REVIEW ARTICLE

Which popular cognitive-enhancement claims hold up? An evidence-graded narrative review for working adults

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ABSTRACT

Background: Working adults are offered many tactics for sharper thinking: meal timing and glucose tracking, "brain foods", brain-training games, focus music, fixed work rhythms, sleep-stage scores, and heat or cold exposure. Few of these claims are presented with the strength of their evidence.

Methods: This evidence-graded narrative review examined popular cognitive-enhancement claims aimed at working adults, drawing on meta-analyses, randomised controlled trials, replication studies, large cohorts and Mendelian randomisation studies. Each claim was graded on four levels (STRONG, MODERATE, LIMITED-EMERGING, NULL-CONTRADICTED), and better-supported alternatives were identified.

Results: Skipping breakfast or short fasting did not meaningfully change adult cognition (pooled g 0.02 across 71 studies). Glycaemic-index effects were null or trivial, sugar did not improve mood and increased fatigue within an hour (NULL-CONTRADICTED), and no evidence supports glucose-spike coaching for cognition in non-diabetic adults. The largest brain-diet trial (MIND) was null. "Willpower budgets" (ego depletion) failed multi-laboratory replications (d 0.04–0.10). The Mozart effect and far transfer from brain-training games did not survive bias control, evidence for binaural beats was contested, and evidence for amplitude-modulated music came from one industry-linked research programme (LIMITED-EMERGING). Fixed Pomodoro or 90-minute work cycles lacked support, wearable REM and slow-wave percentages were not associated with dementia, blue-light filters did not change sleep, and sauna, cold water and chewing gum lacked adequate evidence as cognitive tools. By contrast, hydration (MODERATE), avoiding heavy meals before monotonous work (LIMITED-EMERGING but consistent), correcting iron deficiency, overall diet pattern and waist size had better support.

Conclusions: The additive inputs most heavily marketed for cognition have the weakest or null evidence, while better-supported levers are mostly subtractive or concern deficiency and overall pattern. Detailed meal logging does not meet the evidence bar for cognitive benefit.

1. Introduction

Wellness, productivity and wearable products promise working adults sharper thinking through added inputs: particular foods and meal timings, glucose monitoring, brain-training games, specially designed audio, strict work rhythms, sleep-stage scores and physical "biohacks" such as saunas and cold plunges. Many of these claims rest on a plausible mechanism and an early, often small, positive study. Fewer have survived replication, bias correction or testing in adults of working age.

Overstated claims carry real costs. They divert time and attention from better-supported levers, they can encourage unnecessary tracking, and when they fail they undermine trust in sound advice. Claims that a behaviour "prevents dementia" or "reverses brain age" are especially consequential because they are rarely tested directly.

This review grades the peer-reviewed evidence for popular cognitive-enhancement claims relevant to working adults and, for each claim, identifies what the evidence supports instead. It is one of three companion reviews; the others cover sleep, stress and recovery, and work habits, physical activity, learning strategies and generative AI (companion reviews, in preparation).

2. Methods

2.1 Design

This is an evidence-graded narrative review. It was not conducted as a systematic review, and no protocol was registered.

2.2 Selection of claims

Claims were included if they are commonly promoted to working adults in wellness, productivity and wearable products as ways to improve day-to-day cognitive performance or long-term brain health, and if they have been directly tested or explicitly examined in peer-reviewed research. Claims concerning environment, substances and supplements were out of scope, except where supplement trials show whether a nutrient *status* matters.

2.3 Search and selection of evidence

Sources were identified through searches of PubMed/MEDLINE and of publisher and citation databases accessed through Digital Object Identifiers (DOIs), which also captured journals in psychology, management and education that are not indexed in PubMed. Searches combined terms for each component listed in Section 2.2 with terms for cognitive outcomes (for example cognition, attention, working memory, memory, creativity, cognitive decline and dementia) and for study design (meta-analysis, systematic review, randomised controlled trial, cohort and Mendelian randomisation). Only English-language publications were included. The author

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selected and graded the evidence, with assistance from AI tools (Section 2.6). The final reference list comprises 187 sources published between 1982 and 2026, of which at least 171 are indexed in PubMed.

For each claim, priority was given to meta-analyses, multi-laboratory and preregistered replications, randomised controlled trials (RCTs), large prospective cohorts and Mendelian randomisation (MR) studies. This review is part of a programme of three companion reviews that drew on 17 topic-specific evidence summaries covering several hundred peer-reviewed sources.

2.4 Verification of figures

Every quantitative figure was checked against the abstract or full text of its primary source. Figures that could not be verified against a primary source — for example, numbers reported only in press releases or effect sizes seen only in secondary summaries — were excluded.

2.5 Evidence grading

Each claim was graded on a four-level scale:

- **STRONG:** several consistent meta-analyses or RCTs.
- **MODERATE:** one good meta-analysis, or consistent large cohorts or trials.
- **LIMITED-EMERGING:** single or small studies, or indirect or conflicting evidence.
- **NULL-CONTRADICTED:** well-powered tests or replications failed.

Where the evidence fitted none of these levels, a plain descriptor is used ("unsupported", "unverified", "untested", "conflicting" or "no direct evidence"). "Unsupported" means that no well-powered test exists, which is not the same as a failed test. Horizons are PERFORMANCE (hours to days), M-SHORT (days to weeks) and M-LONG (years to decades). Effect sizes are standardised differences (SMD, *d* or *g*; about 0.2 is small and 0.5 medium) or hazard, risk and odds ratios as reported by the source studies.

2.6 Use of AI tools

Generative AI tools, including Claude (Anthropic), were used in part to assist with identifying and summarising literature, structuring the manuscript, preparing figures and editing language. The author reviewed all AI-assisted content, checked every claim, figure and reference against the primary sources, and takes full responsibility for the content of this article. AI tools are not listed as authors.

3. Results

3.1 Food, meal timing and glucose

3.1.1 Breakfast, fasting, glycaemic index and sugar do not move adult cognition

The largest synthesis of acute fasting — 71 studies and 3,484 participants with a median 12-hour fast, roughly an overnight fast plus a skipped breakfast — found no meaningful difference between fasted and fed participants (g 0.02, 95% CrI −0.05 to 0.10); in the authors' full-text manuscript the adults-only estimate was g −0.01 (N = 2,754), against a small benefit of eating in five child and adolescent studies (g 0.14) [1]. The published abstract also reports modest reductions in performance during fasts for younger (versus older) participants and for longer fasts, and no included study had a mean age above about 40. Fasted participants did slightly worse when tested later in the day (+0.05 SMD per hour) and on inhibitory control (0.16), and slightly *better* on cognitive flexibility (−0.23). In a 10-day randomised trial of 16-hour breakfast-skipping in 122 adults, objective performance and mood were unaffected, but people *felt* less concentrated in fasted mornings [2]. Grade: MODERATE evidence of no meaningful acute effect in adults up to about 40 (PERFORMANCE), with small deficits possible in the youngest adults and during long fasts; the "small but robust" memory benefit in an older narrative review lacks a pooled estimate [3] (LIMITED-EMERGING), and the reliable breakfast benefit in undernourished children does not transfer [4]. Glycaemic load had no effect for two hours after breakfast, and only a borderline memory benefit of low-GL meals after 120 minutes (SMD 0.16, CI touching zero) in 15 adult studies [5]; a double-blind trial in 65 young adults found no memory difference between high- and low-GI desserts [6] — LIMITED-EMERGING. The "sugar rush" is contradicted: across 31 studies, carbohydrate improved mood at no time point and brought *more* fatigue and *less* alertness in the first hour [7] (NULL-CONTRADICTED). Glucose as a willpower fuel has weak evidential value [8], and the ego-depletion effect it was meant to explain was near zero in multi-lab replications (d 0.04 and 0.06) [9,10] — NULL-CONTRADICTED. Laboratory glucose drinks can aid memory (pooled d 0.56 but heterogeneous [11]), yet people with good glucose regulation can get *worse* [12] — LIMITED-EMERGING. Continuous-glucose "spike" coaching for cognition has no evidence base in non-diabetic adults: in about 13,000 ARIC participants, midlife glucose peaks predicted dementia and 20-year decline only in people with diabetes [13], and visit-to-visit variability across years related to lower scores cross-sectionally but not to six-year decline outside incident diabetes [14].

3.1.2 Fasting regimes and dieting styles

Fasting regimes and dieting styles also leave cognition largely unchanged. Four weeks of 16:8 time-restricted eating in 43 women changed neither working memory nor attentional control [15], and a review found intermittent fasting safe for cognition but based on "only 9 low-quality RCTs" [16] — LIMITED-EMERGING (no harm, no gain). Months-to-years of calorie restriction produce small gains (SMD 0.22 across 11 RCTs, with fasting no better than continuous restriction [17]), but in the closest working-age trial — CALERIE, healthy non-obese adults aged about 38 prescribed 25% restriction for two years (11.7% achieved) — spatial working memory did not differ from control (P > 0.99) [18,19], with a "slightly positive" effect only under different covariate adjustment [20]. Ketogenic and very-low-carbohydrate diets showed no cognitive benefit over higher-carbohydrate diets in small trials ([21], n = 11), and over a year mood improved *more* on a low-fat diet [22] — LIMITED-EMERGING.

3.1.3 What survives: meal size, timing and fluids

The acute nutrition effects that hold up concern *how much* and *when*, not *what*. A lunch 40% larger than usual increased focused-attention and search errors in an afternoon test of 35 women [23]; after a night restricted to 5 hours, a heavy 922-kcal lunch versus a light 305-kcal lunch increased sleepiness-related lane drifting in a two-hour monotonous drive, with differences emerging after about 30 minutes [24]; and a review of 11 experiments found impairment "more likely af-

ter a large lunch than a small lunch" [25]. At night, in a randomised simulated-night-shift trial of 39 adults, a small snack (about 10% of daily energy) at 00:30 beat both a large meal (about 30%) and not eating on 04:00 vigilance lapses, reaction time, working memory and simulated driving [26]. Grade: LIMITED-EMERGING but consistent (PERFORMANCE) — the effect is delayed, largest for monotonous sustained-attention work, and worse after short sleep, which describes launch nights and travel days. Fat versus carbohydrate composition gives inconsistent results [27,28], and the afternoon dip itself is circadian (see the sleep section). Short runs of poor eating have measurable but reversible costs: one week of a high-saturated-fat, high-sugar "Western" diet reduced hippocampal-dependent learning in 110 lean young adults (d 0.43), recovering three weeks later [29], and five days of a 75%-fat diet impaired attention and speed in 16 young men [30] — LIMITED-EMERGING (PERFORMANCE, M-SHORT).

Hydration is the acute nutrition element with the most direct evidence. Across 33 studies, dehydration impaired cognition by ES -0.21 overall, with attention (-0.52), motor coordination (-0.40) and executive function (-0.24) most affected and larger effects above 2% body-mass loss (-0.28 vs -0.14) [31], although a meta-analysis restricted to exercise-induced ("active") hypohydration found no significant impairment (g -0.18) [32]. Mood and fatigue effects are more consistent: losses of about 1.4–1.6% of body mass raised fatigue, tension, perceived task difficulty and headache in young men and women [33,34] — studies funded by or co-authored with Danone Research — and independent trials agree: after four hours at 30 °C with a mean loss of only 0.72% of body mass, drinking 300 mL of water improved memory and focused attention in 101 adults [35], and after 12–24 hours of fluid restriction, 200 mL relieved fatigue and mood disturbance while 500 mL was needed to restore working memory [36,37]. Grade: MODERATE (PERFORMANCE), contested for cognition below 2% loss. Thirst is a useful prompt but not a gatekeeper — water sped reaction time only in thirsty people [38], while 25 mL improved visual attention regardless of thirst in 96 adults [39] — LIMITED-EMERGING. Urine colour tracks hydration only as a coarse flag: the widely quoted "+1.1 litres a day per two shades lighter" applies to 24-hour pooled urine [40], and first-morning samples relate poorly to intake [41]. Water-volume logging is not justified: in 1,957 adults aged 55–75 with metabolic syndrome, higher serum osmolarity predicted faster two-year decline (β -0.010) but water intake did not [42], and meeting adequate-intake targets was unrelated to cognition in NHANES [43] — M-LONG hydration LIMITED-EMERGING.

3.1.4 Long-term diet works through pattern, processing and deficiency, not "brain foods"

Mediterranean-style eating is associated with roughly 10–20% lower risk of cognitive disorders in most cohort meta-analyses (e.g., RR 0.79 in 9 cohorts [44]; dementia HR 0.89 in 23 studies [45]), but heterogeneity is high and recent results are mixed: the newest cohort meta-analysis was not significant (HR 0.85, 0.71–1.03) [46], the Malmö midlife cohort (28,025 adults, mean age 58, about 20 years) found no association (HR 0.93) [47], and only 8 of 66 cognitive outcomes favoured the diet across five RCTs [48]. The workplace RCT closest to working-age professionals — DIRECT PLUS, 284 abdominally obese employees (88% men, mean age 51) given monitored lunches and gym access for 18 months — found no cognitive difference between diets, and a smaller decline in hippocampal occupancy on the high-polyphenol Mediterranean diet in participants aged 50 or over (-0.8% vs -1.3%), with "similar patterns" reported in younger participants, tied to improved insulin sensitivity [49]. The MIND diet emerged from Chicago cohorts (pooled HR 0.83 per 3-point increment [50]), but its three-year RCT in 604 adults aged 65 or over, against a control diet with the same mild calorie restriction, found no cognitive or MRI difference (0.035 SD, P = 0.23) [51]. Across 19 RCTs of dietary-pattern interventions (often bundled with calorie restriction or exercise) in 12,119 healthy adults, the pooled cognitive benefit was small (SMD 0.14) [52]. The 2024 Lancet Commission did not include diet among its 14 risk factors, concluding there is "not enough evidence to say [healthy diets] are directly useful for dementia prevention" [53], while WHO conditionally recommends a Mediterranean-like diet and strongly recommends *against* B and E vitamins, omega-3 and multi-nutrient supplements for cognitive risk [54]. Grades: Mediterranean pattern MODERATE (borderline) association, LIMITED causal (M-LONG); MIND as a specific intervention NULL-CONTRADICTED; healthy dietary-pattern interventions MODERATE for a small general effect.

Processing and specific food groups give clearer observational signals. In ELSA-Brasil, 10,775 public servants aged 35–74 (mean 51.6) whose ultra-processed-food (UPF) intake was above the lowest quartile showed 28% faster global cognitive decline and 25% faster executive decline over eight years [55]; in UK Biobank each 10% higher UPF share by weight was associated with 25% higher dementia risk, and swapping 10% UPF for minimally processed food with 19% lower risk [56]; a US cohort found the association independent of Mediterranean, DASH or MIND adherence [57]; and a 2026 meta-analysis gave HR 1.14 overall and 1.19 in people under 60 [58], though another meta-analysis was not significant for dementia [59] — MODERATE (observational, M-LONG), one of the few diet exposures with working-age signals. Processed red meat was associated with higher dementia risk in US adults with mean baseline age 48.9 (HR 1.13; replacing a daily serving with nuts or legumes HR 0.81 [60]) and in UK Biobank (HR 1.44 per 25 g/day, while unprocessed red meat was *inversely* associated [61]) — MODERATE. Fish intake was associated with lower dementia risk (RR 0.82 highest vs lowest; risk of cognitive impairment down to RR 0.70 at 150 g/day [62]), whereas omega-3 supplements were null in older adults [63] — MODERATE (observational). Flavonoid-rich diets were associated with lower dementia risk in 121,986 UK Biobank adults aged 40–70 (HR 0.72 [64]), but the large cocoa-extract trial was null [65]. Specific "brain foods" — berries, leafy greens, nuts, olive oil, eggs — rest on single cohorts or small or null trials (none of five walnut RCTs improved overall cognition [66]) — LIMITED-EMERGING. Overall diet quality in midlife Whitehall II civil servants was not significantly associated with dementia over 25 years (HR 0.97, 0.97 and a borderline 0.87 across waves [67]) — LIMITED-EMERGING (mixed). Sugar-sweetened beverages are mixed (LIMITED-EMERGING).

Nutrient *deficiency*, not optimisation, is what matters for

working-age performance. In mostly menstruating adults (mean age 34.6), iron given to people who were iron-deficient but not anaemic improved short-term memory (d 0.53) and fatigue (d 0.34), with no effect in iron-replete participants [68]; in women aged 18–35, rising ferritin tracked a 5–7-fold improvement in cognitive performance [69]; but intravenous iron in iron-deficient blood donors did not change overall cognition [70] — LIMITED-EMERGING, approaching MODERATE for correcting deficiency (PERFORMANCE, M-SHORT). B-vitamin supplementation lowered homocysteine by 26–28% without cognitive benefit in 22,000 people [71], helping only older adults with MCI and raised homocysteine [72] — LIMITED for B12/folate deficiency, NULL for supplementing replete adults. Vitamin D deficiency (<25 nmol/L) was associated with HR 1.79 for dementia, with Mendelian-randomisation support for a threshold effect of deficiency [73], but genetically higher vitamin D did not improve cognitive scores [74] — LIMITED-EMERGING to MODERATE for vitamin D deficiency and dementia, NULL for supplementing replete adults.

3.1.5 Waist, not weight, is the body-composition signal

Midlife obesity (BMI $\geq$30) is associated with later dementia (RR 1.33 across 589,649 people; overweight 25–29.9 not significant at RR 1.07 [75]), with risk rising above a BMI of about 29–30 [76] and HR 1.93 for obesity at age 50 in Whitehall II civil servants, whose BMI began to fall about 8 years before diagnosis [77]. In 1.3 million people, each 5 kg/m^2 looked protective when BMI was measured within 10 years of diagnosis (HR 0.71) but harmful when measured more than 20 years before (HR 1.16) — the late-life "obesity paradox" is reverse causation [78]. Mendelian randomisation supports a causal effect on vascular dementia (OR 1.63 per SD of BMI, partly through blood pressure [79]) but only a tiny or null one on Alzheimer's disease (OR 1.03 [80]) — MODERATE association (M-LONG); the Lancet Commission weights obesity at about 1% of dementia. Central fat is the sharper signal: midlife sagittal abdominal diameter predicted dementia 36 years later even after adjusting for BMI (top vs bottom quintile HR 1.92 [81]), although pooled waist circumference was weaker (HR 1.10) and not significant under 65 [82] — LIMITED-EMERGING to MODERATE. Obesity combined with a high waist-to-hip ratio went with the lowest grey-matter volume in 9,652 UK Biobank adults aged about 55 [83], but a life-course Mendelian randomisation attributes much of that signal to *childhood* adiposity [84]. For day-to-day performance, the largest Mendelian randomisation (378,877 people) found no causal effect of adiposity on reaction time or memory [85], while others report small causal effects of central or visceral fat — about -0.07 SD of cognition per SD of waist-to-hip ratio [86] and β -0.14 for visceral fat in 8,769 Singaporeans with mean age 51 [87] — LIMITED-EMERGING with conflicting MR. WHO's 2026 guideline notes that waist-to-hip ratio is "a more reliable metric than BMI" [88].

Intentional weight loss gives small short-term gains and no proven long-term protection. Across 20 studies (1,019 adults, mean age 50), RCTs of diet or activity improved memory by SMD 0.35, with publication bias [89]; WHO 2026 added a conditional recommendation that dietary restriction "may be offered" to adults with overweight or obesity (low-to-moderate certainty) — MODERATE for a small memory effect in adults with overweight or obesity, near-null in healthy non-obese working-age adults (CALERIE). The longest trial, Look AHEAD (3,802 adults with type 2 diabetes aged 45–76, about 10 years), produced no difference in mild cognitive impairment (6.4% vs 6.6%) or dementia (1.8% vs 1.8%), with a small relative cognitive deficit in participants with obesity [90,91] — NULL-CONTRADICTED for long-term protection from weight loss per se. Newer analyses point to visceral-fat loss and glycaemic control rather than kilograms: visceral-fat loss in four lifestyle trials predicted larger brain volumes 5–16 years later independent of weight loss [92] (LIMITED-EMERGING). High weight variability was associated with higher dementia risk (HR 1.40 across 16 cohorts [93]), including OR 1.74 for the most variable quartile among Israeli working men aged 40–70 [94] — MODERATE association, LIMITED causal. Crash dieting has a short-term price: in the first week of unsupported dieting, overweight women showed poorer vigilance and planning with a cortisol rise, which group-supported dieters did not [95] (LIMITED-EMERGING).

3.1.6 Verdict on detailed meal logging

The verdict on meal logging follows directly. None of the elements a meal log captures — food items, macros, glycaemic index, breakfast compliance, fasting windows or glucose spikes — has evidence of a meaningful acute cognitive effect in healthy adults, and the elements that do matter can be assessed more simply: hydration and thirst, with urine colour as a coarse flag; meal *size* before monotonous or high-stakes work and a snack rather than a large meal (or nothing) during late-night work; periodic screening of diet pattern, focused on the share of ultra-processed food, processed meat, fish and plant foods; clinical testing of ferritin or vitamin D where risk factors exist; and a waist or waist-to-hip measure rather than scale weight. This recommendation is an inference from the grades above; no study has compared meal logging with these alternatives.

3.2 Willpower, stress and emotion claims

Claim: willpower is a limited daily budget that decisions use up. The ego-depletion model, which holds that exerting self-control draws down a limited resource, underpins advice to ration decisions across the day. Three preregistered multi-laboratory replications found effects close to zero (d 0.04, 0.06 and 0.10) [9,10,96], and the idea that glucose refuels willpower has weak evidential value [8]. Verdict: NULL-CONTRADICTED. Field data on decision quality drifting across long work sessions are mixed and do not depend on this mechanism (see the companion review on work habits).

Claim: a moderate amount of stress optimises performance. This idea, usually attributed to the Yerkes–Dodson law, has no direct empirical support at work. The original 1908 work concerned habit formation in mice and was later recast as a general performance law without new evidence [97,98]. In a meta-analysis of experiments, induced stress lowered creativity overall (d -0.20), time pressure was the most harmful stressor for adults, and the apparent gain from mild evaluative threat was not significant [99]. Verdict: unsupported — not formally null, because no well-powered test exists, but not a sound basis for advice. A related tactic, reappraising arousal as helpful, produced a small performance gain

that shrank to d 0.14 after correction for publication bias [100] (LIMITED-EMERGING to MODERATE).

Claim: writing about worries just before a high-stakes task frees working memory. The original finding (d 2.48) failed a high-powered preregistered replication (d 0.06) [101] and was not supported by a 21-study meta-analysis [102]. Verdict: NULL-CONTRADICTED for the pre-task effect. Expressive writing over several sessions reduces distress only slightly (g −0.12) [103].

3.3 Work-rhythm formulas and productivity statistics

Claim: working in fixed Pomodoro (25/5) or 90-minute "ultradian" cycles boosts productivity. Three small experiments in students comparing Pomodoro-style breaks with other schedules found no performance differences and mixed effects on mood [104–106]. No peer-reviewed study shows that working in 90-minute blocks improves performance; the idea traces to a hypothesis paper [107]. Verdict: LIMITED (mixed) for Pomodoro and no peer-reviewed support for 90-minute cycles. Breaks themselves raise vigour and reduce fatigue [108]; the problem is the fixed formula, not the break.

Claim: multitasking costs 40% of productivity, and refocusing after an interruption takes 23 minutes. Task-switching costs are real and robust in the laboratory [109], but these two specific figures were not found in the abstracts or summaries of the peer-reviewed sources to which they are usually attributed [110–112]. Verdict: unverified. The underlying studies, not the numbers, should be cited.

Claim: a phone merely lying on the desk drains cognitive capacity. The "brain drain" effect failed direct and conceptual replications [113] and survives in meta-analysis only as a small effect on working memory (memory g −0.23) [114,115]. Verdict: small working-memory effect only. Notifications are the better-supported problem: a notification disrupted an attention task even when it was ignored [116].

Claim: typing notes on a laptop harms learning compared with handwriting. The influential laptop finding did not survive direct replication, leaving at most a small longhand advantage (g 0.25) [117,118]. Verdict: LIMITED (mixed). How material is reviewed matters far more: retrieval practice with feedback outperforms restudying (g 0.50) [119].

3.4 Sound for focus

Claim: listening to Mozart makes you smarter. Spatial-task gains after listening to music disappeared once arousal and mood were controlled [120], and a 2023 multiverse meta-analysis attributed the effect to low statistical power and publication bias [121]. Verdict: NULL-CONTRADICTED (provisional).

Claim: binaural beats improve focus. Pooled effects of g 0.40–0.45 come from small, heterogeneous studies [122,123], whereas a careful multi-experiment study found rather strong evidence against an effect on sustained attention [124], and EEG entrainment has been inconsistent [125]. Verdict: LIMITED, contested, trending null for vigilance.

Claim: music with added amplitude modulation improves focus. The main peer-reviewed evidence is a multi-experiment study comparing music with fast amplitude modulation, music with slower modulation and pink noise during a sustained-attention task [126]. The behavioural benefit of strongly modulated music appeared only when it was heard early in the testing session (n = 83); faster modulation was associated with greater activity in attentional networks on fMRI (n = 34) and stronger stimulus–brain coupling on EEG (n = 40); and in two online experiments (n = 175), beta-range modulation helped more than other rates in participants with more ADHD symptoms. The music was produced by a commercial focus-music company that employed the lead author, a competing interest disclosed in a later correction [127]. Verdict: LIMITED-EMERGING — a plausible mechanism and an early, order-dependent behavioural signal from one research group, without independent replication or tests in working adults during real work.

The better-supported advice is subtractive. Background speech and lyrics impair reading and verbal memory, with lyrical music about as disruptive as speech and instrumental music less so [128,129] (STRONG). Self-chosen music may reduce mind-wandering during low-demand, routine tasks [130] (LIMITED-EMERGING).

3.5 Brain training and "cognitive exercise"

Claim: brain-training games make you sharper at work.

Commercial brain training fails the transfer test. People reliably improve at the trained games (near transfer, STRONG), but a second-order meta-analysis found far transfer equal to zero once placebo effects and publication bias were controlled [131], working-memory training did not improve intelligence or other far-transfer measures [132], 11,430 adults training online for six weeks showed no transfer even to closely related untrained tasks [133], and ten weeks of Lumosity in 128 young adults changed neither decision-making nor cognitive performance beyond retest effects [134]. A Cochrane review found only one eligible midlife trial and could not determine efficacy [135]; in the ACTIVE trial of adults averaging 74, speed-of-processing training was not associated with lower 20-year dementia risk as randomised (HR 0.87, 0.72–1.05) [136]. Older-adult meta-analyses report small far-transfer gains (g 0.22 [137]), so the field is contested rather than uniformly null, but no study has measured work performance. Grade: far transfer NULL-CONTRADICTED after bias control; action video games LIMITED and contested [138,139]; bilingualism shows no executive-function advantage after bias correction [140] and delays dementia onset by about 3–5 years without lowering risk [141].

3.6 Sleep technology and circadian claims

Claim: wearable REM and deep-sleep percentages show how well the brain is being protected. In a pooled analysis of five cohorts (4,657 adults), single-night REM and slow-wave sleep percentages were not associated with dementia [142]; a decline in slow-wave sleep over time predicted dementia in one cohort [143]. Verdict: NULL-CONTRADICTED for stage percentages as brain-health scores. Objectively measured fragmentation and sleep regularity carry a stronger long-term signal (see the companion review on sleep, stress and recovery).

Claim: sleep "flushes toxins" from the brain. One night of sleep deprivation raised hippocampal β-amyloid in 20 adults [144] and cerebrospinal-fluid tau by more than 50% [145], but the "glymphatic" clearance model is contested in animal work [146]. Verdict: LIMITED-EMERGING; it should not be marketed as settled science.

Claim: night-mode screens and blue-light glasses protect sleep. iPhone Night Shift made no difference to sleep in a randomised trial [147], and a Cochrane review rated the evidence for blue-light-filtering lenses as very low certainty [148]. Verdict: NULL-CONTRADICTED / very low certainty. Bright light-emitting e-readers in the evening do suppress melatonin and delay the circadian clock [149], so reducing evening light exposure is more defensible than relying on spectral filters.

Claim: "night owls" are cognitively inferior, and everyone should schedule hard work at their chronotype peak. MR found no causal effect of chronotype on cognitive ability [150]; a systematic review found a synchrony advantage in only 45% of studies of 18–45-year-olds [151]; and a study of 48,881 internet users found no synchrony advantage [152]. Verdict: inferiority NULL-CONTRADICTED; synchrony scheduling LIMITED-EMERGING.

Claim: how well you feel you slept tells you how well you will think. In 235 students, self-rated sleep quality largely failed to predict objective cognition [153], and during chronic sleep restriction felt sleepiness levelled off even as measured deficits kept rising [154]. Verdict: self-rating is an unreliable gauge (LIMITED-EMERGING, largely null).

3.7 Heat, cold, gum and active desks

Claims: saunas, cold plunges and chewing gum sharpen the mind.

Frequent sauna bathing was associated with lower dementia risk in two Finnish cohorts recruited in midlife — HR 0.34 for four to seven sessions a week versus one in 2,315 men aged 42–60 [155] and HR 0.81 for 9–12 sessions a month in 13,994 adults, with a non-monotonic dose-response and the strongest association early in follow-up, a pattern consistent with reverse causation [156] — LIMITED-EMERGING (M-LONG), with no replication outside Finland and no trial. For performance there is no evidence of benefit, and two randomised experiments found a 7-minute 50 °C far-infrared sauna the day after learning *impaired* recognition memory in students [157] (LIMITED-EMERGING). Cold exposure has no adequately powered evidence of cognitive enhancement; prolonged or severe cold impairs attention and executive function *during* exposure (15 of 18 experiments [158]; MODERATE harm for prolonged exposure), harm from brief dips is not established, and a 2026 meta-analysis of 13 studies concluded the evidence "does not establish" that cold-water exposure improves mood, stress or well-being [159]. The one large trial in employed adults found 30–90-second cold showers reduced self-reported sickness absence by 29%, without changing illness days or work engagement and without blinding [160] — a work-attendance proxy, not a cognitive outcome. Chewing gum's self-rated alertness effect is inconsistent and expectancy-sensitive, its sustained-attention effect small ($d \approx 0.15$, industry-affiliated meta-analysis [161]) and null in the best-controlled recent trial [162], and memory benefits repeatedly failed to replicate [163] — LIMITED for alertness and attention, NULL-CONTRADICTED for memory. None of the three qualifies as a cognitive-enhancement tool.

Claim: treadmill or cycling desks let you exercise and do focused work at the same time. Active workstations slowed typing (MES −0.55) and mouse work (−1.10) [164], with treadmill desks worst for typing [165]. Verdict: MODERATE evidence of harm for fine-motor computer work. A moderate bout of exercise *before* demanding work is the better-supported tactic [166].

Claim: high-intensity interval training sharpens thinking more than moderate exercise. High-intensity exercise added nothing over moderate exercise (d 0.07) [167]. Verdict: MODERATE evidence of no added benefit.

3.8 Big-number and combined-lifestyle claims

Claim: 45% of dementia is preventable through lifestyle. The Lancet Commission's figure is a theoretical upper bound across 14 risk factors, most of them medical or environmental, and it explicitly assumes causality. The behavioural factors within the scope of this review — physical inactivity (about 2%), depression (about 3%), obesity (about 1%) and social isolation (about 5%), as read from the Commission's rounded figures — total roughly 11% [53]. Verdict: commonly misquoted; the lifestyle share is much smaller and rests on a causal assumption.

Claim: combining healthy habits prevents cognitive decline.

Combining behaviours matters more than optimising any one. A dose-response meta-analysis of 25 cohorts found each additional healthy behaviour associated with 11% lower dementia risk (HR 0.89), and the healthiest versus least healthy group with HR 0.61, with a linear dose-response and no threshold [168]; in 29,072 Chinese adults over 60, four to six healthy factors (diet, exercise, social contact and cognitive activity each at least twice a week, plus non-smoking and no alcohol) slowed memory decline by 0.028 SD a year versus zero or one [169]; and in UK Biobank a favourable lifestyle was associated with lower dementia risk even at high genetic risk (HR 0.68; 1.13% versus 1.78% over eight years), with no lifestyle × genetics interaction [170]. The midlife evidence is directly relevant: in Whitehall II civil servants, each point of a cardiovascular-health score at age 50 was associated with lower dementia risk over 25 years (HR 0.89; behavioural subscale 0.87) [171], and three to four unhealthy behaviours from age 44 roughly doubled the odds of poor executive function in late midlife, with both number and duration mattering (OR 1.84–2.76) [172] — MODERATE association (M-LONG), tempered by the null lagged single-behaviour analyses discussed above.

Trials of structured multi-behaviour programmes in at-risk adults over 55–60 show real but small cognitive benefits: FINGER +0.022 SD a year [173], structured versus self-guided US POINTER +0.029 SD a year [174], LatAm-FINGERS +0.11 SD a year [175], and the trial closest to a digital-coaching model — personalised online coaching in 6,104 Australians aged 55–77 — +0.18 SD over three years [176]. Several trials were null (preDIVA, MAPT, J-MINT, AgeWell.de, and the remote low-intensity APPLE-Tree), and the Cochrane review found a small composite-cognition benefit (MD 0.03, high certainty) with no reduction in dementia incidence (RR 0.94, 0.76–1.18, high certainty), while noting that the benefit was strongest where cognitive training was included, so a learning effect cannot be excluded [177]. More domains are not automatically better: in a network meta-analysis of 109 RCTs, exercise plus cognitive training ranked highest (SMD 0.26) and a four-domain package lower (0.14) [178]. Structure and accountability beat self-guided advice (POINTER,

LatAm-FINGERS) — MODERATE. In working-age adults the evidence is effectively absent: none of seven midlife primary-care trials (mean ages 45–65) changed cognition [179], a Swedish office-worker programme failed to change measured behaviour and therefore cognition [180], and a coach-supported dementia-prevention app lowered risk scores modestly but kept only half its users active and did not measure cognition [181]. Grades: multidomain → composite cognition MODERATE (small, older at-risk adults); → dementia incidence NULL so far; → working-age performance or productivity untested.

Claim: lifestyle programmes reverse brain ageing. In the most relevant working-age trial, 12 months of 150 minutes a week of exercise in 130 adults aged 26–58 reduced MRI-predicted brain age by 0.95 years compared with usual care [182]. By contrast, eight weeks of mindfulness-based stress reduction produced no structural brain change in 218 adults [183], and 18 months of meditation did not change regional brain volume in adults aged 65 or over [184]. Verdict: LIMITED-EMERGING for small shifts in predicted brain age with exercise; claims of "reversal" are not supported.

3.9 Summary of claims

Figure 1 shows the verdict category for each claim, and Table 1 gives the grade, key evidence and a better-supported alternative.

4. Discussion

4.1 Principal findings

Across nutrition, work rhythms, audio, brain training, sleep technology and physical "biohacks", the claims most heavily promoted as ways to add cognitive capacity have the weakest or null evidence. Breakfast, fasting windows, glycaemic index, sugar and glucose spikes do not meaningfully move adult cognition; brain-training games do not transfer to untrained abilities; willpower is not a measurable daily budget; the Mozart effect and pre-task expressive writing failed replication; and saunas, cold plunges and gum do not qualify as cognitive tools.

What survives is mostly subtractive or concerns deficiency and overall pattern: avoiding dehydration, avoiding heavy meals before monotonous or late-night work, correcting iron or vitamin D deficiency where present, keeping ultra-processed food and processed meat low, watching waist size rather than scale weight, and keeping speech and lyrics away from verbal work. Over the long term, combined healthy behaviours are associated with lower dementia risk in cohorts, but trials of structured programmes move composite cognition only slightly and have not reduced dementia incidence.

4.2 Why weak claims persist

Several patterns explain why these claims spread. First, many rest on a plausible mechanism, such as glucose as brain fuel or music as arousal, that makes them intuitively convincing. Second, early studies were often small and reported large effects that shrank on replication: the pre-task writing effect fell from d 2.48 to 0.06, and ego depletion from a widely cited phenomenon to near zero. Third, much of the original evidence comes from students tested in laboratories over minutes rather than from working adults over weeks. Fourth, felt effects diverge from measured ones: in a 10-day trial, people felt less able to concentrate on fasted mornings but performed the same [2], and gum's alertness effect is sensitive to expectations. Finally, associations from older cohorts — for sauna use, body weight or social activity — are easily read as causal, even when lag analyses point to reverse causation. Figure 2 illustrates both sides of the pattern: in nutrition, the heavily marketed claims sit near zero while hydration, deficiency and short-term diet quality show clearer effects (panel A), and across several literatures, effects shrink once replications or bias corrections are applied (panel B).

4.3 Implications for consumers, employers and product designers

These suggestions are inferences from the grades above rather than tested recommendations.

- Do not offer detailed meal, macro, glycaemic-index, breakfast or fasting-window logging, or glucose-spike scores, as cognitive features for healthy adults.
- Do not present brain-training games, action video games or language learning as tools for executive function or work performance.
- Do not present single-night REM or deep-sleep percentages as brain-health scores, or recommend night-mode filters and blue-light glasses for sleep.
- Avoid "willpower budget", "sugar for energy", "optimal stress", fixed Pomodoro or 90-minute rules, Mozart and binaural-beat claims, and present amplitude-modulated focus music as an early-stage approach that still needs independent replication.
- Treat saunas, cold plunges and chewing gum as outside the cognitive domain, and do not recommend treadmill desks for focused computer work.
- Cite the underlying studies rather than viral statistics, and describe long-term lifestyle benefits as associations, not as dementia prevention or brain-age reversal.

4.4 Limitations

This review has several limitations. First, the selection of claims was not systematic, and other popular claims may have been missed. Second, it is a narrative rather than a systematic review, with no formal risk-of-bias assessment of individual studies. Third, the four-level grading scale is study-specific and not equivalent to formal GRADE certainty ratings, and grades are provisional: a NULL-CONTRADICTED verdict can change with new, well-powered evidence. Fourth, "unsupported" and "no direct evidence" mean that a claim has not been adequately tested, not that it has been disproven. Fifth, the evidence on amplitude-modulated music comes from one research programme, and the grade given here should be read in light of the author's competing interest (see Competing interests). Only English-language publications were included. Finally, the author is a founder of a company that develops products for working professionals, some in categories discussed here (see Competing interests).

4.5 Future research

Priorities include: preregistered, adequately powered tests of popular claims in working adults rather than students; head-to-head comparisons of detailed meal logging with simpler hydration and meal-size checks; independent, preregistered replications of amplitude-modulated music in working adults during real work; independent trials of commercial audio and

	Failed tests or replications	Tested: no meaningful effect	Weak, untested or misquoted	Harm or impairment
Food and glucose				
Skipping breakfast / short fasts dull thinking		●		
Low-GI meals sharpen focus			●	
Sugar gives an energy boost	●			
Glucose spikes impair cognition (non-diabetic)			●	
Intermittent fasting / keto sharpen the mind		●		
MIND diet prevents decline	●			
Specific "brain foods"			●	
Weight loss protects the brain long term	●			
Detailed meal logging helps cognition			●	
Willpower and stress				
Willpower is a daily budget	●			
Moderate stress optimises performance			●	
Pre-task expressive writing	●			
Work rhythms and statistics				
Pomodoro / 90-minute cycles			●	
"40% productivity loss", "23 minutes"			●	
A phone on the desk drains the brain			●	
Laptops harm learning			●	
Sound for focus				
Mozart effect	●			
Binaural beats improve focus			●	
Amplitude-modulated music improves focus			●	
Brain training				
Brain games transfer to work	●			
Sleep technology				
REM% / deep-sleep % as brain-health scores	●			
Sleep "flushes toxins"			●	
Night mode / blue-light glasses protect sleep	●			
Night owls are cognitively inferior	●			
Felt sleep quality predicts thinking			●	
Heat, cold and gear				
Sauna sharpens the mind			●	●
Cold plunges sharpen the mind			●	●
Chewing gum sharpens the mind	●		●	
Treadmill desks for focused work				●
HIIT beats moderate exercise		●		
Big-number claims				
45% of dementia preventable by lifestyle			●	
Multidomain programmes prevent dementia	●			
Lifestyle programmes reverse brain ageing			●	

Two dots = mixed verdict (e.g., gum: alertness weak, memory null; sauna and cold: no benefit shown, some impairment).

Fig. 1. Verdicts for 33 popular cognitive-enhancement claims, grouped by domain. Each dot marks a verdict category; two dots indicate a mixed verdict (for example, chewing gum has weak evidence for alertness and null evidence for memory). Detailed grades and sources are given in Table 1, the text and Supplementary Tables S1 and S2.

Table 1. Popular cognitive-enhancement claims, verdicts and better-supported alternatives. Full inventories with sources are given in Supplementary Tables S1 and S2.

Claim	Verdict	Key evidence	Better-supported alternative
Skipping breakfast or short fasting dulls thinking	MODERATE evidence of no meaningful effect (adults up to ~40)	Pooled g 0.02 across 71 studies	—
Low-glycaemic meals sharpen focus	LIMITED (borderline)	SMD 0.16 only after 120 min; blinded RCT null	Avoid heavy meals before monotonous or late-night work
Sugar gives an energy boost	NULL-CONTRADICTED	No mood benefit; more fatigue within 1 h	Check hydration
Glucose "spikes" impair cognition in non-diabetic adults	No direct evidence	Peaks unrelated to decline without diabetes	—
Intermittent fasting or keto sharpens the mind	LIMITED (no harm, no gain)	Null over 10 days to 4 weeks	—
The MIND diet prevents decline	NULL-CONTRADICTED (as an intervention)	3-year RCT: 0.035 SD, P = 0.23	Overall pattern: less ultra-processed food and processed meat (MODERATE association)
Specific "brain foods"	LIMITED-EMERGING	0 of 5 walnut RCTs improved overall cognition	Correct iron or vitamin D deficiency where present
Weight loss protects the brain long term	NULL-CONTRADICTED	MCI 6.4% vs 6.6% over ~10 years	Track waist or waist-to-hip ratio
Detailed meal logging helps cognition	Not supported (inference)	No logged element has a meaningful acute effect	Hydration, meal size, periodic diet-pattern screen
Willpower is a daily budget	NULL-CONTRADICTED	d 0.04–0.10 in multi-lab replications	If-then plans (STRONG for goal attainment)
Moderate stress optimises performance	Unsupported	Induced stress lowers creativity, d −0.20	Stress reappraisal (small, d 0.14)
Pre-task expressive writing frees working memory	NULL-CONTRADICTED	d 0.06 vs original 2.48	—
Pomodoro or 90-minute cycles	LIMITED (mixed) / no peer-reviewed support	No performance difference in small trials	Breaks for energy and fatigue
"40% productivity loss", "23 minutes to refocus"	Unverified	Not found in the cited sources	Cite the switch-cost studies
A phone on the desk drains the brain	Small working-memory effect only	Memory g −0.23; replications failed	Batch notifications
Laptops harm learning	LIMITED (mixed)	Longhand advantage g 0.25 at most	Retrieval practice with feedback
The Mozart effect	NULL-CONTRADICTED (provisional)	Disappears when arousal and mood are controlled	Silence or instrumental audio for verbal work
Binaural beats improve focus	LIMITED, contested	g 0.40–0.45 in small studies vs strong null evidence	—
Amplitude-modulated music improves focus	LIMITED-EMERGING	Early-session benefit in one industry-linked multi-experiment study; no independent replication	Silence or instrumental audio for verbal work
Brain-training games transfer to work	Far transfer NULL-CONTRADICTED	Far transfer = 0 after bias and placebo control	Learning complex new skills; retrieval practice
REM% or deep-sleep % as brain-health scores	NULL-CONTRADICTED	No association with dementia in 5 cohorts	Sleep regularity and objective fragmentation
Night mode and blue-light glasses protect sleep	NULL-CONTRADICTED / very low certainty	No difference in sleep	Less bright evening light
Night owls are cognitively inferior	NULL-CONTRADICTED	MR: no causal effect of chronotype	—
Sauna sharpens the mind	LIMITED-EMERGING (M-LONG, Finland only); possible harm to memory consolidation	HR 0.34–0.81 in two Finnish cohorts	—
Cold plunges sharpen the mind	Enhancement LIMITED; prolonged cold impairs cognition (MODERATE)	Mood benefit not established	—
Chewing gum sharpens the mind	LIMITED (alertness); NULL-CONTRADICTED (memory)	d ≈ 0.15; best-controlled RCT null	—
Treadmill desks for focused work	MODERATE (harm)	Typing MES −0.55; mouse −1.10	Move before demanding work
HIIT beats moderate exercise for cognition	MODERATE (no added benefit)	d 0.07	Moderate bout of ~20 min or more
45% of dementia is preventable through lifestyle	Commonly misquoted	In-scope lifestyle factors total ~11%; causality assumed	—
Multidomain programmes prevent dementia	NULL in trials so far	RR 0.94 (0.76–1.18)	Small composite cognitive gains (MODERATE)

brain-training products with active controls; and lagged or MR analyses for long-term claims such as sauna use.

5. Conclusion

Most of the cognitive-enhancement tactics that working adults are sold — specific foods and meal timings, glucose tracking, brain games, special soundtracks, rigid work rhythms, sleep-stage scores, heat and cold — have weak, null or untested evidence for improving thinking. The better-supported levers are less marketable: stay hydrated, avoid heavy meals before monotonous work, correct real deficiencies, keep overall diet pattern and waist size in check, and protect sleep and attention. Being clear about what does not work is as useful to working adults as promoting what does.

Declarations

CRediT authorship contribution statement

Vishwanath Kannan: conceptualisation, investigation, evidence grading, visualisation, writing – original draft, and writing – review and editing.

Declaration of competing interest

The author is a founder of Adarna Inc., which develops wearable and software products for working professionals, including a focus feature based on amplitude-modulated music — one of the claims graded in this review (Section 3.4). Other claims reviewed here also concern product categories in which the company operates. No product of the company is evaluated in this review.

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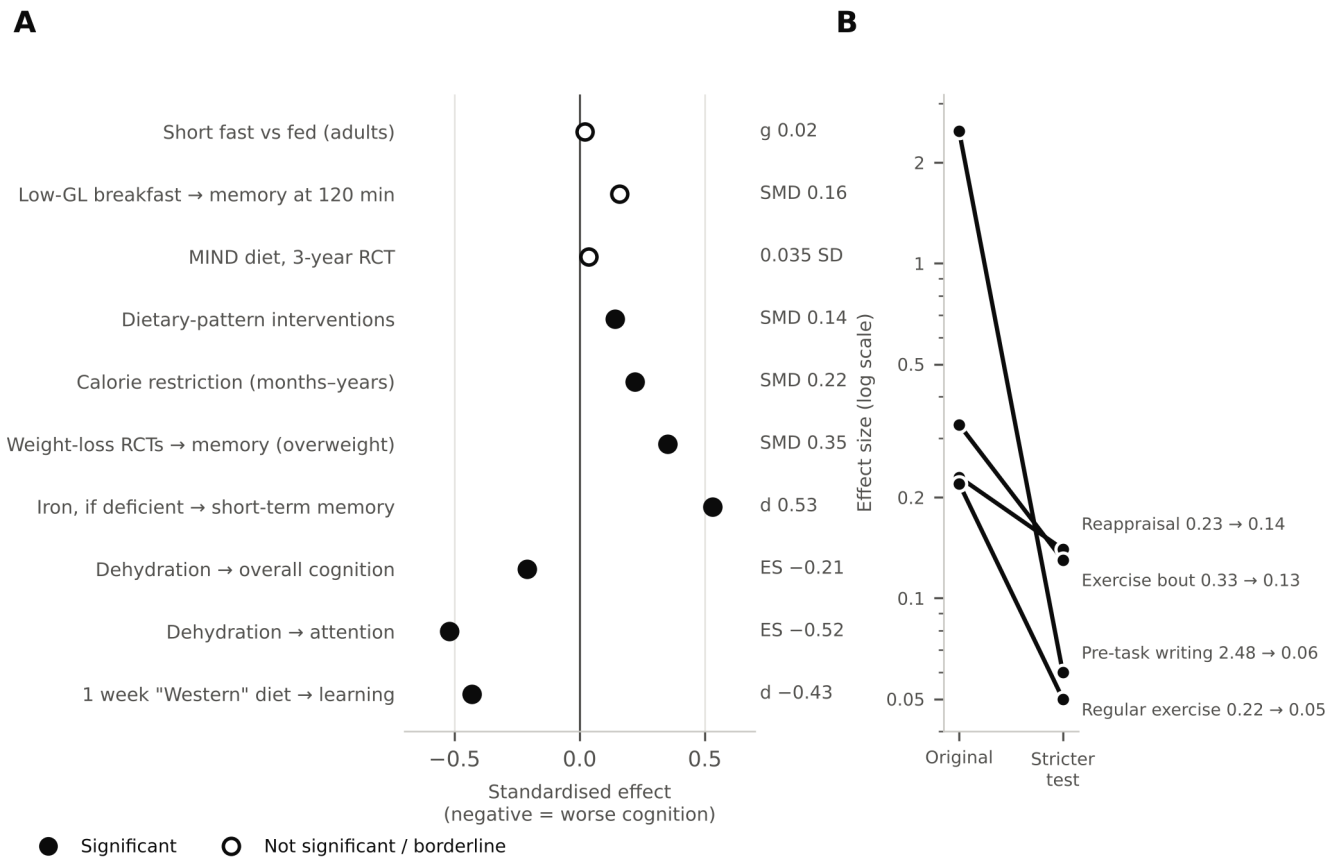


Fig. 2. (A) Reported effect sizes for nutrition claims and better-supported levers; negative values indicate worse cognition. Filled circles are statistically significant; open circles are not significant or borderline. Sources: [1,5,17,29,31,51,52,68,89]. (B) Original or uncorrected estimates compared with replication or bias-corrected estimates, on a logarithmic scale: pre-task expressive writing [101], stress reappraisal [100], a single exercise bout (uncorrected meta-review estimate vs bias-corrected meta-analysis) [166,185], and regular exercise in healthy adults [186]. Estimates come from different analyses and are not directly comparable.

Data availability

No new data were generated. All data discussed are available in the cited publications.

Declaration of generative AI and AI-assisted technologies in the writing process

Generative AI tools, including Claude (Anthropic), were used in part to assist with identifying and summarising literature, structuring the manuscript, preparing figures and editing language. The author reviewed all AI-assisted content, checked every claim, figure and reference against the primary sources, and takes full responsibility for the content of this article. AI tools are not listed as authors.

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Supplementary material

Table S1. Nutrition and body-composition component inventory

Component	Horizon	Grade	Key effect, dose or threshold	Population	Key sources
Breakfast skipping / overnight fasting	PERF	MODERATE evidence of no meaningful effect	Pooled g 0.02 (adults-only −0.01); modest deficits in younger participants and longer fasts; feels less focused, performs the same	Adults $\leq$ ~40	[1,2]
Glycaemic index / load of meals	PERF	LIMITED (borderline)	SMD 0.16 only after 120 min; blinded RCT null	Adults 20–80	[5,6]
Sugar for mood or energy	PERF	NULL-CONTRADICTED	No mood benefit; more fatigue within 1 h	1,259 participants	[7]
Glucose as willpower fuel / ego depletion	PERF	NULL-CONTRADICTED	d 0.04–0.06 in multi-lab replications	Adults	[8,9]
CGM glucose variability (non-diabetic)	PERF, M-LONG	No direct evidence	Peaks unrelated to decline without diabetes	ARIC ~13,000	[13]
Intermittent fasting / time-restricted eating	PERF, M-SHORT	LIMITED (no harm, no gain)	Null over 10 days–4 weeks	Adults	[15,16]
Calorie restriction (months–years)	M-SHORT, M-LONG	LIMITED to MODERATE (small)	SMD 0.22; CALERIE working memory null	Mixed; non-obese ~38 y	[17,18]
Large meal before monotonous or critical work	PERF	LIMITED-EMERGING (consistent)	+40% lunch → more errors; 922 vs 305 kcal → more lapses after short sleep	Women; young men	[23,24]
Night-time eating: snack vs meal vs nothing	PERF	LIMITED-EMERGING	~10% energy snack beat 30% meal and fasting at 04:00	39 non-shift workers	[26]
Days of "Western" high-fat/high-sugar eating	PERF, M-SHORT	LIMITED-EMERGING	Hippocampal learning d 0.43 after 1 week; reversible	Lean young adults	[29]
Dehydration (body-mass loss)	PERF	MODERATE (contested <2%)	ES −0.21; attention −0.52; >2% loss −0.28	Mostly young adults	[31,32]
Mild fluid deficit → mood, fatigue, attention	PERF	MODERATE	0.7–1.6% loss; 200–500 mL restores	Young adults (incl. independent RCTs)	[35,37]
Thirst prompt; urine-colour flag	PERF	LIMITED (task-specific); colour = coarse flag only	25 mL helps attention regardless of thirst	Adults	[39,41]
Water-volume logging	M-LONG	Not supported	Intake unrelated to decline; osmolarity related	55–75 with metabolic syndrome	[42]
Mediterranean-style pattern	M-LONG	MODERATE (borderline) association; LIMITED causal	Cohorts RR ~0.79–0.89; newest HR 0.85 n.s.; RCT cognition mostly null	Mostly older; DIRECT PLUS 51 y	[44,49]
MIND diet as an intervention	M-LONG	NULL-CONTRADICTED	3-y RCT: 0.035 SD, P = 0.23	$\geq$65	[51]
Healthy dietary-pattern interventions (pooled)	PERF, M-LONG	MODERATE (small)	SMD 0.14	12,119 healthy adults	[52]
Ultra-processed food share	M-LONG	MODERATE (observational)	+28% faster decline; HR 1.25 per +10% by weight	Public servants 35–74; UK Biobank	[55,56]
Processed meat	M-LONG	MODERATE (observational)	HR 1.13 ($\geq$0.25 serving/day); HR 1.44 per 25 g/day	Baseline 48.9 y; UK Biobank	[60,61]
Fish intake	M-LONG	MODERATE (observational); supplements null	Dementia RR 0.82	35 studies	[62]
Flavonoid-rich foods	M-LONG	MODERATE (observational); extract RCTs null	HR 0.72	UK Biobank 40–70	[64]
Single "brain foods" (berries, nuts, greens, olive oil, eggs)	M-LONG	LIMITED-EMERGING	Single cohorts; walnut RCTs 0/5	Mostly older	[66]
Midlife overall diet-quality score	M-LONG	LIMITED-EMERGING (mixed)	HR 0.97 (latest wave 0.87, borderline)	Civil servants, mean 50	[67]
Ketogenic / very-low-carb	PERF, M-SHORT	LIMITED-EMERGING (no benefit)	Equal cognition; less mood gain than low-fat	Small trials	[21,22]
Iron deficiency (correcting it)	PERF, M-SHORT	LIMITED-EMERGING → MODERATE	Short-term memory d 0.53, fatigue d 0.34 only if deficient	Menstruating adults ~35	[68]
B12/folate status	M-LONG	LIMITED (deficiency); NULL (supplementing replete)	Homocysteine −26–28% without cognitive benefit; helps only MCI with raised homocysteine	Older adults	[71,72]
Vitamin D status	M-LONG	LIMITED–MODERATE (deficiency → dementia); NULL (supplementing replete; cognitive performance)	<25 nmol/L HR 1.79	UK Biobank 37–73	[73,74]
Midlife obesity (BMI $\geq$30)	M-LONG	MODERATE (association); MR supports vascular dementia	RR 1.33; HR 1.93 at age 50; overweight n.s.	Civil servants; 589,649 adults	[75,77]
Central / visceral fat (waist, WHR)	M-LONG; PERF	LIMITED to MODERATE (M-LONG); LIMITED, conflicting MR (PERF)	SAD HR 1.92 after BMI; −0.07 SD per SD WHR	Midlife cohorts	[81,87]
Intentional lifestyle weight loss (short term)	PERF, M-SHORT	MODERATE (small, overweight/obese); near-null non-obese	Memory SMD 0.35	Mean age 50	[89]
Weight loss for long-term protection	M-LONG	NULL-CONTRADICTED	MCI 6.4% vs 6.6% over ~10 y	T2D 45–76	[90]
Weight cycling / variability	M-LONG	MODERATE association; LIMITED causal	HR 1.40; working men OR 1.74	Cohorts incl. men 40–70	[93,94]
Unsupported crash dieting	PERF	LIMITED-EMERGING (harm)	Week-1 vigilance and planning deficits	Overweight women	[95]

Table S2. Combined-lifestyle and "biohack" inventory

Component	Horizon	Grade	Key effect, dose or threshold	Population	Key sources
Number of healthy behaviours	M-LONG	MODERATE (association)	HR 0.89 per behaviour; 0.61 highest vs lowest; linear	Mostly $\geq$60; Whitehall II at 44–50	[168,172]
Structured multidomain programmes → cognition	M-LONG	MODERATE (small)	+0.02–0.11 SD/yr; online coaching +0.18 SD/3 y	At-risk adults 55–79	[176,177]
Multidomain programmes → dementia incidence	M-LONG	NULL in trials so far (2 trials, high certainty)	RR 0.94 (0.76–1.18)	Older adults	[177]
Structured, accountable vs self-guided coaching	M-LONG	MODERATE	+0.029 SD/yr (POINTER)	60–79	[174]
Combined programme → working-age performance/productivity	PERF, M-SHORT	Untested / NULL in midlife trials	0 of 7 midlife trials changed cognition	Mean age 45–65	[179]

(continued)

Component	Horizon	Grade	Key effect, dose or threshold	Population	Key sources
Exercise compensating for short sleep	M-LONG	LIMITED-EMERGING (no protection)	0.20 SD worse at 10 y (baseline age 50)	ELSA $\geq$50	[187]
Regular sauna	M-LONG; PERF	LIMITED-EMERGING (M-LONG); possible harm to consolidation (PERF)	HR 0.34–0.81 (Finland only)	Finnish men/adults 30–69	[155,157]
Cold water / cold showers	PERF; M-SHORT	Enhancement LIMITED; prolonged-cold harm MODERATE; mood not established	Sickness absence -29% (proxy)	Employed Dutch adults	[158,160]
Chewing gum	PERF	LIMITED (alertness, attention); NULL (memory)	d $\approx$ 0.15; best RCT null	Young adults	[161,162]