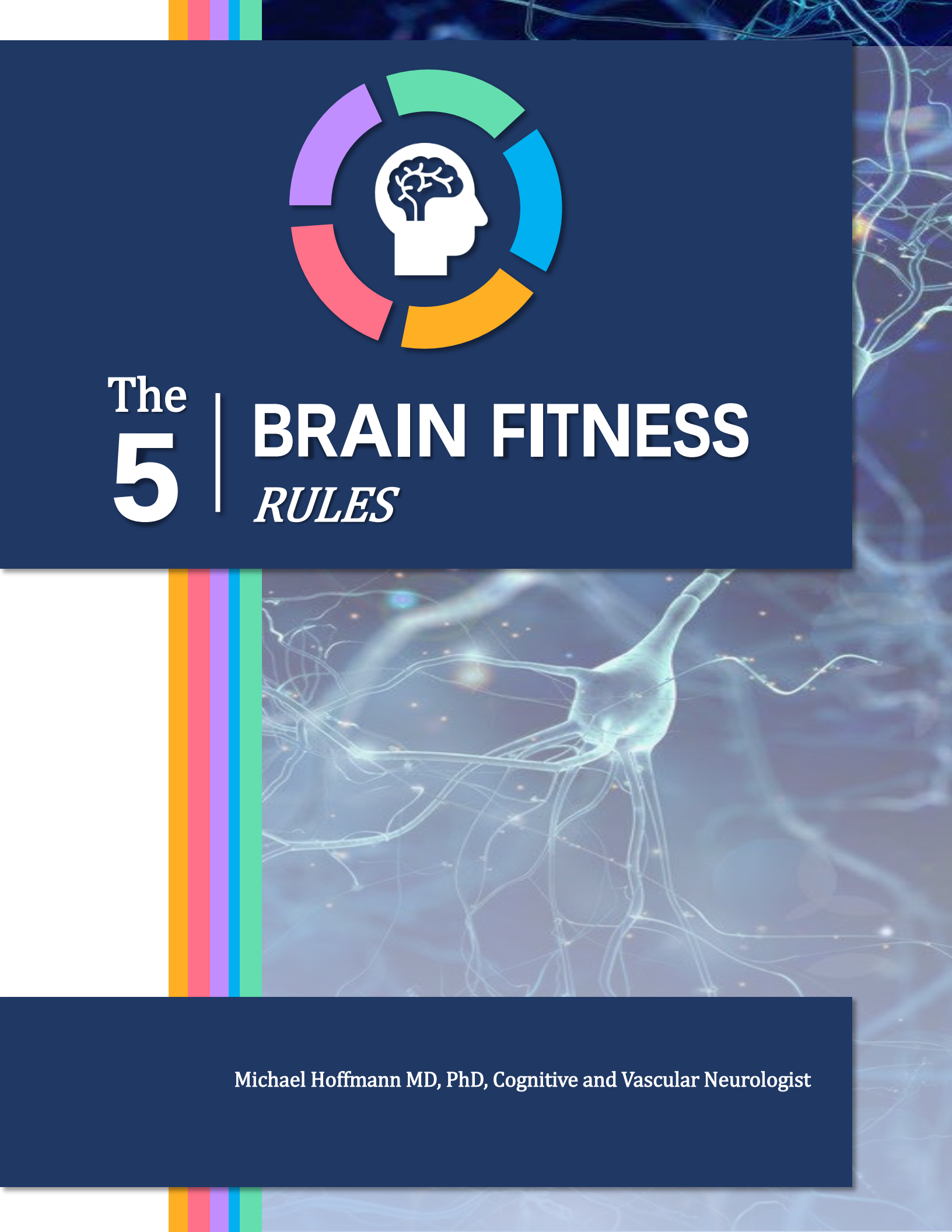


The 5 | BRAIN FITNESS *RULES*

Michael Hoffmann MD, PhD, Cognitive and Vascular Neurologist

Executive Summary

1

Sleep Health

Sleep nurses our body, brain, and emotional health

2

Brain Foods

You cannot “run away” from a bad diet, and private food consumption is difficult to hide

3

Cognitive Exercise

Play, paint, and sing for “brain padding”

4

Physical Exercise

We are “born to run and wired to run”

5

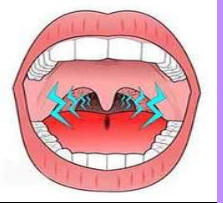
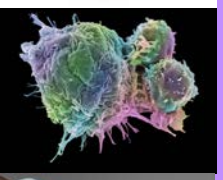
Socialization

We are wired to care and wired to chatter

1 Sleep Quality





How

- Pursue biphasic sleep, 8 hours per 24 hours
- Power nap most afternoons (15–30 minutes)
- Sleep and work according to your chronotype, ~1/3 of you are morning larks, ~1/3 late night owls, ~1/3 mixed
- Keep the same 24-hour sleep schedule; the same sleep onset and wake time improves sleep quality
- Cool temperatures, a darkened room, and low grade background ambient noise facilitate sleep
- Daily sun exposure, best at midday (heliotherapy) assists circadian clock setting, facilitating sleep
- Daily physical exercise improves sleep by boosting adenosine, which promotes sleep
- If you snore or have sleep apnea, employ CPAP or BIPAP or mandibular advancement devices (MAD), while attaining
- your optimum weight at a BMI of 18–25
- Consider keeping a dream log to help understand your brain's offline activity
- Limit night-time blue light LED exposure from electronic devices, which promotes wakefulness
- Avoid anxiety-inducing activities (arguments, contentious correspondence, scary movies) prior to bedtime
- Limit alcohol and other "sleep robbing" medications
- Avoid caffeine-containing drinks after mid-afternoon
- Avoid dependence on long-term sleep medications (hypnotics)

Why

- The brain's "operating systems" – working memory and attention – are dependent on 7–8 hours of restful sleep
- Sleep deprivation results in brain network instability affecting working memory and attention, with important societal health implications, especially in aviation, medicine, and military institutions, where sleep deprivation is common
- During sleep many connections formed during waking are pruned, called synaptic pruning (microglial topiary), which enhances brain function and promotes learning memory, decision-making capability, executive brain function, emotional health, and social interaction
- The sleep cycles flush out metabolic waste (glymphatics)
- Sleep boosts the immune system (natural killer cell activity)
- Sleep regulates metabolism, insulin, glucose, and weight control (the hormones leptin and ghrelin)
- Sleeps promotes cardiovascular fitness and microbiome (gut bacteria essential to our health) fitness
- Dreams are due to brain network pulsations that connect widely separated brain regions to promote creativity, modulate emotional health, are antidepressant, and enhance memory consolidation
- Long-term sleeping tablets (hypnotics) interfere with sleep architecture and have multiple side-effects
- Sleep abnormalities are an important problem in every major neurological and psychiatric condition

Measure and monitoring by you

- Record sleep duration (~8 h per night), whether deep or light, electronically (Apple Watch, Garmin, Fitbit, or similar device)
- Evaluate how healthy your sleep is using the SATED sleep health scale. Rate the following with the scale:
  Rarely or never (0), sometimes (1), usually or always (2)
  1. Satisfaction – are you satisfied with your sleep?
  2. Alertness – do you stay awake all day without dozing?
  3. Timing – are you asleep (or trying to sleep) between 2 a.m. to 4 a.m.?
  4. Efficiency – do you spend <30 minutes awake at night (includes trying to fall asleep and awakenings)?
  5. Duration – do you sleep 6–8 hours per day?
- Score out of 10; poor sleep health = 0 and optimum sleep health = 10

Measure and monitoring by medical professionals

- Home monitoring sleep study with WatchPAT device for REM/NREM, sleep architecture, sleep hypopnea and apnea indices, oxygen desaturation
- Formal laboratory or hospital polysomnogram (sleep study) if suspect one of the sleep disorder syndromes

2 Brain Foods









How

- Overview: The cornerstone to healthy eating involves consuming a **moderate- to high-fat diet** as opposed to the frequently promoted low-fat diet, minimizing grain consumption and drastically reducing sugar intake, which cause heart attacks, strokes, diabetes, obesity, fatty liver, and dementia. Food **quality**, **quantity**, and **timing** of intake are all important. High-quality foods are depicted below, portion size in general involves one plate and one serving. Meal timing involves eating the majority in the first half of the waking day.
- The key whole foods include (1) seafood, (2) eggs, (3) red/white meat (free range), (4) fruit (berries), (5) regular-fat dairy, (6) tubers (potatoes, sweet potatoes, carrots), (7) cruciferous vegetables (broccoli, cabbage), (8) legumes (peas, beans, lentils), (9) probiotics (fermented dairy, yoghurt, pickles, olives, sauerkraut), (10) prebiotics (garlic, onions, leeks), (11) nuts, seeds, and spices (curcumin, cinnamon, oregano, chili peppers, thyme, basil). In general, this may be achieved by following the "original Banting diet," or others such as the Mediterranean, Nordic, Pegan, or Okinawan diets
- Chocolate, coffee, and tea are healthy but adhere to low quantities and avoid consumption later than mid-afternoon because of alerting effects
- Alcohol use, if accustomed, limit to ≤2 drinks/day for men and ≤1.5/day for women
- Practice intermittent fasting (intermittent metabolic switching) for 12–16 hours once per week, plus a monthly 24 h fast
- Minimize whole grains
- Avoid: cane sugar, corn syrup, artificial sweeteners, sodas, diet sodas, trans-fats, vegetables oils, low-fat dairy, processed meats, cigarettes, substance abuse

Why

- Seafood contains docosahexaenoic acid (DHA), which induces brain cell growth, synaptic growth (connections), and complexity, and promotes brain connectivity and has antidepressant effects
- Fruits, spices, resveratrol (red wine), and xanthohumol (dark beers) are good antioxidants
- Eggs, fish, poultry (free range), red meat (free range, not feed lot) supply healthy fats, micronutrients, and essential amino acids, such as tryptophan, the latter of which promotes contentment and mood elevation
- Refined sugars lead to obesity, diabetes, heart disease, stroke, non-alcoholic fatty liver disease (NAFLD), metabolic disease, eye (retinal) disease, and limb artery blockage. Dairy products are healthy, but not if low-fat or fat-free
- Breads (only whole grain) and pasta, limit to small amounts due propensity to "leaky gut" syndrome, gluten sensitivity, and, rarely, celiac disease
- Foster microbiome health by promoting beneficial gut bacteria with probiotic foods and support the latter with prebiotic foods
- Fasting, or intermittent metabolic switching, promotes brain health and beneficial ketosis

Measure and monitoring by you

- Body mass index (BMI): aim for 18–25 (www.nhlbi.nih.gov/health/educational/losewt/BMI/bmicalc.htm)
- Blood pressure: aim for ≤ 130/90

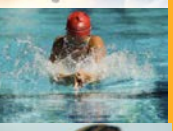
Measure and monitoring by medical professionals

- Do 1–4 in all, and if clinically indicated also do 5–8:

1. Evaluate for metabolic syndrome – blood glucose, HbA1C, fasting insulin, HDL, triglycerides, homocysteine, GGT (NAFLD,) albumin/globulin ratio, uric acid, omega 3/6 ratio
2. Inflammation – C-reactive protein, IL-6, TNF-alpha
3. Vitamin D, B12, folate
4. Hormone levels – thyroid (TSH, free T4)
5. Micronutrients – magnesium, selenium, iodine, zinc, copper, iron
6. Other vitamin levels – E, B1, B2, B3, B6, B9
7. Toxins and deleterious heavy metal level measurement – lead, mercury, manganese, cadmium, arsenic
8. Consider discontinuing drugs that may alter memory and cognition, including anticholinergics, antianxiety, antipsychotic, hypnotics (sleeping tablets), and statins

3 Physical Exercise





How

- Physical exercise (PE) is regarded as a vital sign
- Check cardiac status and balance, if not normally exercising, prior to commencing exercise programs or routines
- There are five components: aerobic (endurance), anaerobic (sprinting), isometric (strength), flexibility (yoga), and balance (axial musculature)
- Aim for ≥5 hours of physical exercise per week
- Do aerobic exercise at ≥70% maximum heart rate (MHR)
- Your MHR may be calculated by a simplified formula: 220 – age
- For example, the MHR of a 50-year-old person would be 220 – 50 = 170
- The 50% and 70% levels for a person aged 50 exercising at a 50% level would be 170 × 0.50 = 85, and for exercising at a 70% level would be 170 × 0.70 = 119

Why

PE promotes new brain cell growth in several cell components (hardware) and has beneficial effects on a number of brain and mind functions (software)

Hardware effects

- Brain cell growth (neurogenesis) due to release of growth factors including, BDNF, IGF1, and VEGF
- New connections are formed (synaptogenesis)
- New brain blood vessel formation (angiogenesis)
- Promotes brain padding (cognitive reserve)

Software effects

- PE has a number effects on the key brain functions
- Improved working memory (the brain's operating system)
- Improved episodic memory (memory for events, faces, places)
- Improved attention (concentration)
- Improved executive function (multitasking, flexibility)

Feel-good neurotransmitters are released

- PE has antidepressant effects and certain exercises such as endurance running may cause euphoria
- Release of the brain's own "marijuana" (endocannabinoids)
- Release of the brain's own "morphine" (opioids)
- Together these alleviate depression and anxiety

Improved sleep

- PE causes adenosine production, which is the body's own powerful sleep-inducing agent
- Reduces the top four major diseases: dementia (~50% reduction), cardiovascular disease, strokes, and cancers

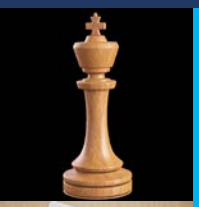
Measure and monitoring by you

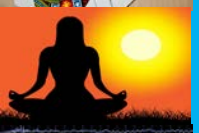
- Overall activity can be measured in metabolic equivalents (MET) per day or per week. Examples of a MET per hour: sitting 1, slow walk 2, yoga 3.2, brisk walk 3.5, cycling 7.5, swimming 9, weight training 10, running 10, kayaking 10, sprinting 23
- Aim for 9–15 MET hours per week
- Or one can record physical activity, such as the number of steps taken per day (for example, 10,000 is good), with smartphones or electronic fitness wearable devices
- Keep a log of timed distance and speed data from activities you do such as walking, running, swimming, cycling, and kayaking with the aid of electronic monitoring devices (Garmin, Fitbit)

Measure and monitoring by medical professionals

- Garmin devices measure VO_2max, the best indicator of overall cardiorespiratory fitness
- VO_2max may also be computed by the formula VO_2max = 15 × HR max/HR rest (Uth–Sorensen–Overgaard–Pedersen test)
- VO_2max can be computed by VO_2 max = d12 – 505/45, where d12 is distance in meters covered in 12 minutes (Cooper test)
- Do vVO_2max estimation for competitive athletes. The vVO_2max is computed by measuring distance run in meters at maximum heart rate for a time of six minutes, and is recorded in meters per second
- Measure heart rate variability (HRV), which allows estimation of stress monitoring by specific Garmin devices (Vivoactive 3)
- Record fitness age as a comparison to your biological age (Garmin devices) or from the website: www.ntnu.edu/cerg/vo2max

4 Cognitive Exercise

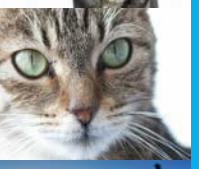
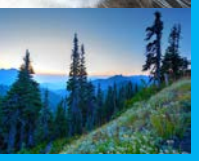










How

- Activities that in general involve problem-solving, gaming, and social interaction which can lead to brain cell growth and boost brain circuits
- Examples include reading, playing music, board games (chess, Stratego, Yhatzee), card games, completing puzzles, computer gaming, Sudoku, or learning a new language
- Meditation and Tai Chi (meditation in motion)
- Engage in one or more of the arts, such as musicality (playing a musical instrument, singing), visual arts (painting, sculpting, pottery), literary arts (poetry, writing), performing arts (dancing), culinary arts (cooking or baking)
- Interacting with the natural environment (biophilia) is beneficial, as shown by the Japanese “forest bathing therapy,” or within aquatic environments
- Animal-assisted interaction and animal-assisted therapies
- Aim for 1–2 hours per day of any of these or combinations thereof
- Exposure to sunlight (heliotherapy) for an ideal of 30 minutes per day

Why

- Builds cognitive reserve (brain padding) that mitigates and protects against the effects of brain disease
- Enhances working memory (the brain’s operating system)
- Meditation “brain builds” both neurons or gray matter and fiber tracts or white matter networks and facilitates focus
- The various arts including visual fine arts, painting, poetry, dance performances, musicality, and culinary arts strengthen working memory and attentional brain circuitry
- The various arts also exercise and “brain build” our emotional, empathic abilities as well as theory of mind, the latter of which is important for interpreting the intentions of others we interact with
- Biophilia, or interacting with the natural environment, boosts our immune system (natural killer cells) by inhaling phytoncides (chemicals released by trees) during forest hikes, for example
- Non-threatening animal interaction, including pets, induces oxytocin release in both the human and the animal; oxytocin is the social-bonding hormone which also decreases inflammation and has been shown to decrease anxiety, depression, post-traumatic stress disorder, and facilitate sociality and emotional health

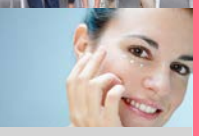
Measure and monitoring by you

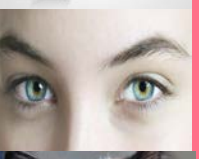
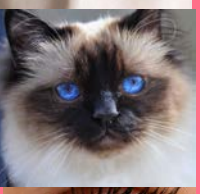
- Computerized games and exercises that can track brain scores.
- Brain activity quotient (AQ) with Brain HQ (www.BrainHQ.com), recommend ~30 minutes, three times per week

Measure and monitoring by medical professionals

- Cognitive evaluation by computerized testing (CNS-VS) battery for working memory, speed of information processing, attention, executive function, and inhibition
- CNS-VS POET subtest (perceptions of emotions test)
- Cerebrovascular reserve by breath-holding index measured with transcranial Doppler
- Cognitive reserve evaluation by metabolic PET brain scan

5 Socialization


How

- Group meetings, sporting clubs, group discussion, group dinners, dancing, and performing arts
- Communicate face to face whenever possible
- Electronic voice or visual communication is also beneficial
- Nurture involvement with social groups

Why

- Sociality was a major factor in initial human brain enlargement as coping with group dynamics and polyadic (many individuals) relationships is very demanding
- Most of human interaction is through non-verbal means such as facial expressions and body posture
- Eye-gaze signaling is considered a very important social communication system that is not easily accomplished by electronic methods
- Emotional micro-expressions refer to fleeting facial expressions lasting microseconds that are sometimes perceived only subconsciously, yet influence our responses and decisions
- Sociality improves brain network integrity and promotes cardiovascular and immune health
- Sociality and interaction with people and pets induces oxytocin, endorphin, and vasospressin secretion in the brain, which have neuro-protective, anti-inflammatory, antianxiety, and antidepressant effects
- Sociality boosts immune function and cardiovascular health
- The digital age has boosted communication abilities but correlated with a relative loss of empathy

Measure and monitoring by you

- Use the Modified Social Network Index (SNI) scored out of a maximum of 12
- The modified SNI evaluates participation once every two weeks with up to 12 different social groups (spouse, parents, child, neighbors, relatives, volunteers, work colleagues, students, sport groups, social clubs, religious groups, charity groups)

Measure and monitoring by medical professionals

- Measure inflammatory markers: CRP, interleukin 6
- Brain network integrity by MRI brain diffusion tensor imaging (DTI)

The 5 | Brain Fitness Key Performance Indicators: Range of Options

1. Sleep Health

a. Sleep duration of 7–8 hours per 24 hours over the last week
b. Sleep health scale (SATED): aim for a score of 10/10
c. Epworth sleep scale, which measures daytime sleepiness (range 0–24), >10 is abnormal
d. PSQI scale for sleep disorders
e. Clinical polysomnography testing with home monitors such as a WatchPat device

2. Brain Foods

a. Aim for a body mass index of 18–25
b. Aim for a BP of 110–130 systolic and 80–90 diastolic
c. There are eight categories of laboratory testing

3. Physical exercise

a. Metabolic equivalents per week (9–15)
b. Overall steps per week >60,000
c. Monitor any preferred exercise type for timed distance: walk, run, swim, paddle, bike
d. VO_2max (≥35 young to middle-aged adult)
e. Fitness age: www.ntnu.edu/cerg/vo2max
f. Monitor heart rate variability (HRV)

4. Cognitive exercise

a. Brain age
b. Brain HQ activity quotient (AQ) computerized score tracking
c. Computerized working memory score (CNS-VS 85–115 is the normal range)
d. CNS-VS subtest computerized scores

5. Socialization

a. Socialization index of ≥10 per two-week period

With brain health comes energy, mood elevation, and happiness