Supplementary Table 1. Main characteristics (sample, light parameters, brain effects and experimental design) of the eligible NIRS and PBM studies reported in this manuscript.

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|  | Author (year) | Sample | Light Parameters | Main Results | Experimental Design |
| NIRS Studies | Kirlilna *et al*. [1] (2013) | Human (n = 15 ; 10 males, 5 females) | PTB time-domain optical brain imager with three wavelengths 689, 797, and 828 nm. Distributions of photon time of flight (DTOFs) acquired with time bins of 24.4 ps width and at a 20 Hz rate. A source-detector separation of 3 cm was chosen for all fNIRS channels. | The authors developed a set of physiological regressors, which were used for physiological de-noising of fNIRS signals. The proposed de-noising method can significantly improve the sensitivity of fNIRS to cerebral signals. | N.A./proof of concept |
| Haeussinger *et al.* [2] (2014) | Human (n = 24; 12 males, 12 females) | Hitachi ETG-4000 continuous wave system: 8 emitters and 8 detectors at a sampling rate of 10 Hz. The optodes formed a quadratic 24 channel probe set that was placed on the right frontal side of each participant's head, while the most inferior and most lateral channel was positioned on EEG marker point Fpz according the international 10–20-system. | To develop a filter method that corrects for extra-cranial skin blood flow. By applying these filters, the authors showed that measuring brain activation in frontal brain areas with fNIRS was substantially improved. | Within subjects design |
| Hernandez-Martin *et al.* [3] (2020) | Human (n = 1) | DYNOT 232 (NIRx) continuous-wave system with 2 frequency-encoded laser sources at 760 nm and 830 nm and a sampling rate of 1.81 Hz. An array of 64 fiber optic probes (32 emitters and 32 detectors) that were separated by 1 cm, used to measure hemodynamic changes in the frontal cortex. 2048 optical channels. | Applying the Bayesian filtering on raw DOT data reduces serial correlations between consecutive points over time, providing data independence and allowing for the use of a GLM (commonly used in the neuroimaging field for mapping cerebral activations). | N.A./ proof of concept |
| Yanagisawa *et al*. [4] (2010) | Human (n = 20 ; 17 males , 3 females) | Multichannel fNIRS optical topography system ETG-7000 (Hitachi), using two wavelengths of 785 and 830 nm. Sampling rate was set at 100 ms. They used two sets of 4 × 4 multichannel probe holders, with 8 emitters and 8 detectors at an inter-probe distance of 3 cm. 24 channels per set. | The effects of a single bout of physical activity were monitored: Improvement of cognitive performance as indexed by the reaction time at a Stroop test. Brain activation due to Stroop interference (incongruent minus neutral) in the lateral prefrontal cortices (LPFC) in both hemispheres. | Event-related, crossover design |
| Lucas *et al*. [5] (2012) | Human (n = 22 ; 13 young, 9 older) | Continuous-wave NIRO-200 device (Hamamatsu Photonics) with 2 channels and 3 wavelengths (735, 810 and 850 nm). | The effects of age on exercise-induced alterations in cognitive executive function were measured: Difficult-task response times improved during exercise, with the improvement greater at 70% heart rate range (HRR) exercise. Higher middle cerebral artery blood flow velocity (MCAv) was correlated with faster response times for simple and difficult tasks at rest, but this relation uncoupled progressively during exercise. Exercise-induced increases in MCAv were similar and unaltered during cognitive tasks for both age groups. Prefrontal cortical hemodynamic NIRS measures [oxyhemoglobin (O2Hb) and total hemoglobin (tHb)] were differentially affected by exercise intensity, age and cognitive task; e.g., there were smaller increases in [O2Hb] and [tHb] in the older group between exercise intensities. | Cross-sectional design |
| Giles *et al*. [6] (2014) | Human (n = 24 ; 14 males, 10 females) | Continuous-wave fNIRS Imager 1100 (fNIR Devices LLC) system with 4 light sources and 10 detectors, with a 2.5 source–detector separation, comprising 16 channels across the dorsal and anterior PFC. Each LED light source emitted light at two wavelengths (730 and 850 nm). Data were recorded at a temporal resolution of 2 Hz. The sensor pad was positioned on the forehead according to the international 10–20 system. | Changes in O2Hb and dHb levels in the PFC by acute exercise: O2Hb and dHb levels in the PFC increased as a function of both exercise load and duration. An 84% (high condition of aged adjusted maximum heart rate) >68% (moderate condition) >52% (low condition) difference was evident after 18 min of cycling for O2Hb and after 23 min of cycling for dHb. | Within subjects design |
| Albinet *et al*. [7] (2014) | Human (n = 34 ; females) | Spatially resolved continuous wave spectrophotometer (NIRO-200, Hamamatsu Photonics).The sampling rate was set at 6 Hz. Two pairs of optodes with an inter-optode distance of 40 mm were bilaterally placed according to the international EEG 10–20 system over the right and left DLPFCs (BAs 9/46). | Cerebral oxygenation response and executive performance as a function of cardiorespiratory fitness: Increases in the [HbO2] responses in the right DLPFC during the Random Number Generation (RNG) task. The high-fit women showed significantly better performance on the RNG tasks compared with the low-fit women. The high-fit women showed significant increases in [HbO2] responses in both left and right DLPFCs during the RNG task. The low-fit women showed significantly less activation in the right DLPFC compared with the right DLPFC of the high-fit women and compared with their own left DLPFC. | Cross-sectional design |
| Dupuy *et al*. [8] (2015) | Human (n = 58 ; 22 younger, 36 older) | Multichannel, continuous-wave spectrometer (CW6, TechEn Inc.), using wavelengths of 830 and 690 nm. Two arrays of 4 sources and 8 detectors were mounted on plastic helmets covering prefrontal regions. Sixteen detectors were placed 2.8 cm away from the emitters, 8 of them were dorsal, while the other eight were ventral. | Main effect of fitness on cerebral oxygenation during the Stroop task such that only high fit women demonstrated a significant increase in the right inferior frontal gyrus. Higher fit women scored better on measures of executive functions than lower fit women. Higher fit women had faster reaction times in the Executive condition of the computerized Stroop task. | Mixed design |
| Ichinose *et al*. [9] (2020) | Human (n = 18) | Multichannel NIRS imaging system (OMM-3000; Shimadzu Co) with multiple continuous wavelengths (780, 805, and 830 nm) and a sampling rate of 130 ms. The NIRS optodes consisted of 12 light-source fibers and 12 detectors, which provided 24-channel simultaneous recording. The optodes were arranged in a 4 × 6 fashion in a multichannel probe holder, and a 30-mm interoptode distance was employed to measure cortical tissue oxygenation. | O2Hb was higher and average reaction time was shorter after exercise than before exercise for both exercise protocols. Intermittent and continuous exercise may improve cognitive function to the same degree after exercise. | Mixed design? |
| Stone *et al.* [10] (2020) | Human (n=23) | Near-Infrared Spectroscopy (NIRS; PortaLite, Artinis Medical 204 Systems) at a rate of 50Hz. The NIRS optode was placed on the DLPFC. | Executive function declined at exercise intensities of ≥80% of heart rate reserve. The decline in executive function was coupled with declines in the oxygenation of the prefrontal cortex, the brain region responsible for executive functioning. | Within subjects design |
| Ochi *et al.* [11] (2018) | Human (n=15) | Multichannel fNIRS optical topography system (ETG-7000, Hitachi) set with two wavelengths of near-infrared light (785 and 830 nm).  Two sets of 4 × 4 multichannel probe holders, with 8 emitters and 8 detectors arranged at an inter-probe distance of 3 cm, resulting in 24 channels per set. | Association between decreased color-word Stroop tasks (CWST) performance and activation in the left DLPFC. Moderate exercise under normobaric hypoxic conditions has negative effects on executive function by reducing task-related activations in the DLPFC. | Within subjects design |
| Mekari *et al.* [12] (2015) | Human (n=19 ; 7 males and 12 females) | Multichannel, continuous-wave spectrometer (CW6, TechEn Inc.), with 830 and 690 nm wavelengths. Two bands of NIRS sources and detectors were positioned on the subject’s head, one on each frontal lobe.  Sixteen detectors were placed optimally 2.8 cm away from the nearest sources. | Low to moderate exercise intensity does not alter executive functioning, but that exercise impairs cognitive functions (executive and non-xecutive) when the physical work-load becomes heavy.  The cerebral HbO2 correlation suggests that a lower availability of HbO2 was associated with slower reaction time in the Executive condition only. | Within subjects design |
| Photobiomodulation (PBM) Studies | Ilic *et al*. [13] (2006) | Rats (n = 118) | Diode laser (808 nm, wavelength) was used to deliver power densities of 7.5, 75, and 750 mW/cm2 transcranially to the brain cortex of mature rats, in either continuous wave (CW) or pulse (Pu) modes. Multiple doses of 7.5 mW/cm2 were also applied. | Safety study: Long-term safety tests lasting 30 and 70 days at optimal 10x and 100x doses, as well as at multiple doses at the same power densities, indicate that the tested laser energy doses are safe under this treatment regime. Neurological deficits and histopathological damage to 750 mW/cm2 CW laser irradiation are attributed to thermal damage and not due to tissue-photon interactions. | Multiple-study article, between subjects design |
| Zivin *et al.* [14] (2009) | Human (n = 660) | NeuroThera Laser System (NTS) uses energy at a wavelength of 808 nm. | Safety study : Transcraneal laser therapy within 24 hours from stroke onset demonstrated safety but did not meet formal statistical significance for efficacy. Favourable trend in the NeuroThera Effectiveness and Safety Trial–2 (NEST-2) which tested the safety and efficacy of TLT in acute ischemic stroke. | Double blind, placebo controlled trial |
| McCarthy *et al.* [15] (2010) | Rats (n = 120) | Continuous-wave (CW) NIR laser light (wavelength, 808 ± 10 nm, 2-mm diameter) with a nominal radiant power of 70 mW; power density, 2.230 mW/cm2, and energy density, 268 J/cm2 at the scalp (10 mW/cm and 1.2 J/cm2 at the cerebral cortical surface); 3 days treatment. | Safety study: No toxicologically important differences were found in the clinical hematology results between sham-control and laser-treated rats for any hematologic parameters examined. Brain and pituitary gland histopathology showed no treatment-related abnormalities or induced neoplasia | Between subjects design |
| Tian *et al.* [16] (2016) | Human (n=18 ; 9 male, 9 female) | 1064-nm laser for 10 minutes to the forehead | Decrease in deoxygenation and increase in haemoglobin oxygenation in both cerebral hemispheres over time during irradiation (10 minutes) and post irradiation (6 minutes). | Multiple-study article, within subjects design |
| Zomorrodi *et al.* [17] (2019) | Human (n=20) | NIR light pulse (810 nm wavelength, 40 Hz) in five different regions (frontal, left/right temporal, precuneus cortex, and intranasal) for a 20-minute session | A reduction of low-frequency power (i.e., delta and theta) and an increase of high-frequency power (i.e., alpha, beta, and gamma) were observed following active stimulation.  Also, significant change between active and sham stimulation, limited to alpha and gamma frequencies. | Crossover design |
| Nagy *et al.* [18] (2021) | Humans (n=60) | Low level laser irradiation via a laser watch (650 nm) which irradiates radial, unlar and middle artery acupoints and a nasal probe simultaneously. The irradiation was applied at maximal power for 30 minutes per session, 2-times/day, 3 days/week for 3 months | Experimental group, which received active PBM in addition to moderate-intensity aerobic exercise, showed more significant results in haemoglobin level and Montreal Cognitive Assessment Scale compared to the control group | Within subjects design |

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