective symptoms, while greenness and destination accessibility correlate with lower anxiety symptoms. Experimental neuroimaging is consistent with a stress pathway, with current city living linked to greater amygdala reactivity during social stress and urban upbringing linked to altered perigenual anterior cingulate responses.

References 47-51

Recommended Ambient Noise Levels for Sleep

> *"The typical number you wanna see … for sound at night is, like, 35 decibels … you see the urban environment, you're looking in the 60 to 70 as a baseline. … Pretty common default is, like, 40 to 50 decibels for a sound machine. More of the data suggests sub-40, especially for kids."*

The WHO recommends that average indoor bedroom noise not exceed 30 dBA, with individual noise events not exceeding 45 dB LAmax on more than 10–15 occasions per night. Outdoor annual nighttime averages should remain below 40 dBA, a threshold linked to self-reported sleep disturbance and increased sedative use. The WHO's 40 dBA outdoor threshold specifically targets vulnerable populations, including children and older adults.

Nighttime noise above approximately 35 dBA indoors is associated with REM sleep disruption, with sensitivity varying by individual and noise source. First noise-induced awakenings typically appear once maximum sound pressure levels exceed 30–35 dB in the bedroom.

Urban nighttime noise levels routinely exceed recommended thresholds by large margins. In 31 major Chinese cities, average environmental noise fluctuated between 50.1 and 60.0 dB(A). Nearly 91% of urban US adolescents lived in communities where day-night noise exceeded the EPA's 55 dB limit. In the Paris Metropolitan Area, about 75.7% of inhabitants were exposed to nighttime road traffic noise exceeding WHO guidelines.

Each 10 dB(A) increase in nighttime noise was associated with a probable 27% increase in poor sleep quality and a 24% reduction in sleep duration (Li et al. 2024). Additionally, residents in high-noise US communities had bedtimes approximately 30–40 minutes later than those in quieter areas (Rudolph et al. 2019).

References 52-61.

Resting Heart Rate and Sleep Duration (Case Example)

> *"We had 1,200 days of data from, I think it was an Oura Ring, and we were actually able to find that … for every one drop in resting heart rate, so his resting heart rate, say, went from 65 beats per minute to 64, he got six more minutes of sleep."*

Oura's Discovery Hub (their in-app analytics feature) supports analyses like "for every 1-unit change in RHR, how does total sleep change?" across many nights of data. In a large de-identified cohort (25,759 members), Oura reports that:

- Longer sleep duration and higher activity are associated with lower RHR and higher HRV.
- Short sleep (<6 h) and low activity are associated with higher RHR and lower HRV.

Reference 62.

Lavender and Sleep Onset

> *"Lavender is moderately associated with helping people fall asleep. So if you actually put lavender smell in your home, in your bedroom, so that you start to associate lavender with falling asleep …"*

A 2025 meta-analysis of 11 RCTs (Shen et al. 2025) with 628 adults found lavender essential oil significantly enhanced sleep quality, with a larger effect when oil was placed directly beside the pillow versus farther away. Placement 15 cm or farther away did not reach significance. They did note that conclusions require verification in more high-quality studies due to the limited quantity and quality of included RCTs. Another 2025 meta-analysis, this time in older adults (10 trials, all inhalation), showed significant sleep quality improvement, with 9 of 10 studies reporting benefit, though heterogeneity was high.

A double-blind RCT in 35 postmenopausal women with insomnia found that lavender inhalation did not clearly beat placebo on the main sleep-quality measure, but it was linked to faster sleep onset and better objective sleep efficiency. The lavender group inhaled Lavandula angustifolia essential oil, while the placebo group inhaled sunflower oil, for 29 days. Both groups also got sleep hygiene guidance and weekly follow-up, which matters because those steps likely improved sleep in both groups.

A critical review (Luo et al. 2022) across diverse clinical populations called for robust, longer-duration trials before evidence-based judgement on efficacy.

Mechanisms Underlying Sleep Promotion

Lavender's sleep-promoting effects depend on the olfactory pathway and central amygdala GABAergic neurons. In mice, silencing these neurons or disrupting olfactory input abolished lavender's ability to shorten NREM sleep latency. Linalool and linalyl acetate are the principal active monomers, with linalool-enriched fractions contributing more to sleep maintenance and linalyl acetate-enriched fractions performing better at sleep initiation.

The mechanism is multifaceted, involving the GABAergic system, cholinergic system, histaminergic system, and monoamines in the limbic system. Active lavender components also bind glutamate NMDA receptors and serotonin transporters, paralleling the GABAergic modulation shared by other herbal sedatives.

References 63-69.

Optimal Bedroom Temperature for Sleep

> *"This is a pretty obvious one. You wanna be cool. Generally, you're looking at 64 to 68 degrees, uh, where you want it to be."*

The optimal ambient temperature for sleep falls roughly between 17–28°C (62.6–82.4°F), with the narrowest consensus around 20–26°C (68–79°F), though the precise optimum depends on bedding insulation, clothing, humidity, age, and gender.

A large-scale analysis of over 3.75 million nights found that bedroom temperatures above 70°F (21°C) were associated with progressively poorer sleep, with each 1°F increase between 60–85°F reducing sleep efficiency by 0.06% (Raj et al. 2020).

Bedroom temperatures above 24°C (75°F) were associated with greater odds of autonomic disruption, reduced heart rate variability and elevated heart rate in older adults, with effects intensifying at higher temperatures.

References 70-75.

Melatonin: Dosage and Accuracy of Labelling

> *"A common dosage for melatonin is, like, five milligrams, sometimes even up to 10. … the evidence, scientific evidence is three to five milligrams. … We will typically use, like, .3, maybe .5, so about a 10th that dose."*
>
> *"There's enough studies that look at the dosage that's actually in the pill versus what's on the label, and they can be up to 100x higher. … the amount of melatonin the next day in their urine is 100x the upper end of the reference range."*

There is no universally agreed-upon melatonin dosage. Recommended doses vary widely depending on the condition being treated, the patient's age, and the formulation used. The FDA does not regulate melatonin, and actual supplement concentrations can deviate from −83% to +478% of labelled content, further complicating dose selection.

A 2024 dose–response meta-analysis of 26 RCTs (1,689 observations) found melatonin gradually reduces sleep onset latency and increases total sleep time, peaking at **3–5 mg/day** for both outcomes. **Timing of administration proved more influential than dose**: administering melatonin 3 hours before bedtime significantly improved efficacy compared with the more common 30-minutes-before-bedtime schedule. Doses below 2 mg did not achieve maximal sleep onset latency reduction, while doses up to 4 mg could be considered when lower doses fail, given individual variability in receptor sensitivity.

Safety Considerations

Doses of ≥10 mg did not increase serious adverse events across a range of clinical conditions, though they were associated with a 40% increase in minor adverse events, primarily headache, dizziness, and drowsiness.

Long-term effects remain insufficiently studied, and additional trials are needed to establish optimal minimum effective doses across populations.

References 76-80.

Evidence-Based Sleep Supplements (Tart Cherry, Chamomile, Kiwi, Magnesium)

> *"Everything you see on this table has moderate to strong scientific evidence that it will help with sleep." On kiwi specifically: "Most studies will actually look at something like the ingestion of two to three kiwis … you will very routinely see people sleeping better after ingestion of kiwis."*

Tart Cherry

Tart cherry has moderate evidence for improving sleep. A meta-analysis of eight trials found significant improvements in objective sleep efficiency and total sleep time, while individual trials reported increased melatonin levels and sleep duration. However, subjective improvements were not statistically significant in the meta-analysis, and one study found no significant effects in healthy adults. The evidence suggests that benefits may be more apparent in people with existing sleep disturbances.

Chamomile

Chamomile has moderate evidence for improving subjective sleep quality. A meta-analysis of 10 trials involving 772 participants found a significant reduction in Pittsburgh Sleep Quality Index (PSQI) scores, a measure of subjective sleep quality. Some studies also reported easier sleep onset and fewer awakenings. However, sleep efficiency and daytime functioning did not improve consistently. No adverse events were reported across the trials.

Kiwifruit

Kiwifruit has moderate evidence for supporting sleep. Consuming two kiwifruits nightly for four weeks improved sleep onset, total sleep time and sleep efficiency in adults with sleep problems. Improvements in sleep duration, efficiency and PSQI scores were also reported in elite athletes. These effects may be linked to kiwifruit's serotonin content, as improved sleep onset occurred without an increase in urinary melatonin in one crossover trial.

Magnesium

Magnesium is recognised as a potentially sleep-supportive micronutrient that may help regulate cortisol production and support sleep architecture, the structure and pattern of sleep. Reviews describe its effects as promising, and a pilot study reported independent sleep benefits from magnesium L-threonate. However, evidence for magnesium as a standalone sleep intervention remains sparse, and its combined effects with tart cherry have not been explored.

Overall Evidence for Sleep Benefits

Tart cherry, chamomile, kiwifruit and magnesium may support sleep, but the evidence remains limited. Tart cherry and kiwifruit have the strongest trial-level support, with reported improvements in sleep duration, onset and efficiency. Chamomile may improve subjective sleep quality, sleep onset and awakenings, although findings for sleep efficiency and daytime functioning are inconsistent. Magnesium may support sleep regulation, but evidence for its use as a standalone intervention is sparse. Across all four interventions, small samples, short intervention periods, heterogeneous dosing and reliance on subjective measures limit the generalisability of the findings.

References 81-87

Caffeine, Sleep Deprivation, and Performance (Meta-Analysis)

> *"We have a meta-analysis led by my colleague, Dr. Ben House … if you look at the research on caffeine and sleep … Coffee can offset that [decline from sleep deprivation]. … But what it doesn't do, at least the data and the meta-analysis suggests, is it doesn't actually put you back into the augmented spot."*

Caffeine can improve attention, reaction time and vigilance in sleep-deprived adults compared with placebo, but the weight of evidence indicates that it does not generally restore performance to well-rested levels. Its benefits are most reliable for vigilance and simple psychomotor tasks, which involve coordinated mental and physical responses, and are weaker or inconsistent for higher-order cognitive control and physical performance. The effects may also diminish during extended sleep deprivation. Although one study found that caffeine restored 10-km running performance after partial sleep deprivation, this result has not been replicated across cognitive tasks

or more severe sleep-loss conditions. Interpretation is further limited because many studies lack a well-rested control condition, making it difficult to distinguish partial improvement from full restoration.

References 88-94.

University of Sussex 2009 Study on Sounds That Wake Sleepers

> *Steven Bartlett: "There was the viral experiment done in 2009 by Mind Lab Sleep Study, where they conducted … the sleep experiment at the University of Sussex. Researchers hooked men and women up to an ECG machine to measure their brainwaves and played a variety of ambient sounds … Men's top trigger was a car alarm. Women's top trigger was a baby crying."*

The claim originates from a small experiment conducted by the independent research consultancy MindLab and commissioned by Lemsip in 2009. According to contemporary media reports, eight men and eight women slept in recreated sleep environments while recorded sounds were played and their brain activity was monitored using electroencephalography (EEG). A car alarm reportedly produced the strongest response among the men, while a crying baby produced the strongest response among the women. However, no peer-reviewed paper, formal research report, complete methodology or statistical analysis can be identified. The findings should therefore be regarded as the results of a small, commercially commissioned experiment reported in the media, rather than evidence from a published University of Sussex study.

References 95, 96.

Postpartum Sleep Disruption Persisting Into Later Life

> *"It is obvious and clear that the last trimester can present a lot of sleep challenges for women, and then especially as soon as the baby's there … In some percentage of women, those patterns will persist, and so you'll see women who have sleep disorders even with adult children that started because of the childbirth situation."*

Sleep disruption is common during the third trimester and after childbirth. Between 66% and 90% of women report poor sleep quality or insomnia symptoms in the third trimester, while a

meta-analysis of 10 studies estimated the pooled prevalence of insomnia at 42.4%. Polysomnographic data, objective recordings of sleep, also show reduced sleep duration and efficiency, more frequent awakenings and decreased REM sleep.

These disturbances are associated with factors including fetal movements, nocturia, back pain, leg cramps, gastroesophageal reflux and nasal congestion. Sleep quality may worsen immediately after delivery because of acute sleep loss and infant care demands, with poor sleep quality reported by 71% of women during the first postpartum month in one large prospective cohort. Sleep efficiency generally begins to recover by 10 to 12 weeks postpartum, although it may not return to pre-pregnancy levels.

Persistence of Sleep Problems After Pregnancy and Childbirth

Longitudinal evidence indicates that sleep disturbances beginning during pregnancy or after childbirth can become chronic in some women. Epidemiological studies report insomnia symptoms in 26–41% of women two years after childbirth, while a cohort of 1,480 women found that 41% met DSM-IV insomnia criteria at two years postpartum, compared with 60% during pregnancy. Persistent sleep problems at two years appeared to be independent of comorbid postnatal depression, suggesting a distinct, ongoing pattern. However, the available longitudinal evidence extends only to two years postpartum, and no study cited followed sleep outcomes continuously until participants' children reached adulthood. The claim that these disorders may persist until that stage is therefore an extrapolation rather than a directly established finding.

References 97-107.

Vitamin D and Ethnic Background

> *"Fairly traditionally, people of African heritage are going to be lower in that marker."*

Studies comparing populations living under similar conditions generally record lower blood concentrations of 25-hydroxyvitamin D [25(OH)D], the main marker used to assess vitamin D status, among people of African descent than among those of European ancestry. The difference is particularly apparent at higher latitudes. Severe deficiency is estimated to be 15 to 20 times more prevalent among African Americans than European Americans, while winter data from the UK

Biobank classified 38.5% of Black African participants as deficient, compared with 17.5% of White European participants.

Geography and lifestyle substantially modify this pattern, as mean concentrations of approximately 46 ng/mL have been reported among Tanzanians living traditional lifestyles near the equator. Greater skin pigmentation reduces the UVB radiation available for vitamin D production in the skin, which may contribute to lower concentrations in regions with less sunlight. However, lower total 25(OH)D has not been convincingly linked to poorer bone or cardiometabolic health in African-descent populations, and whether standard deficiency thresholds are equally appropriate across populations remains unresolved.

References 108-116.

Cholesterol Reduction Through Lifestyle Change: A Case Example

> *"His total cholesterol was 347. We got him down to 223 … and we did that exclusively with lifestyle … Fiber … Stress reduction … Went from 223 to 163. Now, that took a statin."*

Greater dietary fibre intake, particularly soluble, viscous-forming fibre, can modestly reduce total cholesterol. An umbrella analysis of 52 meta-analyses involving 47,197 participants found a significant overall reduction, while a dose-response analysis of 181 randomised controlled trials involving 14,505 participants reported an average decrease of 10.82 mg/dL with soluble fibre supplementation and a further decrease of 6.11 mg/dL for each additional 5 g consumed daily. Soluble fibres generally reduce total and LDL cholesterol by approximately 5–10%, with gel-forming types such as β-glucan, psyllium and arabinoxylan appearing more effective than insoluble or non-viscous forms.

Food sources may produce greater reductions than supplements, while fibre type, dose and initial cholesterol concentration can influence the response. One trial found no significant reduction from oat bran fibre in adults with normal cholesterol. Soluble fibre primarily acts by promoting bile acid excretion, which increases the liver's use of cholesterol to produce new bile acids.

Stress reduction and Cholesterol Reduction

Whether psychological stress reduction independently lowers total cholesterol remains unclear because this relationship has not been directly tested. Fibre intake is associated with lower inflammatory markers, but any connection between stress-related inflammation and cholesterol reduction remains plausible rather than established.

Statins and Cholesterol Reduction

Statin medications can produce substantial reductions in cholesterol, with their greatest effect occurring on LDL cholesterol. An overview of 16 randomised trials involving approximately 29,000 participants reported average reductions of 22% in total cholesterol and 30% in LDL cholesterol. The magnitude varies according to the medication and dose, ranging from approximately 20% for pravastatin 10 mg to around 60% for rosuvastatin 40 mg. Doubling a statin dose produces an additional LDL reduction of approximately 7%. Statins achieve these effects by inhibiting HMG-CoA reductase, a key enzyme in cholesterol production, which reduces cholesterol synthesis in the liver and increases the removal of LDL from the blood. Individual responses can differ considerably, however. In one trial of rosuvastatin 20 mg, 46% of participants achieved an LDL reduction of at least 50%, while 11% experienced no reduction or an increase. Statins therefore produce large average reductions in cholesterol, although the response depends on the medication, dose and individual.

References 117-134.

Fibre Intake Guidance Relative to Caloric Intake

> *"The rough rule of thumb we typically use is around 15 grams of fiber per 1,000 calories you eat."*

The Institute of Medicine's specific Adequate Intake is 14 g per 1,000 kcal. This standard was derived from prospective cohort research linking fibre consumption with protection against coronary heart disease and applies from one year of age onwards. At an energy intake of 2,000 kcal per day, it corresponds to approximately 28 g of fibre. Recommendations vary internationally, with the Nordic Nutrition Recommendations and World Health Organization using approximately 12.5 g per 1,000 kcal, while the United Kingdom sets a fixed target of 30 g per day. Typical consumption frequently falls below these levels. Adults in the United States average approximately 15–17 g per day, or

6.6–7.5 g per 1,000 kcal, and only around 5% meet the Adequate Intake. The most accurate general figure is therefore 14 g per 1,000 kcal, although recommendations commonly range from 12.5 to 14 g depending on the country and the health outcome used to establish the target.

References 135-141.

CRP as an Acute-Phase Inflammatory Marker Linked to Cholesterol

> *"Probably like your most classic inflammation marker is called CRP."*

C-reactive protein (CRP) is an acute-phase protein (a blood protein that increases during inflammation) produced mainly by hepatocytes (liver cells) in response to inflammatory signalling. It contributes to innate immunity by recognising pathogens and activating complement (a system of proteins that supports immune responses). High-sensitivity CRP (hs-CRP) assays detect low-grade, chronic inflammation, with concentrations below 1 mg/L (milligrams per litre), between 1 and 3 mg/L, and above 3 mg/L corresponding to low, moderate and high cardiovascular risk.

Inflammation and cholesterol represent distinct but interacting cardiovascular risk pathways. hs-CRP and low-density lipoprotein (LDL) cholesterol independently predict cardiovascular events, with the greatest risk occurring when both are elevated. CRP can also recognise oxidized low-density lipoprotein (ox-LDL) and promote its uptake by macrophages (immune cells that engulf harmful or damaged material), creating a biological link between inflammation and cholesterol-related plaque formation. However, CRP is not considered a direct cause of atherosclerosis (the accumulation of fatty plaques within arteries). It is instead a clinically useful marker of inflammation that can accompany and amplify cholesterol-related cardiovascular risk.

References 142-148.

Asymptomatic Coronary Artery Blockage in a Young, Fit Individual

> *"His cardiologist said, 'No, you don't need it. You're young.' … Got it anyways, and he had a, I think he had a 50% blockage of his what's called the widow maker."*

The left anterior descending (LAD) artery supplies blood to a large area of the myocardium (heart muscle). Severe stenosis (narrowing) or occlusion (blockage) in its proximal segment, located near the artery's origin, can restrict blood flow across much of the heart's anterior wall. This may cause an extensive myocardial infarction (heart attack), irregular heart rhythms, impaired heart function or sudden death, accounting for the term 'widow maker'.

Wellens' syndrome is a pre-infarction warning state associated with critical proximal LAD narrowing, often exceeding 90%. It produces characteristic changes on an electrocardiogram (ECG), a recording of the heart's electrical activity, even when blood markers of heart injury are normal or only mildly elevated. Approximately 75% of untreated patients with Wellens' syndrome develop an extensive anterior myocardial infarction within days, making urgent revascularisation (restoration of blood flow) essential.

Prevalence of Asymptomatic Coronary Artery Disease

Asymptomatic coronary artery disease (CAD), meaning coronary plaque or arterial narrowing without noticeable symptoms, is relatively common, although substantial blockage is less frequent in low-risk populations. In a study of 2,359 asymptomatic adults in the United States, 49% had some coronary plaque, but only 6% had stenosis (narrowing) of at least 50%. Similarly, 22% of 1,000 asymptomatic Korean adults had plaque, while 5% had narrowing of at least 50% and 2% had severe narrowing of at least 75%.

Prevalence is considerably higher among people with established risk factors or related conditions. Obstructive CAD was found in 29.3% of ischaemic stroke survivors, while significant narrowing occurred in 52.9% of patients with peripheral artery disease. Estimates among people with type 2 diabetes ranged from 31.4% to 84%, depending on the assessment method. Reported rates therefore range from approximately 4% to more than 80%, largely because populations,

detection methods and definitions differ. Silent coronary plaque is common, but substantial asymptomatic blockage is not equally common across all groups and is concentrated particularly among people at higher cardiovascular risk.

References 149-156.

Widespread Underconsumption of Potassium

> *"90% of people under-consume potassium. It's not as concentrated in our soil as it used to be."*

Potassium intake is below recommended levels across most populations worldwide. A systematic review of 104 studies across 52 countries estimated a mean global intake of 2.25 g per day and found that only 14% of people met the World Health Organization (WHO) target of at least 3.5 g per day, leaving 86% below this level. In the United States, fewer than 2% of adults met the higher Institute of Medicine target of 4,700 mg per day. Substantial shortfalls have also been reported internationally, with 95% of people in Mexico, 91.9% in Britain and more than 90% of young adults in South Africa consuming less than the WHO target. The proportion falling below recommended intake varies according to the guideline applied. For example, 13.3% of Austrian adults met a target of 4,000 mg per day, compared with 23.8% meeting the lower European Food Safety Authority target of 3,500 mg per day.

References 157-162.

Testosterone's Relationship With Age

> *"Testosterone actually doesn't decline with age much. So it should be the same from about age 40 to age 80 in men specifically. It's gonna be around the average man is gonna be 450 to 550."*

Testosterone levels in men generally decrease with age, although the rate varies according to the form of testosterone measured and the study method. Total testosterone typically declines by 1–2% per year after the age of 30, while bioavailable testosterone (the fraction readily available to tissues) falls by approximately 2–3% annually. Among men aged 40–70, cross-sectional studies, which compare different age groups at one point in time, estimate annual declines of 0.4–0.8% in total

testosterone and approximately 2% in free testosterone. Longitudinal research, which follows the same individuals over time, has recorded a steeper 1.6% annual decline in total testosterone, suggesting that changes in health may accelerate the reduction.

Patterns nevertheless differ between cohorts, with one study finding that bioavailable testosterone declined throughout adulthood while total testosterone remained relatively stable until around age 70. Separately, a population-level secular decline (a change occurring across generations) of approximately 0.56% per year has been identified independently of age, body mass index and testing method. Among men aged 15–39, mean total testosterone decreased by approximately 25%, from 605 to 451 ng/dL, between 1999 and 2016.

References 163-169.

Testosterone's Limited Role in Exercise-Induced Muscle Growth

> *"We have actually excellent research to show things like muscle growth with exercise are little, if at all, impacted by testosterone concentrations, which is counterintuitive."*

Short-lived increases in circulating testosterone after resistance exercise do not reliably predict muscle hypertrophy (growth in muscle size) or strength gains. Some studies have reported associations between post-exercise testosterone responses and subsequent muscle growth, but these findings are outnumbered by studies showing no relationship and do not establish a causal effect. Intramuscular androgen receptor (AR) content, meaning the amount of the receptor through which testosterone acts within muscle, is more consistently associated with increases in lean body mass and muscle fibre size. Baseline androgen status also appears important.

Suppressing endogenous testosterone (testosterone produced within the body) to hypogonadal levels (abnormally low concentrations) reduces gains in muscle mass, strength and thickness during resistance training, suggesting that testosterone is necessary for normal growth responses but does not explain differences in hypertrophy by itself. Supraphysiological testosterone (concentrations above the normal physiological range) substantially increases hypertrophy, while women achieve similar relative muscle growth to men despite having markedly lower circulating testosterone. Among pre-menopausal women, bioavailable testosterone (the fraction available to tissues), rather than total testosterone, has been associated with hypertrophy. Local androgen

receptor signalling and intramuscular testosterone activity therefore appear more relevant than transient changes in blood testosterone after exercise.

References 170-178.

Omega-3 Intake and Mercury Exposure

> *"The more omega-3s you consume, the more mercury goes up. … Because most omega-3 sources are gonna be filled with mercury."*

Omega-3 fatty acids and methylmercury (a form of mercury found in seafood) occur together in fish and shellfish, making fish consumption a source of both. Among women of childbearing age in the United States, fish consumption, omega-3 intake and methylmercury exposure showed moderate correlations of 0.66–0.68. However, omega-3 and mercury concentrations vary independently between species, so greater omega-3 content does not necessarily indicate greater mercury exposure.

Salmon, sardines and trout generally provide high omega-3 levels with low methylmercury, whereas swordfish and shark contain high methylmercury with variable omega-3 content. Canned white tuna presents a less favourable balance than canned light tuna or flounder. This balance is particularly important during pregnancy and childhood, when vulnerability to methylmercury is greater, although models indicate that maternal fish consumption can still provide an overall neurodevelopmental benefit.

Cardiovascular findings suggest that omega-3 fatty acids and mercury may have opposing associations, with omega-3 intake linked to benefit and mercury exposure linked to adverse effects independently of omega-3 levels. Fish-oil supplements generally contain mercury below regulatory limits. The balance between omega-3 intake and mercury exposure therefore depends largely on the fish species consumed.

References 179-185.

Exercise-Induced Increases in Blood Volume

> *"It's one of the primary adaptations to endurance, is you'll physically have more blood in your body. … You have more red blood cells … you're able to carry more oxygen to fuel those mitochondria."*

Endurance training produces coordinated increases in plasma volume, red blood cell mass and total haemoglobin (the oxygen-carrying protein in red blood cells). Plasma volume expands after only a few training sessions, while erythropoiesis (red blood cell production) develops more gradually through transient increases in erythropoietin (EPO), a hormone that stimulates this process. After several months of regular exercise, red blood cell volume may increase by up to 10% in healthy individuals, while endurance champions may have up to 40% more than untrained people. Because plasma volume initially expands faster than red blood cell mass, haematocrit (the proportion of blood occupied by red blood cells) may temporarily fall, producing the appearance of 'sports anaemia' despite an increase in total red blood cells.

Greater haemoglobin mass increases the blood's oxygen-carrying capacity and contributes to improvements in VO_2max (the maximum rate of oxygen use during exercise). Training also increases cardiac output, vascularisation, red blood cell flexibility and mitochondrial capacity. Together, these changes enhance oxygen transport from the lungs to mitochondria (cellular structures that use oxygen in energy production).

References 186-192.

Historical Novelty of Structured Exercise

> *"Remember, exercise is a novel made-up term. This is a new thing to us. … Putting that into a structured non-daily activity is a last 75-year phenomenon."*

The use of physical activity to support health has ancient documented roots. Susruta prescribed moderate daily exercise around 600 BCE, while Hippocrates provided an early written exercise prescription between 460 and 370 BCE. Formal experimental study of exercise physiology

(the body's responses and adaptations to physical activity) began in the mid-19th century, with foundational work on muscular oxygen supply, heat production and maximal oxygen uptake emerging during the early 20th century. Population-level research developed later. Studies beginning in the 1950s linked occupational physical activity with lower coronary heart disease risk, while subsequent research associated low physical fitness with higher mortality.

The framing of physical inactivity as a public-health problem has developed largely over the past four decades, leading to activity guidelines, surveillance programmes and professional training. The term 'Exercise is Medicine' entered the scientific literature in 1993 and became a formal global health initiative in 2007. Health-related exercise therefore has a long intellectual and scientific history, while its organisation as a modern public-health and clinical framework is comparatively recent.

References 193-198.

Cardiovascular Fitness as a Predictor of Mortality

> *"Late 1980s, Stephen Blair and his team started looking at giant databases and started to realize that cardiovascular fitness, VO2 max, VO2 peak … were predicting how long people are gonna live. And in fact, they started to realize it was out-predicting what we call traditional clinical markers: blood pressure, your cholesterol levels."*

From the late 1980s through the 1990s, Steven Blair and colleagues used large preventive-medicine cohorts to examine cardiorespiratory fitness (the capacity of the heart, lungs and circulation to support physical activity) in relation to all-cause and cardiovascular mortality. Their research found that lower fitness independently predicted higher mortality after accounting for other health factors.

In a 1996 cohort, low fitness was associated with an adjusted relative risk (RR, a comparison of risk between groups) of 1.52 in men and 2.10 in women. Among men, this association was somewhat stronger than those for elevated systolic blood pressure and high cholesterol, which each had an adjusted relative risk of 1.34. In women, low fitness and smoking were significant independent predictors, whereas blood pressure and cholesterol were not statistically significant in the reported model. A 1991 study also found that mortality declined as fitness increased among both

hypertensive and normotensive men, even after adjustment for age, cholesterol, systolic blood pressure, body mass index and smoking.

Blair's cohort research therefore established cardiorespiratory fitness as an independent prognostic marker and, in the 1996 male model, a somewhat stronger predictor of mortality than blood pressure or cholesterol.

References 199-201.

Grip Strength Asymmetry as an Emerging Research Area

> *"Over the last probably three years, I would imagine there are over 20 to 25 studies that have been published on a very specific type of grip strength … grip strength asymmetry … the asymmetry actually matters because most of the work in that area is in groups with neurological disease … early predictions of Alzheimer's, Parkinson's."*

Grip strength asymmetry, a measurable imbalance in handgrip strength between the dominant and nondominant hands, has emerged as a clinically meaningful indicator of neurological, functional, and mortality risk in ageing populations, while also serving as a marker of sport-specific adaptation in athletes. Multiple studies have examined this construct, most defining asymmetry as a >10% strength difference between hands using the ratio of nondominant to dominant handgrip strength (HGS).

In a large US panel of 17,163 ageing Americans, any HGS asymmetry alone increased odds of lower cognitive functioning by 15%, while the combination of asymmetry and weakness nearly doubled the odds. Dominant and nondominant asymmetry each independently predicted cognitive impairment when paired with weakness, with odds ratios of 1.89 and 2.10, respectively. Handgrip strength (HGS) asymmetry is associated with a 66% increased hazard of incident neurodegenerative disorders over 4 years among 4,925 Chinese older adults, independent of low grip strength.

However, not all studies confirm an independent cognitive effect. In the Yishun Study of 330 community-dwelling older adults, low HGS but not asymmetry was independently associated with poorer global cognition, memory, and functional mobility. Combined low and asymmetric HGS

associations with cognitive function appeared driven by grip strength rather than the asymmetry itself.

Because neurodegenerative disorders develop over a long preclinical period, researchers propose that HGS asymmetry may serve as a simple screening tool to detect at-risk populations before symptom onset. However, no study has yet examined whether this association differs between Alzheimer's disease and Parkinson's disease specifically, as the available data pooled all neurodegenerative disorders together.

Subclinical strength deficits may appear decades before clinical onset of neurodegenerative disease, as noted in Parkinson's literature, suggesting a long preclinical window where grip metrics could theoretically signal risk. However, Parkinson's patients had significantly lower bilateral HGS than healthy controls, but grip strength did not independently predict Parkinson's disease status in regression models. No study in the current literature that was found during this search has specifically tested whether HGS asymmetry (as opposed to absolute grip strength) predicts incident Parkinson's disease.

Limitations

The evidence base has several constraints that temper conclusions about disease-specific prediction. The only study directly linking HGS asymmetry to neurodegenerative disorders (Chen et al. 2022) used self-reported, physician-diagnosed outcomes without distinguishing Alzheimer's from Parkinson's, and its 4-year follow-up may be insufficient for conditions with decades-long prodromal periods.

A cross-sectional Singaporean study (Peng et al. 2023) found no association between HGS asymmetry and cognitive function, adding a discordant note to the longitudinal evidence.

While lower grip strength broadly is associated with increased Alzheimer's risk (HR 1.41 in meta-analysis), and a dose-response relationship exists between higher grip strength and reduced Alzheimer's incidence, these findings concern absolute strength rather than bilateral asymmetry.

The specific question of whether HGS asymmetry independently predicts Alzheimer's or Parkinson's disease, as distinct from general cognitive decline or pooled neurodegenerative disorders, remains unanswered and requires longitudinal studies with disease-specific endpoints.

References 202, 206.

Sarcopenia and the Emerging Concept of ‘Powerpenia’

> *“The term that we've been using for a long time is sarcopenia, and this is the accelerated loss of muscle … but now there's a turn of scientific attention to powerpenia, which is are you losing the power faster than you should be losing power … highly associated with … fractures, dislocations … especially post age 60 or 65.”*

Powerpenia is a recently introduced term designating the decline in skeletal muscle power, the product of force and velocity of contraction, that occurs with ageing, clinical disease, and/or physical inactivity. The concept was proposed to fill a gap between sarcopenia (loss of muscle mass) and dynapenia (loss of muscle strength), neither of which specifically addresses muscle power as a diagnostic criterion. Only 2 of 220 dynapenia studies published between 2008 and 2023 directly measured muscle power to classify patients, underscoring the need for a distinct term.

The nearest well-defined concept is **osteodynapenia**, the combination of low bone mass (osteopenia/osteoporosis) and low muscle strength (dynapenia), which has been prospectively studied for fracture risk. Osteodynapenia was associated with a 2.07-fold higher incident fracture risk over 10 years compared to having neither dynapenia nor osteopenia. Dynapenia alone also increased fracture risk, as did osteopenia alone. However, the combined conditions did not exceed the risk of their individual components; osteodynapenia did not produce significantly greater fracture risk than dynapenia or osteopenia alone.

References 207-209.

Muscle Growth: Training Frequency Versus Weekly Training Volume

> *"As long as you hit the same volume throughout the week, the amount of times you go to the gym doesn't matter that much, in theory."*

Across the strongest meta-analyses, training frequency by itself usually has little effect on hypertrophy when total weekly volume is equated. For strength, the picture is slightly less uniform, but several reviews still report no significant independent frequency effect under volume-matched conditions, with benefits from higher frequency often explained by the extra volume it enables rather than by the frequency itself.

References 210-215.

Rest Interval Length Between Sets and Muscle Growth

> *Steven Bartlett: "Everyone talks about taking shorter rests in the gym to build more muscle." Andy Galpin: "Not consistent with the evidence. … If you were to probably spend 60 to 90 seconds or maybe up to two minutes resting in between each set, generally, you recover enough to have a higher quality set the next one."*

Inter-set rest interval duration influences muscle hypertrophy, with longer rest periods (>60 s) generally producing a small but consistent hypertrophic benefit over shorter intervals (≤60 s). This effect appears driven by better preservation of training volume load, as shorter rests necessitate greater load reductions across subsequent sets. Longer rest intervals facilitate greater neuromuscular recovery, higher force output, and increased total exercise volume compared with shorter rests. When volume load is equalised between short and long rest conditions, hypertrophy outcomes converge, suggesting that volume load rather than rest interval per se is the primary driver.

The most recent Bayesian meta-analysis found substantial overlap in hypertrophy effect sizes across rest interval categories, with central estimates marginally favouring longer rest for arm and thigh musculature but not whole body. No appreciable hypertrophy differences were detected beyond 90 s of rest, consistent with evidence that volume load detriments plateau past this

threshold. Additionally, training to failure versus non-failure did not meaningfully alter the rest interval–hypertrophy relationship. A separate meta-analysis in resistance-trained males found longer ISRs (>60 s) produced only minimal hypertrophy benefit (SMD = 0.08), with high variability across studies.

References 216-221.

Adaptive Thermogenesis and Exercise-Induced Weight Loss

> *"This is, you know, Herman Pontzer stuff in large part, showing things like if you burn, say, 500 calories with exercise … your body will change how many calories it burns throughout the day in response to that 500 calories from exercise."*

The literature supports partial compensation: exercise usually raises total daily energy expenditure, but by less than the full exercise cost in many people. The size of that compensation varies widely, and some newer studies argue it is smaller or absent in certain settings.

In humans, the average response is not a full 1:1 addition of exercise calories to total daily burn. A large cross-sectional analysis estimated about 28% compensation, meaning only 72% of extra activity calories translated into extra calories burnt that day. A 2026 synthesis of human aerobic exercise interventions estimated that total daily energy expenditure rose by only about 30% of the increase predicted by a simple additive model.

Compensation can happen because people unconsciously reduce non-exercise movement after starting structured exercise. A 2023 review found about 67% of studies reported a compensatory decrease in non-exercise physical activity, including 80% of short-term studies and 63% of longer-term studies. In women with overweight or obesity, a supervised exercise programme produced an early and sustained drop in non-structured physical activity even though reported energy intake did not significantly change.

Another mechanism is a reduction in resting or basal expenditure, especially over longer interventions or under energy stress. Reviews and large datasets report that reduced basal energy expenditure contributes to compensation. A 2026 intervention study estimated compensation of

39% of exercise energy expenditure and attributed about 100 kcal/day of that to downregulated resting and sleeping metabolism.

Some studies do not find metabolic compensation. In one randomised trial, total daily energy expenditure rose slightly with exercise, but 24-hour, resting, and sleeping expenditure did not change, suggesting compensation was not due to lower sedentary metabolism. A 10-month exercise trial also found no compensatory decreases in non-exercise energy expenditure or non-exercise physical activity.

A few recent papers support a more additive model. One observational study found a linear positive association between physical activity and total energy expenditure, with no evidence for constraint or compensation. Another 2026 longitudinal plus cross-sectional study found that increasing activity did not suppress resting expenditure, supporting independence of activity and resting energy expenditure.

References 222-230.

Intermittent Fasting Versus Calorie Control for Fat Loss

> *"You will see some studies that show super moderate differences. You're talking about grams of fat loss difference … over the course of six weeks or eight weeks … we did a study in my lab on that. We were actually unique because we're the first ones to look at muscle growth [with 16/8 fasting] in a hypercaloric state."*

Blake et al. state that "a 16:8 TRE approach in a caloric surplus to maximally increase muscle mass and strength remains unexplored," and their 2025 trial then tests exactly that in well-trained men and women. They reported that 16:8 time-restricted eating during an 8-week, high-protein caloric surplus can still support gains in muscle and strength in well-trained adults, but with some practical tradeoffs.

This was a randomised trial in 17 well-trained adults: 10 men and 7 women. Both groups ate a 10% hypercaloric diet with 2.2 g/kg/day protein and completed supervised resistance training 4 times per week for 8 weeks. The only main diet difference was meal timing: the time-restricted

eating (TRE) group ate within an 8-hour window starting at least 1 hour after training, while the control group spread the same calories across the day.

Both groups gained strength, muscular endurance, and fat-free mass over the 8 weeks. Calorie and macronutrient intake did not differ statistically between groups, so the comparison largely isolates the effect of feeding window rather than total intake.

The main tradeoff was that the TRE group completed lower total training volume and reported lower daily energy, and their squat 1RM improved about 4.0 ± 1.9 kg less than the fed group. At the same time, fat-free mass gains were similar, while the fed group gained 1.4 ± 0.6 kg more fat mass than TRE. Mood and sleep ratings did not change in either group.

The paper addresses a gap the authors explicitly identify: prior TRE resistance-training studies had not tested a 16:8 surplus-bulking design aimed at maximising hypertrophy and strength. But the sample was small, the participants were young and already well trained, and the intervention lasted only 8 weeks, so generalisation is limited.

The authors' overall conclusion is that 16:8 TRE is viable, not optimal, during a muscle-gain phase: it preserved hypertrophy and most performance outcomes, but the lower energy ratings, lower training volume, and slightly smaller squat gains matter for people prioritising maximal performance.

Reference 231.

References

1. Young, T., Palta, M., Dempsey, J., Skatrud, J., Weber, S., & Badr, S. (1993). The occurrence of sleep-disordered breathing among middle-aged adults.. The New England journal of medicine, 328 17, 1230-5 .

2. Peppard, P., Young, T., Barnet, J., Palta, M., Hagen, E., & Hla, K. (2013). Increased prevalence of sleep-disordered breathing in adults.. American journal of epidemiology, 177 9, 1006-14 .

3. Cunningham, J., Hunter, M., Budgeon, C., Murray, K., Knuiman, M., Hui, J., Hillman, D., Singh, B., & James, A. (2021). The prevalence and comorbidities of obstructive sleep apnea in middle-aged men and women: the Busselton Healthy Ageing Study. Journal of Clinical Sleep Medicine, 17, 2029 - 2039.

4. Young, T., Peppard, P., & Gottlieb, D. (2002). Epidemiology of obstructive sleep apnea: a population health perspective.. American journal of respiratory and critical care medicine, 165 9, 1217-39 .

5. Faria, A., Allen, A., Fox, N., Ayas, N., & Laher, I. (2020). The public health burden of obstructive sleep apnea. Sleep Science, 14, 257 - 265.

6. Sharma, S., & Stansbury, R. (2021). How we do it: Sleep Disordered Breathing in Hospitalized patients - A game Changer?. Chest.

7. Santilli, M., Manciocchi, E., D'Addazio, G., Di Maria, E., D'Attilio, M., Femminella, B., & Sinjari, B. (2021). Prevalence of Obstructive Sleep Apnea Syndrome: A Single-Center Retrospective Study. International Journal of Environmental Research and Public Health, 18.

8. Bouloukaki, I., Fabozzi, A., Schwarz, E., & Schiza, S. E. (2026). Advances in the Diagnosis and Treatment of Obstructive Sleep Apnea in Women. Pulmonary Therapy, 12, 181 - 199.

9. Basoglu, O., & Taşbakan, M. (2018). Gender differences in clinical and polysomnographic features of obstructive sleep apnea: a clinical study of 2827 patients. Sleep and Breathing, 22, 241-249.

10. Geer, J., & Hilbert, J. (2021). Gender Issues in Obstructive Sleep Apnea. The Yale Journal of Biology and Medicine, 94, 487 - 496.

11. Lindberg, E., Benediktsdóttir, B., Franklin, K., Holm, M., Johannessen, A., Jögi, R., Gislason, T., Real, F. G., Schlünssen, V., & Janson, C. (2017). Women with symptoms of sleep-disordered breathing are less likely to be diagnosed and treated for sleep apnea than men.. Sleep medicine, 35, 17-22 .

12. Gomes, A. M., Aibe, M. S., Boulos, M., & Furlan, J. C. (2025). A systematic review on sleep-related breathing disorders in athletes and para-athletes.. Sleep medicine, 136, 106882.

13. Sikora, M., Panek, M., Łakomy, O., Siatkowski, S., Głowacka, E., & Żebrowska, A. (2026). Obstructive Sleep Apnea and Recovery in Athletes: BMI and Neck Circumference and Their Impact on Recovery Capacity and Injury Risk. Life, 16.

14. Rim, A. J., Miller, J. T., Jackson, M., Ko, Y.-A., Patel, N., Rajesh, S., DiGregorio, H., Chami, R. E., Mansour, J., Owais, M., Sherrer, J. M., Simpson, E., Walker, B., Wolmer, S., Galante, A., Clark, C. B., Baggish, A. L., Bliwise, D. L., & Kim, J. H. (2025). Sleep Health and Associations With Early Cardiovascular Risk in U.S. Collegiate Female Athletes. JACC: Advances, 4.

15. Bouloukaki, I., Fabozzi, A., Schwarz, E., & Schiza, S. E. (2026). Advances in the Diagnosis and Treatment of Obstructive Sleep Apnea in Women. Pulmonary Therapy, 12, 181 - 199.

16. Sung, E.-R., & Collop, N. A. (2025). Obstructive Sleep Apnoea in Women: What Do We Know and What Don't We Know?. Respirology, 30, 1127 - 1130.

17. Young, T., Palta, M., Dempsey, J., Skatrud, J., Weber, S., & Badr, S. (1993). The occurrence of sleep-disordered breathing among middle-aged adults.. The New England journal of medicine, 328 17, 1230-5 .

18. Peppard, P., Young, T., Barnet, J., Palta, M., Hagen, E., & Hla, K. (2013). Increased prevalence of sleep-disordered breathing in adults.. American journal of epidemiology, 177 9, 1006-14 .

19. Cunningham, J., Hunter, M., Budgeon, C., Murray, K., Knuiman, M., Hui, J., Hillman, D., Singh, B., & James, A. (2021). The prevalence and comorbidities of obstructive sleep apnea in middle-aged men and women: the Busselton Healthy Ageing Study. Journal of Clinical Sleep Medicine, 17, 2029 - 2039.

20. Senaratna, C., Perret, J., Lodge, C., Lowe, A., Campbell, B., Matheson, M., Hamilton, G., & Dharmage, S. (2017). Prevalence of obstructive sleep apnea in the general population: A systematic review.. Sleep medicine reviews, 34, 70-81 .

21. Franklin, K., & Lindberg, E. (2015). Obstructive sleep apnea is a common disorder in the population-a review on the epidemiology of sleep apnea.. Journal of thoracic disease, 7 8, 1311-22 .

22. Huang, T., Lin, B., Markt, S., Stampfer, M., Laden, F., Hu, F., Tworoger, S., & Redline, S. (2018). Sex differences in the associations of obstructive sleep apnoea with epidemiological factors. The European respiratory journal, 51.

23. Sönmez, I., Dupuy, A. V., Yu, K., Cronin, J., Yee, J., & Azarbarzin, A. (2025). Unmasking Obstructive Sleep Apnea: Estimated Prevalence and Impact in the United States.. Respiratory medicine, 108348 .

24. Fietze, I., Laharnar, N., Obst, A., Ewert, R., Felix, S., Garcia, C., Gläser, S., Glos, M., Schmidt, C., Stubbe, B., Völzke, H., Zimmermann, S., & Penzel, T. (2018). Prevalence and association analysis of obstructive sleep apnea with gender and age differences – Results of SHIP-Trend. Journal of Sleep Research, 28.

25. Tufik, S., Porcacchia, A., Pires, G., & Andersen, M. L. (2026). Prevalence and Risk Factors for Obstructive Sleep Apnea in São Paulo: Findings From the 4th Edition of the EPISONO Study. Journal of Sleep Research, 35.

26. Bixler, E., Vgontzas, A., Lin, H.-M., Have, T., Rein, J., Vela-bueno, A., & Kales, A. (2001). Prevalence of sleep-disordered breathing in women: effects of gender.. American journal of respiratory and critical care medicine, 163 3 Pt 1, 608-13 .

27. Zasadzińska-Stempniak, K., Zajaczkiewicz, H., & Kukwa, A. (2024). Prevalence of Obstructive Sleep Apnea in the Young Adult Population: A Systematic Review. Journal of Clinical Medicine, 13.

28. Ba, E., Sa, L., Ldj, T., & Sa, J. (2024). Sleep apnea endotypes and their implications for clinical practise.. Sleep medicine, 126, 260-266 .

29. Nokes, B., Orr, J., White, S., Luu, S., Chen, Z., Alex, R. M., Sands, S., Wojeck, B., Owens, R. L., Malhotra, A., & Schmickl, C. (2024). The Effect of Obesity on Sleep Apnea Pathogenesis

Differs in Women vs Men: Multiple Mediation Analyses in the Retrospective SNOOzzzE Cohort.. Journal of applied physiology.

30. Ludovico, M., Bakker, J., Cronin, J., Yee, J., & White, D. (2024). Obstructive sleep apnea and obesity: A review of epidemiology, pathophysiology and the effect of weight-loss treatments.. Sleep medicine reviews, 78, 101996 .

31. Randerath, W., Baillieul, S., & Tamisier, R. (2024). Central sleep apnoea: not just one phenotype. European Respiratory Review, 33.

32. Wang, X., Zhou, T., Huang, W., Zhang, J., Zou, J., Guan, J., Yi, H., & Yin, S. (2024). Differences in physiological endotypes between non-positional and positional obstructive sleep apnea: Results from Shanghai Sleep Health Study cohort.. Chest.

33. Schyvens, A.-M., Van Oost, N. C., Aerts, J., Masci, F., Peters, B., Neven, A., Dirix, H., Wets, G., Ross, V., & Verbraecken, J. (2023). Accuracy of Fitbit Charge 4, Garmin Vivosmart 4, and WHOOP Versus Polysomnography: Systematic Review. JMIR mHealth and uHealth, 12.

34. Schyvens, A.-M., Peters, B., Van Oost, N. C., Aerts, J.-M., Masci, F., Neven, A., Dirix, H., Wets, G., Ross, V., & Verbraecken, J. (2025). A performance validation of six commercial wrist-worn wearable sleep-tracking devices for sleep stage scoring compared to polysomnography. Sleep Advances: A Journal of the Sleep Research Society, 6.

35. De Zambotti, M., Goldstein, C., Cook, J. D., Menghini, L., Altini, M., Cheng, P., & Robillard, R. (2023). State of the Science and Recommendations for Using Wearable Technology in Sleep and Circadian Research.. Sleep.

36. Altini, M., & Kinnunen, H. (2021). The Promise of Sleep: A Multi-Sensor Approach for Accurate Sleep Stage Detection Using the Oura Ring. Sensors (Basel, Switzerland), 21.

37. Silva, F. B., Uribe, L. F., Cepeda, F., Alquati, V. F. S., Guimarães, J. P. S., Silva, Y. G. A., Santos, O., De Oliveira, A. A., De Aguiar, G. H. M., Andersen, M., Tufik, S., Lee, W., Li, L., & Penatti, O. A. B. (2024). Sleep staging algorithm based on smartwatch sensors for healthy and sleep apnea populations.. Sleep medicine, 119, 535-548 .

38. Robbins, R., Weaver, M. D., Sullivan, J. P., Quan, S. F., Gilmore, K., Shaw, S., Benz, A., Qadri, S., Barger, L. K., Czeisler, C., & Duffy, J. F. (2024). Accuracy of Three Commercial Wearable Devices for Sleep Tracking in Healthy Adults. Sensors (Basel, Switzerland), 24.

39. Kainec, K., Caccavaro, J., Barnes, M., Hoff, C., Berlin, A., & Spencer, R. M. C. (2024). Evaluating Accuracy in Five Commercial Sleep-Tracking Devices Compared to Research-Grade Actigraphy and Polysomnography. Sensors (Basel, Switzerland), 24.

40. Youngstedt, S., Goff, E. E., Reynolds, A. M., Kripke, D., Irwin, M., Bootzin, R., Khan, N., & Jean-Louis, G. (2015). Has Adult Sleep Duration Declined Over the Last 50+ Years?. Sleep medicine reviews, 28, 69 - 85.

41. Bin, Y. S., Marshall, N. S., & Glozier, N. (2012). Secular trends in adult sleep duration: a systematic review. Sleep medicine reviews, 16(3), 223–230.

42. Hublin, C., Haasio, L., & Kaprio, J. (2020). Changes in self-reported sleep duration with age - a 36-year longitudinal study of Finnish adults. BMC Public Health, 20.

43. Picturing Earth in a New Light—NASA Science. (n.d.). Retrieved 12 August 2026, from https://science.nasa.gov/earth/earth-observatory/picturing-earth-in-a-new-light/

44. Li, T., et al. (2026) Satellite imagery reveals increasing volatility in human night-time activity. Nature, 652, 379–386.

45. NASA (2026, April 13) NASA Night-light Imagery Tracks US Energy Transition, Global Volatility.

46. NASA's Scientific Visualization Studio (2026, April 8) Global Nighttime Lights Change (2014–2022).

47. Mouly, T., Mishra, G., Hystad, P., Nieuwenhuijsen, M., & Knibbs, L. (2023). Residential greenspace and anxiety symptoms among Australian women living in major cities: A longitudinal analysis.. Environment international, 179, 108110 .

48. Van Der Wal, J. M., Van Borkulo, C. D., Deserno, M., Breedvelt, J. J. F., Lees, M., Lokman, J. C., Borsboom, D., Denys, D., Van Holst, R. V., Smidt, M., Stronks, K., Lucassen, P., Van Weert, J. V., Sloot, P., Bockting, C., & Wiers, R. (2021). Advancing urban mental health research: from complexity science to actionable targets for intervention.. The lancet. Psychiatry.

49. Ochnik, D., Buława, B., Nagel, P., Gachowski, M., & Budziński, M. (2024). Urbanization, loneliness and mental health model - A cross-sectional network analysis with a representative sample. Scientific Reports, 14.

50. Xu, J., Liu, N., Polemiti, E., Garcia-Mondragon, L., Tang, J., Liu, X., Lett, T., Yu, L., Nöthen, M., Feng, J., Yu, C., Marquand, A., Schumann, G., Walter, H., Heinz, A., Ralser, M., Twardziok, S., Vaidya, N., Serin, E., . . . Ogoh, G. (2023). Effects of urban living environments on mental health in adults. Nature Medicine, 29, 1456 - 1467.

51. Lederbogen, F., Kirsch, P., Haddad, L., Streit, F., Tost, H., Schuch, P., Wüst, S., Pruessner, J., Rietschel, M., Deuschle, M., & Meyer-Lindenberg, A. (2011). City living and urban upbringing affect neural social stress processing in humans. Nature, 474, 498-501.

52. Michaud, D. S., Keith, S., & Denning, A. (2019). Evaluating project-related noise impacts on sleep in environmental assessments: A proposal to apply decibel adjustments to nighttime noise events based on their time of occurrence over the sleep period time. The Journal of the Acoustical Society of America.

53. Chauvineau, M., Host, S., Ndiaye, K., Sineau, M., Decourt, V., Hellot, M., Mietlicki, F., & Léger, D. (2025). Night-Time Exposure to Road, Railway, Aircraft, and Recreational Noise Is Associated with Hypnotic Psychotropic Drug Dispensing for Chronic Insomnia in the Paris Metropolitan Area. International Journal of Environmental Research and Public Health, 22.

54. Yasmeen, S., Li, B., Du, C., & Liu, H. (2025). Exploring the Interconnection of Sleep Quality, Indoor Environmental Factors, and Energy Efficiency: Strategies for Sustainable Sleep Environments. Indoor Air, 2025.

55. Basner, M., Smith, M. G., Cordoza, M., Kayser, M. S., Carlin, M., Ecker, A. J., Gilad, Y., Park-Chavar, S., Rennie, K., Schneller, V., Walsh, S., Shou, H., Cao, Q., Younes, M., Aeschbach, D., & Jones, C. W. (2026). Efficacy of pink noise and earplugs for mitigating the effects of intermittent environmental noise exposure on sleep. Sleep, 49.

56. Ren, W., Lu, P., Wang, Y., & Hong, X. (2024). Understanding the association between urban noise and nighttime light in China. Scientific Reports, 14.

57. Rudolph, K., Shev, A., Paksarian, D., Merikangas, K., Mennitt, D., James, P., & Casey, J. (2019). Environmental noise and sleep and mental health outcomes in a nationally representative sample of urban US adolescents. Environmental Epidemiology, 3.

58. Chauvineau, M., Host, S., Ndiaye, K., Sineau, M., Decourt, V., Hellot, M., Mietlicki, F., & Léger, D. (2025). Night-Time Exposure to Road, Railway, Aircraft, and Recreational Noise Is

Associated with Hypnotic Psychotropic Drug Dispensing for Chronic Insomnia in the Paris Metropolitan Area. International Journal of Environmental Research and Public Health, 22.

59. Li, W., Cai, J., Liao, G., Kwan, M.-P., & Tse, L. (2024). Individual-level noise exposure and its association with sleep quality and duration: A cross-sectional study using real-time data.. The Science of the total environment, 177047 .

60. Rudolph, K., Shev, A., Paksarian, D., Merikangas, K., Mennitt, D., James, P., & Casey, J. (2019). Environmental noise and sleep and mental health outcomes in a nationally representative sample of urban US adolescents. Environmental Epidemiology, 3.

61. Yamagami, Y., Obayashi, K., Tai, Y., & Saeki, K. (2023). Association between indoor noise level at night and objective/subjective sleep quality in the older population: a cross-sectional study of the HEIJO-KYO cohort. Sleep, 46.

62. Lomas, E. (2025, July 31). How Do Oura Members' Sleep Patterns and Heart Health Metrics Change with Age? The Pulse Blog.

63. Shen, H., Zhang, L.-J., & Zhu, W. (2025). The Sleep-Enhancing Effect of Lavender Essential Oil in Adults. Holistic Nursing Practice, 40, 105 - 118.

64. Ostovar, M., Khademizadeh, M. H., Namjoyan, F., Kazemi, A., Vakili, S., Mosavat, S., Mohit, M., & Hashempur, M. H. (2025). A systematic review and meta-analysis of clinical trials on lavender for sleep disorders in the elderly.. Experimental gerontology, 112919.

65. Lucena, L. D. R., Santos-Junior, J. G. D., Tufik, S., & Hachul, H. (2021). Lavender essential oil on postmenopausal women with insomnia: double-blind randomized trial.. Complementary therapies in medicine, 102726 .

66. Ren, Y., Chu, W.-W., Yang, X.-W., Xin, L., Gao, J.-X., Yan, G., Wang, C., Chen, Y.-N., Xie, J.-F., Spruyt, K., Lin, J.-S., Hou, Y.-P., & Shao, Y.-F. (2024). Lavender improves sleep through olfactory perception and GABAergic neurons of the central amygdala.. Journal of ethnopharmacology, 118942 .

67. Xu, Y., L., Liu, F., Yao, L., Wang, W., Yang, S., & Han, T.-L. (2022). Lavender essential oil fractions alleviate sleep disorders induced by the combination of anxiety and caffeine in mice.. Journal of ethnopharmacology, 115868 .

68. Bruni, O., Ferini-Strambi, L., Giacomoni, E., & Pellegrino, P. (2021). Herbal Remedies and Their Possible Effect on the GABAergic System and Sleep. Nutrients, 13.

69. Luo, J., & Jiang, W. (2022). A critical review on clinical evidence of the efficacy of lavender in sleep disorders. Phytotherapy Research, 36, 2342 - 2351.

70. Caddick, Z. A., Gregory, K., Arsintescu, L., & Flynn-Evans, E. (2018). A review of the environmental parameters necessary for an optimal sleep environment. Building and Environment, 132, 11-20.

71. Baniassadi, A., Manor, B., Yu, W., Travison, T., & Lipsitz, L. (2023). Nighttime Ambient Temperature and Sleep in Community-Dwelling Older Adults. The Science of the total environment, 899, 165623 - 165623.

72. Fan, X., Shao, H., Sakamoto, M., Kuga, K., Lan, L., Wyon, D., Ito, K., Bivolarova, M., Liao, C., & Wargocki, P. (2022). The effects of ventilation and temperature on sleep quality and next-day work performance: pilot measurements in a climate chamber. Building and Environment.

73. Raj, A., Ruder, M., Rus, H., Gahan, L., O'Mullane, B., Danoff-Burg, S., & Raymann, R. (2020). 1214 Higher Bedroom Temperature Associated With Poorer Sleep: Data From Over 3.75 Million Nights. Sleep, 43.

74. O'Connor, F. K., Bach, A. J. E., Forbes, C., Rutherford, S., Binnewies, S., Sabapathy, S., & Morris, N. (2025). Effect of nighttime bedroom temperature on heart rate variability in older adults: an observational study. BMC Medicine, 23.

75. Nicol, F. (2019). Temperature and sleep. Energy and Buildings.

76. George, S., Sripathy, A., Rehman, A., George, J., Chirayil, K., Frost, E. D., Ramanathan, N., Joseph, S., Ghobrial-Sedky, K., Sripathy, A., Maldonado, J., McCagh, J., & Koola, M. (2025). Melatonin dose and timing: Do we have it right?. CNS Spectrums, 30.

77. Givler, D., Givler, A., Luther, P. M., Wenger, D. M., Ahmadzadeh, S., Shekoohi, S., Edinoff, A. N., Dorius, B., Baptiste, C. J., Cornett, E., Kaye, A., & Kaye, A. (2023). Chronic Administration of Melatonin: Physiological and Clinical Considerations. Neurology International, 15, 518 - 533.

78. Cruz-Sanabria, F., Bruno, S., Crippa, A., Frumento, P., Scarselli, M., Skene, D. J., & Faraguna, U. (2024). Optimizing the Time and Dose of Melatonin as a Sleep-Promoting Drug: A Systematic Review of Randomized Controlled Trials and Dose–Response Meta-Analysis. Journal of Pineal Research, 76.

79. Schrire, Z. M., Phillips, C., Chapman, J., Duffy, S., Wong, G., D'Rozario, A., Comas, M., Raisin, I., Saini, B., Gordon, C., McKinnon, A., Naismith, S., Marshall, N., Grunstein, R., & Hoyos, C. (2021). Safety of higher doses of melatonin in adults: A systematic review and meta-analysis. Journal of Pineal Research, 72.

80. Palagini, L., Manni, R., Aguglia, E., Amore, M., Brugnoli, R., Bioulac, S., Bourgin, P., Franchi, M. J., Girardi, P., Grassi, L., Lopez, R., Mencacci, C., Plazzi, G., Maruani, J., Minervino, A., Philip, P., Parola, S. R., Poirot, I., Nobili, L., . . . Geoffroy, P. (2021). International Expert Opinions and Recommendations on the Use of Melatonin in the Treatment of Insomnia and Circadian Sleep Disturbances in Adult Neuropsychiatric Disorders. Frontiers in Psychiatry, 12.

81. Doherty, R. J., Madigan, S., Warrington, G., & Ellis, J. (2019). Sleep and Nutrition Interactions: Implications for Athletes. Nutrients, 11.

82. Howatson, G., Bell, P., Tallent, J., Middleton, B., McHugh, M., & Ellis, J. (2012). Effect of tart cherry juice (Prunus cerasus) on melatonin levels and enhanced sleep quality. European Journal of Nutrition, 51, 909-916.

83. Losso, J., Finley, J., Karki, N., Liu, A. G., Pan, W., Prudente, A., Tipton, R., Yu, Y., & Greenway, F. (2017). Pilot Study of Tart Cherry Juice for the Treatment of Insomnia and Investigation of Mechanisms. American journal of therapeutics, 25, e194 - e201.

84. Kazemi, A., Shojaei-Zarghani, S., Eskandarzadeh, P., & Hashempur, M. H. (2024). Effects of chamomile (Matricaria chamomilla L.) on sleep: A systematic review and meta-analysis of clinical trials.. Complementary therapies in medicine, 103071 .

85. Abou-Khalil, R. (2025). Nutritional Interventions for Enhancing Sleep Quality: The Role of Diet and Key Nutrients in Regulating Sleep Patterns and Disorders. Food Science & Nutrition, 13.

86. Rackard, G., Madigan, S., Connolly, J., Keaver, L., Ryan, L., & Doherty, R. (2025). Nutrition Strategies to Promote Sleep in Elite Athletes: A Scoping Review. Sports, 13.

87. Conti, F. (2025). Dietary Protocols to Promote and Improve Restful Sleep: A Narrative Review. Nutrition Reviews, 84, 962 - 980.

88. Irwin, C., Khalesi, S., Desbrow, B., & McCartney, D. (2019). Effects of acute caffeine consumption following sleep loss on cognitive, physical, occupational and driving performance: A systematic review and meta-analysis.. Neuroscience and biobehavioral reviews.

89. Hansen, D., Ramakrishnan, S., Satterfield, B., Wesensten, N., Layton, M., Reifman, J., & Van Dongen, H. V. (2018). Randomized, double-blind, placebo-controlled, crossover study of the effects of repeated-dose caffeine on neurobehavioral performance during 48 h of total sleep deprivation. Psychopharmacology, 236, 1313-1322.

90. Killgore, W., & Kamimori, G. (2020). Multiple caffeine doses maintain vigilance, attention, complex motor sequence expression, and manual dexterity during 77 hours of total sleep deprivation. Neurobiology of Sleep and Circadian Rhythms, 9.

91. Stepan, M., Altmann, E., & Fenn, K. (2021). Caffeine Selectively Mitigates Cognitive Deficits Caused by Sleep Deprivation. Journal of experimental psychology. Learning, memory, and cognition, 47, 1371 - 1382.

92. Lieberman, H., Tharion, W., Shukitt-Hale, B., Speckman, K. L., & Tulley, R. (2002). Effects of caffeine, sleep loss, and stress on cognitive performance and mood during U.S. Navy SEAL training. Psychopharmacology, 164, 250-261.

93. Quiquempoix, M., Drogou, C., Erblang, M., Van Beers, P., Guillard, M., Tardo-Dino, P.-E., Rabat, A., Léger, D., Chennaoui, M., Gomez-Mérino, D., & Sauvet, F. (2023). Relationship between Habitual Caffeine Consumption, Attentional Performance, and Individual Alpha Frequency during Total Sleep Deprivation. International Journal of Environmental Research and Public Health, 20.

94. Tsai, Y., Chen, T., Chan, Y.-C., Huang, C.-C., Lai, T., Liao, Y., Metcalfe, R. S., Chen, Y.-C., & Wang, H.-S. (2024). Acute caffeine supplementation offsets the impairment in 10-km running performance following one night of partial sleep deprivation: a randomized controlled crossover trial. European Journal of Applied Physiology, 125, 825 - 835.

95. https://time.com/archive/7144977/are-men-more-likely-to-sleep-through-babies-cries/

96. https://www.telegraph.co.uk/news/newstopics/howaboutthat/6684362/Buzzing-flies-more-likely-to-wake-men-than-crying-babies-study.html

97. Garbazza, C., Hackethal, S., Riccardi, S., Cajochen, C., Cicolin, A., D'Agostino, A., Cirignotta, F., & Manconi, M. (2019). Polysomnographic features of pregnancy: A systematic review.. Sleep medicine reviews, 50, 101249 .

98. Manconi, M., Van Der Gaag, L. C., Mangili, F., Garbazza, C., Riccardi, S., Cajochen, C., Mondini, S., Furia, F., Zambrelli, E., Baiardi, S., Giordano, A., Rizzo, N., Fonti, C., Viora, E., D'Agostino, A., Cicolin, A., Cirignotta, F., Aquilino, D., Barassi, A., . . . Gyr, T. (2023). Sleep and sleep disorders during pregnancy and postpartum: The Life-ON study.. Sleep medicine, 113, 41-48 .

99. Salari, N., Darvishi, N., Khaledi-Paveh, B., Vaisi-Raygani, A., Jalali, R., Daneshkhah, A., Bartina, Y., & Mohammadi, M. (2021). A systematic review and meta-analysis of prevalence of insomnia in the third trimester of pregnancy. BMC Pregnancy and Childbirth, 21.

100. Obeysekare, J., Obeysekare, J., Cohen, Z. L., Coles, M., Pearlstein, T., Monzón, C., Flynn, E., & Sharkey, K. (2020). Delayed sleep timing and circadian rhythms in pregnancy and transdiagnostic symptoms associated with postpartum depression. Translational Psychiatry, 10.

101. Kalmbach, D. (2022). The emerging role of prenatal insomnia therapy in the prevention of perinatal depression and anxiety.. Sleep.

102. Sivertsen, B., Hysing, M., Dørheim, S., & Eberhard-Gran, M. (2015). Trajectories of maternal sleep problems before and after childbirth: a longitudinal population-based study. BMC Pregnancy and Childbirth, 15.

103. Polo-Kantola, P. (2022). Sleep disturbances in pregnancy: Why and how should we manage them?. Acta Obstetricia et Gynecologica Scandinavica, 101, 270 - 272.

104. Witkowska-Zimny, M., Zhyvotovska, A., Isakov, R. I., Boiko, D. I., & Nieradko-Iwanicka, B. (2024). Maternal Sleeping Problems Before and After Childbirth - A Systematic Review. International Journal of Women's Health, 16, 345 - 371.

105. Lui, K.-T., Kimoff, R., Panyarath, P., & Pamidi, S. (2022). Persistence and prevalence of sleep-disordered breathing after delivery: A scoping review of longitudinal and cross-sectional studies.. Sleep medicine reviews, 65, 101674 .

106. Sultan, P., Guo, N., Kawai, M., Barwick, F., Carvalho, B., Mackey, S., Kallen, M., Gould, C., & Butwick, A. (2023). Prevalence and predictors for postpartum sleep disorders: a nationwide analysis. The Journal of Maternal-Fetal & Neonatal Medicine, 36.

107. Herrera Morales, A., Choh, A., Bauer, C. X., Czerwinski, S., & Lee, M. (2025). Maternal Sleep Disorders and Maternal and Birth Outcomes: A Retrospective US Claims-Based Study. Brain and Behavior, 15.

108. Harris, S. (2006). Vitamin D and African Americans.. The Journal of nutrition, 136 4, 1126-9 .

109. Signorello, L., Williams, S. M., Zheng, W., Smith, J. R., Long, J., Cai, Q., Hargreaves, M., Hollis, B., & Blot, W. (2010). Blood vitamin D levels in relation to genetic estimation of African ancestry. Cancer epidemiology, biomarkers & prevention : a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology, 19, 2325 - 2331.

110. Haddad, S., Ruiz-Narváez, E., Cozier, Y., Gerlovin, H., Rosenberg, L., & Palmer, J. (2018). Association of Degree of European Genetic Ancestry With Serum Vitamin D Levels in African Americans. American Journal of Epidemiology, 187, 1420–1423.

111. Ames, B., Grant, W., & Willett, W. (2021). Does the High Prevalence of Vitamin D Deficiency in African Americans Contribute to Health Disparities?. Nutrients, 13.

112. O'Connor, M. Y., Thoreson, C. K., Ramsey, N. L. M., Ricks, M., & Sumner, A. (2013). The Uncertain Significance of Low Vitamin D levels in African Descent Populations: A Review of the Bone and Cardiometabolic Literature. Progress in cardiovascular diseases, 56, 261 - 269.

113. Mogire, R., Mutua, A., Kimita, W., Kamau, A., Bejon, P., Pettifor, J., Adeyemo, A., Williams, T., & Atkinson, S. (2019). Prevalence of vitamin D deficiency in Africa: a systematic review and meta-analysis. The Lancet. Global Health, 8, e134 - e142.

114. Sutherland, J. P., Zhou, A., Leach, M., & Hyppönen, E. (2020). Differences and determinants of vitamin D deficiency among UK biobank participants: A cross-ethnic and socioeconomic study.. Clinical nutrition.

115. Nesby-O'Dell, S., Scanlon, K., Cogswell, M., Gillespie, C., Hollis, B., Looker, A., Allen, C., Doughertly, C., Gunter, E., & Bowman, B. (2002). Hypovitaminosis D prevalence and determinants among African American and white women of reproductive age: third National Health and Nutrition Examination Survey, 1988-1994.. The American journal of clinical nutrition, 76 1, 187-92 .

116. Vearing, R., Hart, K., Charlton, K., Probst, Y., Blackbourn, D., Ahmadi, K., Lanham-New, S., & Darling, A. (2021). Vitamin D Status of the British African-Caribbean Residents: Analysis of the UK Biobank Cohort. Nutrients, 13.

117. Fu, L., Zhang, G., Qian, S., Zhang, Q., & Tan, M. (2022). Associations between dietary fiber intake and cardiovascular risk factors: An umbrella review of meta-analyses of randomized controlled trials. Frontiers in Nutrition, 9.

118. Ghavami, A., Ziaei, R., Talebi, S., Barghchi, H., Nattagh-Eshtivani, E., Moradi, S., Rahbarinejad, P., Mohammadi, H., Ghasemi-Tehrani, H., Marx, W., & Askari, G. (2023). Soluble Fiber Supplementation and Serum Lipid Profile: A Systematic Review and Dose-Response Meta-Analysis of Randomized Controlled Trials. Advances in Nutrition, 14, 465 - 474.

119. Brown, L., Rosner, B., Willett, W., & Sacks, F. M. (1999). Cholesterol-lowering effects of dietary fiber: a meta-analysis.. The American journal of clinical nutrition, 69 1, 30-42 .

120. Estruch, R., Martínez-González, M., Corella, D., Basora-Gallisá, J., Ruíz-Gutiérrez, V., Covas, M., Fiol, M., Gómez-Gracia, E., Lopez-Sabater, M., Escoda, R., Pena, M. A., Díez-Espino, J., Lahoz, C., Lapetra, J., Sáez, G., & Ros, E. (2009). Effects of dietary fibre intake on risk factors for cardiovascular disease in subjects at high risk. Journal of Epidemiology & Community Health, 63, 582 - 588.

121. Surampudi, P. N., Enkhmaa, B., Anuurad, E., & Berglund, L. (2016). Lipid Lowering with Soluble Dietary Fiber. Current Atherosclerosis Reports, 18, 1-13.

122. Lancaster, S. M., Lee-McMullen, B., Abbott, C. W., Quijada, J., Hornburg, D., Park, H., Perelman, D., Peterson, D. J., Tang, M., Robinson, A. E., Ahadi, S., Contrepois, K., Hung, C.-J., Ashland, M., McLaughlin, T., Boonyanit, A., Horning, A. M., Sonnenburg, J., & Snyder, M. P. (2022). Global, distinctive and personal changes in molecular and microbial profiles by specific fibers in humans. Cell host & microbe, 30, 848 - 862.e7.

123. Reynolds, A., Akerman, A., Kumar, S., Pham, H. T. D., Coffey, S., & Mann, J. (2022). Dietary fibre in hypertension and cardiovascular disease management: systematic review and meta-analyses. BMC Medicine, 20.

124. Lennernäs, H., & Fager, G. (1997). Pharmacodynamics and Pharmacokinetics of the HMG-CoA Reductase Inhibitors. Clinical Pharmacokinetics, 32, 403-425.

125. Dayar, E., & Pechanova, O. (2022). Targeted Strategy in Lipid-Lowering Therapy. Biomedicines, 10.

126. Hebert, P. R., Gaziano, J., Chan, K., & Hennekens, C. (1997). Cholesterol lowering with statin drugs, risk of stroke, and total mortality. An overview of randomized trials.. JAMA, 278 4, 313-21 .

127. Law, M., Wald, N., & Rudnicka, A. (2003). Quantifying effect of statins on low density lipoprotein cholesterol, ischaemic heart disease, and stroke: systematic review and meta-analysis. BMJ : British Medical Journal, 326, 1423.

128. Nawrocki, J. W., Weiss, S., Davidson, M. H., Sprecher, D., Schwartz, S., Lupien, P., Jones, P., Haber, H., & Black, D. (1995). Reduction of LDL cholesterol by 25% to 60% in patients with primary hypercholesterolemia by atorvastatin, a new HMG-CoA reductase inhibitor.. Arteriosclerosis, thrombosis, and vascular biology, 15 5, 678-82 .

129. Tobert, J. (1987). New developments in lipid-lowering therapy: the role of inhibitors of hydroxymethylglutaryl-coenzyme A reductase.. Circulation, 76 3, 534-8 .

130. Maron, D., Fazio, S., & Linton, M. (2000). Current perspectives on statins.. Circulation, 101 2, 207-13 .

131. Mcpherson, R., Adreak, N., & Sharma, A. (2024). Medications for Lipid Control: Statins vs Newer Drugs.. The Canadian journal of cardiology, 40 8S, S26-S34 .

132. Ridker, P., Mora, S., & Rose, L. (2016). Percent reduction in LDL cholesterol following high-intensity statin therapy: potential implications for guidelines and for the prescription of emerging lipid-lowering agents.. European heart journal, 37 17, 1373-9 .

133. Koskinas, K., Siontis, G., Piccolo, R., Mavridis, D., Räber, L., Mach, F., & Windecker, S. (2018). Effect of statins and non-statin LDL-lowering medications on cardiovascular outcomes in

secondary prevention: a meta-analysis of randomized trials. European Heart Journal, 39, 1172–1180.

134. Byrne, P., Demasi, M., Jones, M., Smith, S. M., O'Brien, K., & DuBroff, R. (2022). Evaluating the Association Between Low-Density Lipoprotein Cholesterol Reduction and Relative and Absolute Effects of Statin Treatment: A Systematic Review and Meta-analysis.. JAMA internal medicine.

135. Dahl, W., & Stewart, M. (2015). Position of the Academy of Nutrition and Dietetics: Health Implications of Dietary Fiber.. Journal of the Academy of Nutrition and Dietetics, 115 11, 1861-70

136. Korczak, R., & Slavin, J. (2020). Definitions, regulations, and new frontiers for dietary fiber and whole grains.. Nutrition reviews, 78 Supplement_1, 6-12 .

137. Slavin, J. (2008). Position of the American Dietetic Association: health implications of dietary fiber.. Journal of the American Dietetic Association, 108 10, 1716-31 .

138. Anderson, J. W., Baird, P., Davis, R., Ferreri, S., Knudtson, M., Koraym, A., Waters, V., & Williams, C. L. (2009). Health benefits of dietary fiber.. Nutrition reviews, 67 4, 188-205 .

139. Tucker, L. (2018). Dietary Fiber and Telomere Length in 5674 U.S. Adults: An NHANES Study of Biological Aging. Nutrients, 10. https://doi.org/10.3390/nu10040400

140. Carlsen, H., & Pajari, A. (2023). Dietary fiber – a scoping review for Nordic Nutrition Recommendations 2023. Food & Nutrition Research, 67.

141. Stephen, A., Champ, M., Cloran, S. J., Fleith, M., Van Lieshout, L., Mejborn, H., & Burley, V. (2017). Dietary fibre in Europe: current state of knowledge on definitions, sources, recommendations, intakes and relationships to health. Nutrition Research Reviews, 30, 149 - 190.

142. Ridker, P. (2003). Clinical application of C-reactive protein for cardiovascular disease detection and prevention.. Circulation, 107 3, 363-9 .

143. Amezcua-Castillo, E., González-Pacheco, H., Martín, A. S.-S., Méndez-Ocampo, P., Gutiérrez-Moctezuma, I., Massó, F., Sierra-Lara, D., Springall, R., Rodríguez, E., Arias-Mendoza, A., & Amezcua-Guerra, L. (2023). C-Reactive Protein: The Quintessential

Marker of Systemic Inflammation in Coronary Artery Disease—Advancing toward Precision Medicine. Biomedicines, 11.

144. Quispe, R., Michos, E., Martin, S., Puri, R., Toth, P., Suwaidi, A. J., Banach, M., Virani, S., Blumenthal, R., Jones, S., & Elshazly, M. (2020). High-Sensitivity C-Reactive Protein Discordance With Atherogenic Lipid Measures and Incidence of Atherosclerotic Cardiovascular Disease in Primary Prevention: The ARIC Study. Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease, 9.

145. Ridker, P., Bhatt, D. L., Pradhan, A., Glynn, R., Macfadyen, J. G., & Nissen, S. (2023). Inflammation and cholesterol as predictors of cardiovascular events among patients receiving statin therapy: a collaborative analysis of three randomised trials.. Lancet.

146. Ridker, M. P. M. M., Moorthy, P. V. M., Cook, S. N. R., Rifai, N., Lee, S. I.-M., & Buring, S. J. E. (2024). Inflammation, Cholesterol, Lipoprotein(a) and 30-Year Cardiovascular Outcomes in Women. The New England journal of medicine, 391, 2087 - 2097.

147. Gao, Y., Wang, M., Wang, R., Jiang, J., Hu, Y., Wang, W., Wang, Y., & Li, H. (2024). The predictive value of the hs-CRP/HDL-C ratio, an inflammation-lipid composite marker, for cardiovascular disease in middle-aged and elderly people: evidence from a large national cohort study. Lipids in Health and Disease, 23.

148. Xie, S., Galimberti, F., Olmastroni, E., Luscher, T. F., Carugo, S., Catapano, A., & Casula, M. (2024). Effect of lipid-lowering therapies on C-reactive protein levels: a comprehensive meta-analysis of randomized controlled trials. Cardiovascular Research, 120, 333 - 344.

149. Swarath, S., Maharaj, N., Hall, A. M., Frederick, J., Seecheran, R., Seecheran, V., & Seecheran, N. (2023). The South African Flag Sign: An Electrocardiographic Flag for All Coronary Territories?. Journal of Investigative Medicine High Impact Case Reports, 11.

150. Muharam, Y. M., Ahmad, R., & Harmy, M. (2013). The ' widow maker': Electrocardiogram features that should not be missed.. Malaysian family physician : the official journal of the Academy of Family Physicians of Malaysia, 8 1, 45-7 .

151. Hollar, L., Hartness, O., & Doering, T. (2015). Recognizing Wellens' syndrome, a warning sign of critical proximal LAD artery stenosis and impending anterior myocardial infarction. Journal of Community Hospital Internal Medicine Perspectives, 5.

152. Nasir, K., Cainzos-Achirica, M., Valero-Elizondo, J., Ali, S., Havistin, R., Lakshman, S., Blaha, M., Blankstein, R., Shapiro, M., Arias, L., Saxena, A., Feldman, T., Budoff, M., Ziffer, J., Fialkow, J., & Cury, R. C. (2022). Coronary Atherosclerosis in an Asymptomatic U.S. Population: Miami Heart Study at Baptist Health South Florida.. JACC. Cardiovascular imaging, 15 9, 1604-1618 .

153. Sama, C., Abdelhaleem, A., Velu, D., Chobufo, M. D., Fongwen, N. T., Budoff, M., Roberts, M., Balla, S., Mills, J. D., Njim, T., Greathouse, M., Zeb, I., & Hamirani, Y. S. (2023). Non-calcified plaque in asymptomatic patients with zero coronary artery calcium score: A systematic review and meta-analysis.. Journal of cardiovascular computed tomography.

154. Choi, E., Choi, S.-I., Rivera, J. J., Nasir, K., Chang, S., Chun, E., Kim, H., Choi, D., Blumenthal, R., & Chang, H. (2008). Coronary computed tomography angiography as a screening tool for the detection of occult coronary artery disease in asymptomatic individuals.. Journal of the American College of Cardiology, 52 5, 357-65 .

155. Calvet, D., Touzé, E., Varenne, O., Sablayrolles, J., Weber, S., & Mas, J. (2010). Prevalence of Asymptomatic Coronary Artery Disease in Ischemic Stroke Patients: The PRECORIS Study. Circulation, 121, 1623-1629.

156. Tagawa, M., Takeuchi, S., Nakamura, Y., Saeki, M., Taniguchi, Y., Ohno, T., Watanabe, H., Ochiai, Y., Kato, K., Chinushi, M., & Aizawa, Y. (2019). Asymptomatic Coronary Artery Disease in Japanese Patients With the Acute Ischemic Stroke.. Journal of stroke and cerebrovascular diseases : the official journal of National Stroke Association, 28 3, 612-618 .

157. Reddin, C., Ferguson, J., Murphy, R., Clarke, A., Judge, C., Griffith, V., Alvarez, A., Smyth, A., Mente, A., Yusuf, S., & O'Donnell, M. (2023). Global mean potassium intake: a systematic review and Bayesian meta-analysis. European Journal of Nutrition, 62, 2027 - 2037.

158. Cogswell, M., Zhang, Z., Carriquiry, A., Gunn, J. P., Kuklina, E. V., Saydah, S., Yang, Q., & Moshfegh, A. (2012). Sodium and potassium intakes among US adults: NHANES 2003-2008.. The American journal of clinical nutrition, 96 3, 647-57 .

159. Stone, M. S., Martyn, L., & Weaver, C. (2016). Potassium Intake, Bioavailability, Hypertension, and Glucose Control. Nutrients, 8. https://doi.org/10.3390/nu8070444

160. Tan, M., He, F., Wang, C., & Macgregor, G. (2019). Twenty-Four-Hour Urinary Sodium and Potassium Excretion in China: A Systematic Review and Meta-Analysis. Journal of the American Heart Association: Cardiovascular and Cerebrovascular Disease, 8.

161. Donfrancesco, C., Lo Noce, C., Russo, O., Buttari, B., Profumo, E., Minutoli, D., Di Lonardo, A., Iacone, R., Vespasiano, F., Vannucchi, S., Onder, G., Galletti, F., Galeone, D., Bellisario, P., Di Lenarda, A., Giampaoli, S., Palmieri, L., & Strazzullo, P. (2020). Trend in potassium intake and Na/K ratio in the Italian adult population between the 2008 and 2018 CUORE project surveys.. Nutrition, metabolism, and cardiovascular diseases : NMCD, 31 3, 814-826 .

162. Kumssa, D., Joy, E., & Broadley, M. (2021). Global Trends (1961–2017) in Human Dietary Potassium Supplies. Nutrients, 13.

163. Feldman, H., Longcope, C., Derby, C., Johannes, C., Araujo, A., Coviello, A., Bremner, W., & Mckinlay, J. (2002). Age trends in the level of serum testosterone and other hormones in middle-aged men: longitudinal results from the Massachusetts male aging study.. The Journal of clinical endocrinology and metabolism, 87 2, 589-98 .

164. Cheng, H., Zhang, X., Li, Y., Cao, D., Luo, C., Zhang, Q., Zhang, S., & Jiao, Y. (2024). Age-related testosterone decline: mechanisms and intervention strategies. Reproductive Biology and Endocrinology : RB&E, 22.

165. Fraile-Martínez, Ó., Ortega, M., & García-Montero, C. (2026). Understanding the Secular Decline in Testosterone: Mechanisms, Consequences, and Clinical Perspectives. International Journal of Molecular Sciences, 27.

166. Lokeshwar, S., Patel, P., Fantus, R., Halpern, J., Chang, C., Kargi, A., & Ramasamy, R. (2020). Decline in Serum Testosterone Levels Among Adolescent and Young Adult Men in the USA.. European urology focus.

167. Ogoniak, L., Sandmann, S., Varghese, J., Ziller, M., Neuhaus, N., & Busch, A. S. (2025). Role of Genetics in the Age-Related Testosterone Decline in Men - A UK Biobank Study.. European journal of endocrinology.

168. Kanabar, R., Mazur, A., Plum, A., & Schmied, J. (2022). Correlates of testosterone change as men age. The Aging Male, 25, 29 - 40.

169. Goulian, A. J., Ashkezari, A., & Eleswarapu, S. (2026). Unmasking Masculinity: Biological, Behavioral, and Social Determinants of Testosterone Deficiency in U.S. Men, 2011–2023. American Journal of Men's Health, 20.

170. Vingren, J., Kraemer, W., Ratamess, N., Anderson, J. M., Volek, J., & Maresh, C. (2010). Testosterone Physiology in Resistance Exercise and Training. Sports Medicine, 40, 1037-1053.

171. Morton, R. W., Sato, K., Gallaugher, M., Oikawa, S. Y., McNicholas, P., Fujita, S., & Phillips, S. M. (2018). Muscle Androgen Receptor Content but Not Systemic Hormones Is Associated With Resistance Training-Induced Skeletal Muscle Hypertrophy in Healthy, Young Men. Frontiers in Physiology, 9.

172. Mitchell, C., Churchward-Venne, T., Bellamy, L. M., Parise, G., Baker, S., & Phillips, S. M. (2013). Muscular and Systemic Correlates of Resistance Training-Induced Muscle Hypertrophy. PLoS ONE, 8.

173. West, D. W. D., Burd, N., Tang, J. E., Moore, D., Staples, A. W., Holwerda, A., Baker, S., & Phillips, S. M. (2010). Elevations in ostensibly anabolic hormones with resistance exercise enhance neither training-induced muscle hypertrophy nor strength of the elbow flexors.. Journal of applied physiology, 108 1, 60-7

174. Laurentino, G., Loenneke, J., Ugrinowitsch, C., Aoki, M., Soares, A., Roschel, H., & Tricoli, V. (2022). Blood-Flow-Restriction-Training-Induced Hormonal Response is not Associated with Gains in Muscle Size and Strength. Journal of Human Kinetics, 83, 235 - 243.

175. Räntilä, A., Ahtiainen, J., & Häkkinen, K. (2023). Effects of Acute Loading Induced Fatigability, Acute Serum Hormone Responses and Training Volume to Individual Hypertrophy and Maximal Strength during 10 Weeks of Strength Training.. Journal of sports science & medicine, 22 3, 559-570 .

176. Alexander, S. E., Gatto, B., Knowles, O. E., Williams, R. M., Fiebig, K. N., Jansons, P., Della Gatta, P. A., Garnham, A., Eynon, N., Wadley, G., Aisbett, B., Hiam, D., & Lamon, S. (2024). Bioavailable testosterone and androgen receptor activation, but not total testosterone, are associated with muscle mass and strength in females. The Journal of Physiology, 603, 5181 - 5208.

177. Gharahdaghi, N., Rudrappa, S., Brook, M., Farrash, W. F., Idris, I., Aziz, M. H. A., Kadi, F., Papaioannou, K.-G., Phillips, B., Sian, T., Herrod, P. J., Wilkinson, D., Szewczyk, N., Smith, K., & Atherton, P. (2022). Pharmacological hypogonadism impairs molecular transducers of exercise-induced muscle growth in humans. Journal of Cachexia, Sarcopenia and Muscle, 13, 1134 - 1150.

178. Van Every, D. W., D'Souza, A. C., & Phillips, S. M. (2024). Hormones, Hypertrophy, and Hype: An Evidence-Guided Primer on Endogenous Endocrine Influences on Exercise-Induced Muscle Hypertrophy. Exercise and Sport Sciences Reviews, 52, 117 - 125.

179. Mahaffey, K., Sunderland, E., Chan, H., Choi, A., Grandjean, P., Mariën, K., Oken, E., Sakamoto, M., Schoeny, R., Weihe, P., Yan, C.-H., & Yasutake, A. (2011). Balancing the benefits of n-3 polyunsaturated fatty acids and the risks of methylmercury exposure from fish consumption. Nutrition reviews, 69, 493 - 508.

180. Mahaffey, K., Clickner, R., & Jeffries, R. (2008). Methylmercury and omega-3 fatty acids: co-occurrence of dietary sources with emphasis on fish and shellfish.. Environmental research, 107 1, 20-9 .

181. Ginsberg, G., & Toal, B. (2008). Quantitative Approach for Incorporating Methylmercury Risks and Omega-3 Fatty Acid Benefits in Developing Species-Specific Fish Consumption Advice. Environmental Health Perspectives, 117, 267 - 275.

182. Cantoral, A., Batis, C., & Basu, N. (2017). National estimation of seafood consumption in Mexico: Implications for exposure to methylmercury and polyunsaturated fatty acids.. Chemosphere, 174, 289-296 .

183. Laird, M. J., Henao, J. J. A., Reyes, E., Stark, K., Low, G., Swanson, H., & Laird, B. D. (2018). Mercury and omega-3 fatty acid profiles in freshwater fish of the Dehcho Region, Northwest Territories: Informing risk benefit assessments.. The Science of the total environment, 637-638, 1508-1517.

184. Spiller, P., Van Wijngaarden, E., Adams, H. R., Strain, J., McSorley, E., Mulhern, M., Conway, M., Yeates, A., Carrington, C., Bolger, P. M., Morgan, K. M., Taylor, C., Ralston, N., Crawford, M. A., Hibbeln, J. R., Brenna, J., & Myers, G. J. (2023). Net Effects Explains the Benefits to Children from Maternal Fish Consumption Despite Methylmercury in Fish. Neurotoxicology, 99, 195 - 205.

185. Nunes, E., Cavaco, A., & Carvalho, C. (2014). Children's Health Risk and Benefits of Fish Consumption: Risk Indices Based on a Diet Diary Follow-Up of Two Weeks. Journal of Toxicology and Environmental Health, Part A, 77, 103 - 114.

186. Mairbäurl, H. (2013). Red blood cells in sports: effects of exercise and training on oxygen supply by red blood cells. Frontiers in Physiology, 4.

187. Montero, D., & Lundby, C. (2018). Regulation of Red Blood Cell Volume with Exercise Training. Comprehensive Physiology, 9.

188. Demircioğlu, S., Tekinalp, A., Korkmaz, C., Baylan, F. A., & Merter, M. (2025). Changes in body composition and their association with erythrocyte mass in regular exercisers: A cross-sectional study. Medicine, 104.

189. Ciekot-Sołtysiak, M., Kusy, K., Podgórski, T., Pospieszna, B., & Zieliński, J. (2024). Changes in red blood cell parameters during incremental exercise in highly trained athletes of different sport specializations. PeerJ, 12.

190. Stefanović, R., Ristic, B., & Drvenica, I. T. (2024). Red blood cell adaptations induced by exercise. Srpski medicinski casopis Lekarske komore.

191. Poole, D., & Musch, T. (2023). Capillary-Mitochondrial Oxygen Transport in Muscle: Paradigm Shifts. Function, 4.

192. Chatzinikolaou, P., Margaritelis, N. V., Paschalis, V., Theodorou, A., Moushi, E., Vrabas, I., Kyparos, A., Fatouros, I., D'Alessandro, A., & Nikolaidis, M. (2025). Erythrocyte Glycolytic and Redox Metabolism Affects Muscle Oxygenation and Exercise Performance: A Randomized Double-Blind Crossover Study in Men. Sports Medicine (Auckland, N.z.), 55, 3157 - 3181.

193. Hargreaves, M. (2021). Exercise and Health, Historical Perspectives and New Insights.. Journal of applied physiology.

194. Kent, J., & Hayes, K. L. (2021). Exercise Physiology From 1980 to 2020: Application of the Natural Sciences. Kinesiology review (Champaign, Ill.), 10, 238 - 247.

195. Matthews, M. J., Kanungo, S., Baker, R. J., & Kenter, K. (2024). Exercise Physiology: A Review of Established Concepts and Current Questions. Physiologia.

196. Keadle, S., Bustamante, E., & Buman, M. (2021). Physical Activity and Public Health: Four Decades of Progress. Kinesiology Review. https://doi.org/10.1123/kr.2021-0028

197. Pedersen, B. (2019). The Physiology of Optimizing Health with a Focus on Exercise as Medicine.. Annual review of physiology, 81, 607-627 .

198. Jones, H., George, K., Scott, A., Buckley, J., Watson, P., Oxborough, D., Thijssen, D., Graves, L. E. F., Whyte, G., McGregor, G., Naylor, L., Rosenberg, M., Askew, C., & Green, D. (2021). Charter to establish clinical exercise physiology as a recognised allied health profession in the UK: a call to action. BMJ Open Sport — Exercise Medicine, 7.

199. Blair, S., Kampert, J., Kohl, H., Barlow, C., Macera, C., Paffenbarger, R., & Gibbons, L. (1996). Influences of Cardiorespiratory Fitness and Other Precursors on Cardiovascular Disease and All-Cause Mortality in Men and Women. JAMA, 276, 205-210.

200. Blair, S., Kohl, H., Barlow, C., & Gibbons, L. (1991). Physical fitness and all-cause mortality in hypertensive men.. Annals of medicine, 23 3, 307-12 .

201. Blair, S., Kohl, H., Paffenbarger, R., Clark, D. G., Cooper, K., & Gibbons, L. (1989). Physical fitness and all-cause mortality. A prospective study of healthy men and women.. JAMA, 262 17, 2395-401 .

202. McGrath, R., Cawthon, P., Cesari, M., Snih, A. S., & Clark, B. (2020). Handgrip Strength Asymmetry and Weakness Are Associated with Lower Cognitive Function: A Panel Study. Journal of the American Geriatrics Society, 68.

203. Chen, Z., Ho, M., & Chau, P. (2022). Handgrip strength asymmetry is associated with the risk of neurodegenerative disorders among Chinese older adults. Journal of Cachexia, Sarcopenia and Muscle, 13, 1013 - 1023.

204. Peng, L., Xiang, Q., Zhou, Y., & Yin, R. (2024). Associations of Handgrip Strength Weakness and Asymmetry with Lower Cognitive Function: Results from the National Health and Nutrition Examination Survey (2011–2014). Journal of Alzheimer's Disease, 99, 393 - 402.

205. Arazi, H., Olia, R. B. B., & Eghbali, E. (2023). Are the digit ratio (2D:4D) and hand grip strength related to Parkinson disease in elderly males?. BMC Sports Science, Medicine and Rehabilitation, 15.

206. Núñez-Cortés, R., Calatayud, J., Calonge-Pascual, S., Andersen, L. L., Bláfoss, R., López-Gil, J. F., & López-Bueno, R. (2025). Dose-Response Association of Handgrip Strength With Alzheimer's Disease: A Longitudinal Study Involving 85,979 Adults. International Journal of Geriatric Psychiatry, 40.

207. Freitas, S. R., Cruz-Montecinos, C., Ratel, S., & Pinto, R. S. (2024). Powerpenia Should be Considered a Biomarker of Healthy Aging. Sports Medicine - Open, 10.

208. Pellegrino, R., Paganelli, R., Di Iorio, A., Candeloro, M., Volpato, S., Bandinelli, S., Moretti, A., Iolascon, G., Tanaka, T., & Ferrucci, L. (2025). Role for neurological and immunological resilience in the pathway of the aging muscle powerpenia: InCHIANTI study longitudinal results. GeroScience, 47, 5591 - 5604.

209. Balogun, S., Winzenberg, T., Wills, K., Scott, D., Callisaya, M., Cicuttini, F., Jones, G., & Aitken, D. (2019). Prospective associations of osteosarcopenia and osteodynapenia with incident fracture and mortality over 10 years in community-dwelling older adults.. Archives of gerontology and geriatrics, 82, 67-73 .

210. Schoenfeld, B., Grgic, J., & Krieger, J. (2019). How many times per week should a muscle be trained to maximize muscle hypertrophy? A systematic review and meta-analysis of studies examining the effects of resistance training frequency. Journal of Sports Sciences, 37, 1286 - 1295.

211. Grgic, J., Schoenfeld, B., & Latella, C. (2019). Resistance training frequency and skeletal muscle hypertrophy: A review of available evidence.. Journal of science and medicine in sport, 22 3, 361-370 .

212. Mcleod, J. C., Currier, B., Lowisz, C., & Phillips, S. M. (2023). The influence of resistance exercise training prescription variables on skeletal muscle mass, strength, and physical function in healthy adults: An umbrella review. Journal of Sport and Health Science, 13, 47 - 60.

213. Ralston, G. W., Kilgore, L., Wyatt, F., Buchan, D. S., & Baker, J. (2018). Weekly Training Frequency Effects on Strength Gain: A Meta-Analysis. Sports Medicine - Open, 4.

214. Hamarsland, H., & Rønnestad, B. (2022). Equal-Volume Strength Training With Different Training Frequencies Induces Similar Muscle Hypertrophy and Strength Improvement in Trained Participants. Frontiers in Physiology, 12.

215. Swinton, P., Schoenfeld, B. J., & Murphy, A. (2024). Dose–Response Modelling of Resistance Exercise Across Outcome Domains in Strength and Conditioning: A Meta-analysis. Sports Medicine (Auckland, N.z.), 54, 1579 - 1594.

216. Singer, A., Wolf, M., Generoso, L., Arias, E., Delcastillo, K., Echevarria, E., Martinez, A., Korakakis, P. A., Refalo, M. C., Swinton, P., & Schoenfeld, B. (2024). Give it a rest: a systematic review with Bayesian meta-analysis on the effect of inter-set rest interval duration on muscle hypertrophy. Frontiers in Sports and Active Living, 6.

217. Grgic, J., Lazinica, B., Mikulic, P., Krieger, J., & Schoenfeld, B. (2017). The effects of short versus long inter-set rest intervals in resistance training on measures of muscle hypertrophy: A systematic review. European Journal of Sport Science, 17, 983 - 993.

218. Keskin, Y., Uzoho, C. M., & Abdulrahman, C. M. (2025). Effects of Rest Interval Length on Muscle Hypertrophy in Amateur Bodybuilders. Qubahan Journal of Coaching and Sports Sciences.

219. McMahon, G., Best, N. G., Coulter, T., & Erskine, R. M. (2024). Increased Neuromuscular Activity, Force Output, and Resistance Exercise Volume When Using 5-Minute Compared with 2-Minute Rest Intervals Between the Sets. Journal of Strength and Conditioning Research, 38, 1527 - 1534.

220. McKendry, J., Pérez-López, A., McLeod, M., Luo, D., Dent, J. R., Smeuninx, B., Yu, J., Taylor, A., Philp, A., & Breen, L. (2016). Short inter-set rest blunts resistance exercise-induced increases in myofibrillar protein synthesis and intracellular signalling in young males. Experimental Physiology, 101.

221. Davidson, L., & Barillas, S. (2025). Investigating the Impact of Less Than or Greater Than 60 Seconds of Inter-Set Rest on Muscle Hypertrophy and Strength Increases in Males with >1 Year of Resistance Training Experience: Systematic Review with Meta-Analysis.

222. Careau, V., Halsey, L., Pontzer, H., Ainslie, P., Andersen, L., Anderson, L., Arab, L., Baddou, I., Bedu-Addo, K., Blaak, E., Blanc, S., Bonomi, A., Bouten, C., Buchowski, M., Butte, N., Camps, S., Close, G., Cooper, J., Das, S., . . . Speakman, J. (2021). Energy compensation and adiposity in humans. Current biology : CB, 31, 4659 - 4666.e2.

223. Pontzer, H., & Trexler, E. T. (2026). The evidence for constrained total energy expenditure in humans and other animals.. Current biology : CB.

224. Mansfeldt, J., & Magkos, F. (2023). Compensatory Responses to Exercise Training As Barriers to Weight Loss: Changes in Energy Intake and Non-exercise Physical Activity. Current Nutrition Reports, 12, 327-337.

225. Riou, M.-È., Jomphe-Tremblay, S., Lamothe, G., Finlayson, G., Blundell, J., Décarie-Spain, L., Gagnon, J.-C., & Doucet, É. (2019). Energy Compensation Following a Supervised Exercise Intervention in Women Living With Overweight/Obesity Is Accompanied by an Early and Sustained Decrease in Non-structured Physical Activity. Frontiers in Physiology, 10.

226. Westerterp, K. (2017). Exercise, energy expenditure and energy balance, as measured with doubly labelled water. Proceedings of the Nutrition Society, 77, 4 - 10.

227. Ew, F., Sanchez-Delgado, G., Ck, M., E, R., H, P., & Lm, R. (2024). No evidence for metabolic adaptation during exercise-related energy compensation. iScience, 27.

228. Willis, E., Herrmann, S., Honas, J., Lee, J., Donnelly, J., & Washburn, R. (2014). Nonexercise Energy Expenditure and Physical Activity in the Midwest Exercise Trial 2. Medicine and science in sports and exercise, 46, 2286 - 2294.

229. Howard, K. R., Prado-Nóvoa, O., Zorrilla-Revilla, G., Laskaridou, E., Reid, G. R., Marinik, E., Stamatiou, M., Hambly, C., Davy, B. M., Speakman, J. R., & Davy, K. P. (2025). Physical activity is directly associated with total energy expenditure without evidence of constraint or compensation. Proceedings of the National Academy of Sciences of the United States of America, 122.

230. Yegian, A. K., Pachus, E., Redman, L., Heymsfield, S., Falkenhain, K., Harris, A. R., Chacko, S., Wong, W. W., Lieberman, D. E., Greenhaff, P., & Petersen, M. (2026). Longitudinal and cross-sectional evidence that daily resting and activity energy expenditures are independent in humans. The Journal of Physiology, 604.

231. Blake, D. T., Hamane, C., Pacheco, C., Henselmans, M., Tinsley, G., Costa, P. B., Coburn, J. W., Campidell, T., & Galpin, A. J. (2025). Hypercaloric 16:8 time-restricted eating during 8 weeks of resistance exercise in well-trained men and women. Journal of the International Society of Sports Nutrition, 22.