Supplementary Material 5. Key Results Regarding Associations with, or Effects of Physical Activity on Cognition (and vice versa)

First Author, Year	Self-Reported Outcome(s) (+/0/-)	Overall Classification
Observational Studies (n=26)		
Barlow-Krelina (2020)	[+] Physically active survivors reported fewer neurocognitive problems across multiple domains compared with consistently inactive survivors. These associations were replicated for risk of impairment, except that inconsistent PA was not significantly associated with impairment in emotion regulation in non-CNS survivors. Adjusting for the presence of a chronic health condition or body mass index attenuated associations between PA consistency and CCSS Neurocognitive Questionnaire scores. [+] Higher PA intensity and quantity were associated with fewer neurocognitive problems in task efficiency and organization for CNS and non-CNS survivor groups. [+] Consistent PA was associated with improvements in all cognitive domains compared with consistent inactivity in both survivor groups. [+] Inconsistent PA was associated with improved task efficiency and organization problems over time compared with consistent inactivity in both survivor groups and improved memory problems in non-CNS survivors. *Results comparing survivors and sibling groups or involving siblings only are omitted here given the review objectives.*	Positive
Bedillion (2019)	[0] No significant interaction of MPA and depression effects on cognitive function. [+] MPA and VPA moderated the effect of chemotherapy on PCI at moderate and high levels of MPA and VPA, such that higher MPA and VPA was associated with improved PCI but only for those who did not undergo chemotherapy. [+] The above effects were replicated with PCA for both moderate and high levels of MPA and VPA. [0] There was no significant moderation effects by MPA on PCI or PCA for anastrozole or letrozole. [+] Depression significantly mediated the effect of exemestane on PCI and PCA only in those with high levels of MPA, such that depression decreased, and perceived cognition improved for those who received exemestane and engaged in more MPA. [+] Depression mediated the effects of tamoxifen on cognitive function only in those with moderate levels of MPA. [+] Depression mediated the effect of anastrozole on PCI and PCA such that cognitive function decreased as depression increased in those who received anastrozole, but only for those who did not engage in VPA. [0] No effect for VPA in the models for letrozole and exemestane. [+] Depression mediated the effect of tamoxifen on PCI and PCA in those who engaged in moderate levels of VPA.	Positive
Bender (2021)	[+/0] Average daily steps were associated with attention and psychomotor speed, but not with any other domain of cognitive function. [0] Average hours of daily LPA and VPA were not associated with any domain of cognitive function. [+/0] Average hours of daily MPA and MVPA were associated with visual memory, but not with any other domain of cognitive function. [+] Average daily energy expenditure was associated with visual memory and psychomotor speed, but not with any other domain of cognitive function.	Positive
Cooke (2016)	[+] Those who engaged in more MPA had smaller white matter lesion volumes. [+] Those with greater MPA levels performed better on the story memory recall. [+] Lesion volume directly and indirectly (via MPA) influenced story memory recall. *Results from analyses involving non cancer age-matched controls are omitted.*	Positive
Crowgey (2014)	[+] Exercise behaviour was associated with visual memory. [0] Exercise behaviour was not associated with any other cognitive domain (i.e., psychomotor speed, reaction time, complex attention, cognitive flexibility, processing speed, executive functioning, composite memory, verbal memory). *Results from analyses involving non cancer age-matched controls are omitted.*	Inconclusive
Ehlers (2017)	[+] MVPA was directly and indirectly associated with executive function through fatigue. [+/0] MVPA was not directly associated with working memory but was indirectly associated with working memory through fatigue.	Positive

Ehlers (2018)	[0] MVPA and LPA were not associated with task-switch stay or switch accuracy. [0] MVPA was not associated with faster reaction time on stay trials in a single effects model. [+] MVPA was associated with faster reaction time on switch trials in a single effects model. [+] Replacing 30 min of sedentary time with MVPA yielded faster reaction times on stay and switch trials. [+] Replacing 30 min of LPA with MVPA yielded faster reaction times on stay and switch trials. [0] Replacing 30 min of sedentary time with LPA was not associated with faster reaction times on either task-switch outcome. [-] LPA was associated with slower TMT-A completion in a single effects model. [+/0] MVPA was not associated with TMT-A completion in a single effects model, but was in the partition model. [-] Replacing 30 min of sedentary time with LPA was associated with slower TMT-A completion. [0] Replacing 30 min of sedentary time with MVPA was not associated with changes in TMT-A completion time. [-/+] Replacing 30 min of LPA with sedentary time or MVPA was associated with faster TMT-A completion. [0] MVPA and LPA were not associated with TMT-B completion time. [+] MVPA was associated with faster TMT-B completion in a partition model. [-] Replacing sedentary time with LPA was associated with slower TMT-B completion. [0] Replacing sedentary time with MVPA was not associated with TMT-B completion time. [+] Replacing LPA with MVPA yielded faster TMT B completion.	Inconclusive
Fitzpatrick (2012)	[+/0] At 6 weeks, total METs were associated with the Montreal Cognitive Assessment for those on chemotherapy, but not for those not on chemotherapy.	Inconclusive
Gendron (2020)	[0] No significant preventive fractions for PA on any cognitive function outcomes (i.e., TMT (visual scanning, number sequencing, letter sequencing, number-letter switching), Verbal Fluency (letter fluency, category fluency, category switching), WAIS/WISC-IV (global digit span, working memory index, letter-number sequencing), Grooved Pegboard (dominant hand, non-dominant hand).	Inconclusive
Hartman (2015)	[+/0] Middle PA tertile was associated with visual–spatial, but not executive functioning, verbal functioning, attention, information processing, memory, nor motor skills in separate linear regression models. [+/0] High PA tertile was associated with attention and executive functioning, but not visual-spatial, verbal functioning, information processing, memory, nor motor skills in separate linear regression models. [0] Impairment status ('impaired' vs 'not impaired') was not associated with PA categorized into tertiles in logistic regression models.	Inconclusive
Hocking (2013)	[+] Positive baseline (T1) cognitive competence was associated with higher PA levels after 2 months (adjusting for T1 PA and other covariates). *Results comparing survivors and healthy comparison young adults or involving healthy comparison young adults only are omitted.*	Positive
Hooke (2018)	[+/0] Higher PA was not associated with the baseline symptom cluster (of fatigue, sleep disturbance, pain, nausea, and depression), but was associated with the symptom cluster over time; the improving symptom cluster was associated with increased cognition over time. [-] Increasing PA over time was associated with a worsening symptom cluster over time, and the worsening symptom cluster was associated with decreased cognition over time.	Inconclusive
Huang (2017)	[0] PA was not associated with changes in immediate memory, delayed memory, verbal fluency, or attention.	Inconclusive
Knowlton (2020)	[+/0] Survivors, but not advanced disease patients, who met current exercise guidelines reported less memory and concentration difficulty than those who did not meet exercise guidelines.	Inconclusive
Mackenzie (2016)	[+/0] Total PA was associated with shorter reaction times on the 2-back task, but not the 1-back task. *Results from analyses involving non cancer age-matched controls are omitted.*	Inconclusive
Marin-Chollom (2022)	[0] MPA and hard PA were not associated with any cognitive domain (i.e., working memory, processing speed, episodic memory, inhibitory control and attention, cognitive flexibility, fluid abilities). [+/0] Very hard PA was associated with better processing speed and fluid abilities, but not working memory, episodic memory, inhibitory control and attention, or cognitive flexibility. [+/0] Total MVPA was associated with better cognitive flexibility, but not working memory, processing speed, episodic memory, inhibitory control and attention, or fluid abilities.	Inconclusive
Marinac (2015)	[+/0] MVPA was associated with information processing speed, but not with memory or executive function. The association was weakened when the model was adjusted for body mass index. [0] LPA was not associated with information processing speed, memory, or executive function.	Inconclusive
Mohammadi (2013)	[+] PA was associated with cognitive functioning.	Positive

Myers (2015)	[+] Exercise frequency was associated with PCI. [+] Exercise had a moderating effect on the relationship between body mass index and PCI (i.e., as exercise frequency increased, the association between body mass index and PCI disappeared). *Results comparing survivors and healthy controls or involving healthy controls only are omitted.*	Positive
Myers (2017)	[+] Exercise frequency was associated with better perceived cognitive functioning.	Positive
Peng (2021)	[0] PA was not associated with motor processing speed, memory, inattentiveness, inattentiveness, or sustained attention (based on performance on a neurocognitive battery). [+] PA was associated with less attention problems (refers to features of inattention, hyperactivity, and impulsivity) and sluggish cognitive tempo (refers to symptoms associated with inconsistent alertness and slowness in thinking) (based on the Child Behavior Checklist/Adult Behavior Checklist).	Inconclusive
Phillips (2017)	[+] Self-report PA was indirectly associated with subjective memory at baseline via changes in exercise self-efficacy and distress, and via changes in exercise self-efficacy and fatigue at baseline. [+] Change in self-report PA from baseline to 6-month follow-up was indirectly associated with subjective memory via changes in exercise self-efficacy and distress, and via changes in exercise self-efficacy and fatigue. [+] Accelerometer-based PA was indirectly associated with subjective memory via exercise self-efficacy and distress at baseline. [+] Change in accelerometer-based PA from baseline to 6-month follow-up was indirectly associated with subjective memory via changes in exercise self-efficacy and distress.	Positive
Salerno (2021)[a]	[+/0] Meeting PA guidelines at baseline (T1) was associated with less perceived impairments (FACT-Cog PCI), better cognitive function (FACT-Cog Total), and better sustained attention (Rapid Visual Processing; RVP) (but not visual memory after a 12-sec delay [Delayed Match-to-Sample; DMS]) over time compared to not meeting PA guidelines at baseline. [+] MVPA measured at the previous time point was associated with less perceived impairments (FACT-Cog PCI), better cognitive function (FACT-Cog Total), and better sustained attention (RVP) trajectories. [0] Index-specific PA intensities were not associated with any cognitive outcomes. [+] Survivors who always met PA guidelines demonstrated better cognitive function scores post-chemotherapy (T2), better cognitive recovery 6 months post-chemotherapy (T3), and a higher mean score at T3 as compared to those who never met guidelines, those who went from meeting to not meeting guidelines, and those who went from not meeting to meeting guidelines (based on the FACT-Cog). [+] Survivors who met PA guidelines at T1 had better sustained attention at all three time points, regardless of meeting guidelines at T2 (based on the RVP). [+] Survivors who never met PA guidelines had worse visual memory after a 12-second delay than those who always met PA guidelines, who went from meeting to not meeting guidelines, and those who went from not meeting to meeting guidelines (based on the DMS). [+] Survivors who never met PA guidelines had clinically meaningful declines on the FACT-Cog PCI and FACT-Cog Total. *Results comparing survivors and controls or involving controls only are omitted.*	Positive
Tonorezos (2019)	[+] Fewer impairments in task completion, organization, and working memory were observed among exercising survivors as compared to those who were not exercising vigorously (based on MET hours per week). [+/0] Among those meeting national exercise guidelines for vigorous activity, task completion and working memory were less likely to be impaired compared to those not meeting guidelines, although differences were not observed for the other domains of cognitive function (i.e., emotional regulation, organization).	Positive
vanVeen (2019)	[0] Adherence to PA recommendations was not associated with cognitive functioning.	Inconclusive
Williams (2022)	[+/0] Meeting PA recommendations was associated with a lower risk of impairment in task efficiency and organization, but not emotional regulation or memory. *Results comparing survivors and sibling groups or involving siblings only are omitted.*	Inconclusive
(Quasi-)Experimental Studies (n=71)		
Arneil (2019)	[0] PA was not associated with cognitive function at a singular time point nor over time.	Inconclusive
Backman (2014)	[0] No significant differences between groups for cognitive functioning.	Inconclusive
Bade (2021)	[+/0] Intervention and control group reported improvements in cognitive functioning without a between-group difference. [0] Increased step count in the intervention group was not associated with improvements in cognitive functioning.	Inconclusive
Baumann (2010)	[0] No change in cognitive function within the training group, and no differences between groups for cognitive functioning at admission or discharge.	Inconclusive
Benzing (2020)	[0] Exergaming did not improve core executive functions (i.e., visual working memory, inhibition, switching), other cognitive domains (e.g., fluid intelligence, planning, memory, attention, processing speed, motor abilities), nor parents' ratings of their children's executive functions).	Inconclusive

Bryant (2017)	[-/0] Decreases were observed in perceived cognitive abilities in the intervention and control groups; difference in change between groups were not significant.	Negative
Buffart (2015)	[0] No between-group differences in cognitive function were observed.	Inconclusive
Campbell (2018)	[0] Compared to the control group, self-reported cognitive function (i.e., PCI, Impact on QoL, Comment from Others, PCA) did not improve for the exercise group (based on the FACT-Cog). [+/0] Compared to the control group, the exercise group had a reduced time to complete the TMT-A, but no other differences between control and intervention groups were noted for objective neuropsychological tests (i.e., Controlled Oral Word Association Test, Animal Naming, TMT (B and difference), Hopkins Verbal Learning Test (total recall, delayed recall, retention, recognition discrimination index), Stroop Test). [+/0/-] For the fMRI data, all three regions (i.e., right angular cingulate cortex, left superior frontal gyrus, right medial frontal gyrus) showed a group-by-time interaction in the Stroop incongruent-neutral contrast. Although the main effect of group was not significant, the intervention group showed less % signal change in the hemodynamic response in the right angular cingulate cortex and left superior frontal gyrus while the control group showed less % signal change in the right medial frontal gyrus. Controlling for baseline group differences, correlational analyses indicated that none of the % signal change in any of the regions of interest correlated with the response time measure at the end of the study.	Inconclusive
Cantarero-Villanueva (2013)	[+] Significant group-by-time interaction for cognitive/mood; the intervention improved cognitive/mood aspects immediately after discharge as compared with usual treatment care (based on the Piper Fatigue Scale). [+] Aquatic group maintained improvements in cognitive/mood at 6-month follow-up. [0] No effects were observed for confusion immediately after discharge or at 6-month follow-up (based on the Profile of Mood States).	Positive
Cox (2020)	[+] Exercise training predicted improved response accuracy at 12-weeks post training during No-Go trials relative to Go trials. [+] Exercise training predicted functional connectivity changes in theta, alpha, and high gamma frequency bands during Go and Go/No-Go trials. [0] No changes in response latency and resting state connectivity.	Positive
Culos-Reed (2006)	[0] No differences between the intervention and the control group at post-intervention were seen for cognitive disorganization (based on the Symptoms of Stress Inventory), confusion (based on the Profile of Mood States), nor cognitive function (based on the EORTC QLQ-C30).	Inconclusive
Derry (2015)	[0/+] Cognitive complaints did not differ between yoga and wait list groups immediately post-intervention, but at 3-month follow-up, yoga participants reported fewer cognitive problems than waitlist participants. Additionally, those who practiced yoga more frequently reported fewer cognitive complaints at 3-month follow-up than those who practiced less frequently. [0/+] Cognitive complaints did not improve from immediately post-intervention to 3-month follow-up for the control or yoga groups. However, those with higher yoga practice frequency (but not those with no or lower yoga practice frequency) reported decreased cognitive complaints immediately post-intervention to 3-month follow-up.	Inconclusive
Dimeo (2004)	[0] Cognitive function remained unchanged in the exercise and relaxation training groups.	Inconclusive
Fazzino (2017)[a]	[+] Cognitive difficulty (concentration) scores improved from baseline to 6 months. [0] Baseline cognitive difficulty was not associated with change in MVPA from baseline to 6 months. [+/0] Cognitive difficulty at 6 months was associated with change in MVPA from 6 to 18 months, but results became non-significant when adding Medical Outcomes Study Short-Form 12 scores at 6 months to the model.	Positive
Fontana (2021)	[+/0] Organization skills improved from start (T1) to end of program (T3) (based on the Behavior Rating Inventory of Executive Function), but no differences were noted for other executive processes (i.e., inhibition, initiation, flexibility/shifting, working memory). [+] Verbal long-term memory (i.e., encoding and delayed recall) and labyrinth skills improved from T1 to T3. [0] For all neuropsychological testing, no differences between the type of intervention (pure physical versus physical/attentional activity) or the intervention sequence was identified.	Inconclusive
Galantino (2008)	[0] Trends in improved perceived cognition in 2/3 participants (based on the Perceived Cognition Questionnaire). [0] Variability in the cognitive domains of attention, memory, psychomotor function/processing speed, learning, and problem solving using the CogState neuropsychological battery.	Inconclusive
Galantino (2012)	[0] Some trends were seen in cognition (specifically, reductions in errors and improvements in speed of task completion), but no definitive conclusion can be made.	Inconclusive
Galiano-Castillo (2016)	[+] Cognitive functioning improved in the telerehabilitation group compared with the control group post-intervention. [+] 6-month maintenance of effects was found.	Positive

Galiano-Castillo (2017)	[+/0] Telerehabilitation group had significantly improved results for the total number of consonants recalled (but not for the 0s, 9s, 18s, and 36s delay intervals) as compared to the control group (based on the Auditory Consonant Trigrams). [+] 6-month maintenance of effects was found. [0] No effects were observed for the TMT (A, B, or the difference).	Inconclusive
Galveo (2010)	[+] Exercise group showed a greater increase in cognitive functioning as compared to usual care.	Positive
Gehring (2020)	[+] Based on neuropsychological tests, after correction for baseline cognitive performance, the exercise group had higher scores than the control group at follow-up on measures of attention (i.e., attentional inhibition [Stroop Test-Interference], attention span [WAIS Digit Span-Forward], and auditory selective attention and working memory [Test of Everyday Attention (TEA)-Elevator Counting with Distraction]). [0] No effect was observed for certain measures of attention (i.e., information processing speed [Letter Digit Substitution Test-Read], psychomotor and information processing speed [Letter Digit Substitution Test-Write], attention span [Digit Span-Backward], sustained selective attention [TEA-Telephone Search Task], and divided attention [TEA-Telephone Search Task while Counting]). [0] No effect was observed for all measures of memory (i.e., immediate verbal recall [Visual Verbal Learning Test (VVLT)-Trial 1], verbal learning [VVLT-Total], delayed verbal memory [VVLT-Delayed Recall], immediate verbal association memory [WMS-III Verbal Paired Associates-Direct Recall List A], verbal association learning [WMS-III Verbal Paired Associates-Total Recall], and delayed verbal association memory [WMS-III Verbal Paired Associates-Delayed Recall]) and executive function (i.e., alternating attention/shifting [Concept Shifting Test-Shift], speed and flexibility of verbal thought process [GIT-Letter Fluency], speed and flexibility of verbal thought process and application of strategies (GIT-Category Fluency), and auditory working memory/shifting (TEA-Elevator Counting with Reversal]). [0] No effect was observed for self-reported cognitive functioning (based on the Medical Outcomes Study Questionnaire and the Cognitive Failure Questionnaire).	Inconclusive
Gokal (2016)	[0] No time-by-group effect on feelings confusion (based on the Profile of Mode States subscale).	Inconclusive
Gokal (2018)	[+] Compared with the control group, the intervention had a positive effect on perceived cognitive functioning (based on the Cognitive Failure Questionnaire); scores remained stable in the intervention group across the 12-week period and increased in the control group. [0] No main effects for between or within group, nor any interaction between the two, for sustained attention (Sustained Attention to Response Task), executive function (Stroop Test), working memory (WAIS-III Digit Span [Forwards and Backwards]), or perceptual organization (WAIS-III Visuospatial Skills) (based on neuropsychological measures). [+/0] Based on additional analyses (i.e., removing interactions), Digit Span scores were greater in the intervention group than the control group post-intervention, and at post-intervention compared with pre-intervention; no other effects observed between nor within groups.	Inconclusive
Hacker (2011)	[+/0] Significant time effects were noted for cognitive functioning (i.e., participants reported decreases in cognitive functioning during hospitalization followed by improvements 6-weeks following hospital discharge), but no significant group or group-by-time interaction effects were observed.	Inconclusive
Hartman (2018)	[+] Exercise arm had greater improvements in processing speed as compared to control arm (based on the Oral Symbol Digit Test from the NIH Toolbox). [+/0] For all other neurocognitive measures (i.e., crystallized composite, fluid composite, dimensional card sort, flanker inhibitory, pattern comparison, picture sequence, or auditory verbal learning) except List Sorting (for working memory), scores increased significantly from baseline to 12 weeks, but there were no significant between-group differences. [0] No difference between arms for self-reported applied cognitive abilities nor cognitive concerns (based on the Patient-Reported Outcome Measurement Information System). [+] Within the exercise arm, greater increase in MVPA was associated with a greater improvement in the Oral Symbol Digit score, self-reported applied cognitive abilities, and self-reported cognitive concerns. [+/0] Within the exercise arm, greater increase in total PA (MVPA plus light activity) was associated with greater improvement in the Fluid Composite score and the Picture Sequence score; all other components of the Fluid Composite score (except List Sorting) were not associated with increased total PA.	Inconclusive
Hartman (2019)	[+/0] Anxiety, but not physical functioning, mediated the intervention effect on self-reported cognitive abilities (based on the Patient-Reported Outcome Measurement Information System); differences in change between the exercise and control arms were, in part, because of greater decreases in anxiety in exercise arm. [0] Neither anxiety nor physical functioning mediated the effect of the intervention on processing speed (based on the Oral Symbol Digit Test from the NIH Toolbox).	Inconclusive
Henke (2014)	[+] Significant differences were found in cognitive functioning after the intervention in favour of the intervention group.	Positive
Howell (2018)	[+] Neurocognitive outcomes (i.e., vocabulary and visual-spatial construction [WASI] and cognitive flexibility [Delis-Kaplan Executive Function System]) improved in the intervention group from baseline to 24 weeks, but not in the control group. [0] Change in neurocognitive outcomes between the intervention group and control group did not differ at 6-month follow-up.	Positive

Janelsins (2016)	[+] Intervention group had a significantly reduced memory difficulty compared to the control group post-intervention. [+] Baseline sleep quality moderated the effects of postintervention memory difficulty in the intervention group compared to the control group [+/0] Changes in sleep quality were a mediator for reduced memory difficulty in the intervention group compared to the control group, but changes in memory difficulty did not mediate improved sleep quality in the intervention group compared with the control group.	Positive
Knoerl (2022)	[0] Mind-body group experienced significant improvements in cognitive function from enrollment to 1-month post-surgery in comparison to the exercise group. [0] Within-group comparisons demonstrated that exercise group did not experience improvements in cognitive functioning.	Inconclusive
Knols (2011)	[0] No group-by-time effect on cognitive functioning was observed.	Inconclusive
Korstjens (2011)	[+/0] Negative problem orientation (but not positive problem orientation, rational problem solving, or impulsivity style) improved in the comprehensive physical training and the comprehensive physical training plus cognitive behavioural training groups; no between-group differences were noted. [+] Improvements were maintained at 3- and 9-month follow-up.	Inconclusive
Lambert (2021)	[+] Diffusion Tensor Imaging results indicated post-intervention increases in fractional anisotropy of the bilateral hippocampal cingulum, left anterior corona radiata, middle cingulum, left anterior thalamic radiation, and left cerebellum. [+] Resting state functional magnetic resonance imaging results demonstrated a post-intervention decrease in the overall resting functional connectivity of the posterior default mode network and post-intervention increases in the cerebellar and visual networks.	Positive
Larkey (2016)	[+] Qigong/Tai Chi Easy and sham Qigong groups demonstrated pre-to-post intervention improvements in self-reported cognitive function (based on the FACT-Cog PCI and Impact on QoL subscales), with no significant differences between groups. [+] Time effect for Letter Number Sequencing and Digit Span scores; no group or time-by-group effect.	Positive
Leach (2015)	[0] FACT-Cog subscale scores did not change from baseline to 12 weeks.	Inconclusive
Leach (2016)	[0] No differences in perceived cognitive functioning from baseline to 12 weeks, nor from baseline to 24 weeks.	Inconclusive
Livingston (2015)	[0] No significant differences in perceived cognitive functioning from baseline to follow-up.	Inconclusive
Mijwel (2018)	[+] Self-reported cognitive functioning remained unchanged for the resistance and high-intensity interval training group compared to declines reported by the control group; mean change did not differ from the moderate-intensity aerobic and high-intensity interval training group. [0] Mean change in self-reported cognitive function did not differ between moderate-intensity aerobic and high-intensity interval training group versus the control group.	Inconclusive
Miki (2014)	[+] Main (time, group) and interaction (time-by-group) effects were observed; Frontal Assessment Battery scores (consisting of six domains: conceptualization [Similarities], mental flexibility [Lexical Fluency], programming [Luria Motor Sequence], sensitivity to interference [Conflicting Instructions], inhibitory control [Go/No-Go Test], and environmental autonomy [Comprehension Behaviour] improved more for the intervention group as compared to the control group.	Positive
Morielli (2021)	[-] Cognitive functioning decreased from baseline to post-chemoradiation in the exercise group as compared to the usual care group. [0] No differences observed for cognitive functioning post-chemoradiation.	Negative
Myers (2019)	[+/0] FACT-Cog PCI scores improved for the Qigong and gentle exercise groups as compared to the support group from baseline (T1) to 4 weeks post-intervention (T3), but not from T1 to post-intervention (T2); no differences in change between Qigong and gentle exercise groups. [+/0] FACT-Cog PCA subscale scores improved for the Qigong compared to the support group from T1 to T3 but not from T1 to T2; no differences in change between Qigong and gentle exercise groups or between the gentle exercise and support groups. [+/0] PROMIS cognitive general concerns scores improved from T1 to T2, but not from T2 to T3 in all three groups scores; no differences between groups were noted. [0] No group differences noted for PROMIS cognitive abilities short form scores. [+/-/0] For neuropsychological tests, the Qigong group improved more than the gentle exercise group on the TMT-A from T1 to T3, the support group improved more than the gentle exercise group on the F-A-S Test of Verbal Fluency from T1 to T3, and the gentle exercise group improved more on the Rey Auditory Verbal Learning Test (RAVLT) for memory (RAVLT delay) than the support group; no group differences were found for RAVLT 1-5 total, RAVLT interference, RAVLT post interference, RAVLT recognition A, RAVLT recognition B, or TMT-B.	Inconclusive
Northey (2019)	[0] No significant time-by-group interaction effects for verbal learning, episodic memory, executive function, nor working memory.	Inconclusive
Nusca (2021)	[+] Cognitive functioning was better 2 months after the start of exercise (T1) in the intervention group as compared to the control group. [0] No group differences in cognitive functioning 2 months at T1.	Inconclusive

Oechsle (2014)	[+] Intervention group had lower impairment of cognition (based on the Modified Fatigue Impact Scale) after the completion of chemotherapy as compared to the control group. [0] Cognitive functioning (based on the EORTC QLQ-C30) did not differ between the intervention and control groups.	Inconclusive
Oh (2010)	[0] No significant differences between intervention and control groups on the Profile of Mode States confusion subscale.	Inconclusive
Oh (2012)	[+] Intervention group reported significant improvements in cognitive functioning (based on the EORTC QLQ-C30 and 3 FACT-Cog subscales [PCI, PCA, Impact on QoL]) as compared to those in the usual care group at 10 weeks follow-up after controlling for baseline scores.	Positive
Park (2021)	[+] Cognitive functioning improved from baseline to post-intervention.	Positive
Pasyar (2019)	[0] No significant difference in self-reported cognitive functioning between groups 4 or 8 weeks after starting the intervention.	Inconclusive
Peterson (2018)	[+/0] Verbal fluidity (based on the Controlled Oral Word Association Test [Gender, Age, and Education]) improved in the cancer control group but no changes were observed on other tests (i.e., Brief Cognitive Screen, Logical Memory [I, II, & %], TMT [A & B], Block Design, Letter Number Sequencing, Coding). [0] No changes were observed for the cognitive training or aerobic plus cognitive training groups. [+/0] Aspects of verbal learning and memory (Logical Memory I & II), perceptual reasoning (Block Design) and working memory, executive function, and attention (Letter Number Sequencing) improved in the aerobic training group; no changes were observed on other tests (i.e., Brief Cognitive Screen, Logical Memory %, TMT [A & B], Coding, Controlled Oral Word Association Test [Gender, Age, and Education]).	Inconclusive
Peterson (2020)	[+/0] Patient increased from pre- to post-intervention in 6/12 cognitive tests.	Inconclusive
Poier (2018)	[+] Cognitive functioning increased in the multimodal therapy (i.e., comprised of sleep education, psychoeducation, eurythmy therapy, painting therapy) and combination therapy (i.e., comprised of multimodal therapy plus aerobic training) groups compared to baseline after 10 weeks of intervention (T1) and 6 months later (T2); increases were only observed at T1 for the aerobic training group. [0] Cognitive functioning did not differ at T1 or T2 between the combined therapy and aerobic training groups; it was better in the multimodal therapy group at T2 as compared to the aerobic training group, but no differences were observed at T1.	Positive
Reid-Arndt (2012)	[+/0] Changes in neuropsychological test scores were observed on measures of immediate memory (Rey Auditory Verbal Learning Test [Trial 1, Trials 1-5], Logical Memory I), delayed memory (Logical Memory II), verbal fluency (Controlled Oral Word Association Test), attention (TMT-A), and executive function (TMT-B, Stroop Test); however, reliable change index analyses with group mean scores for these 8 measures indicated they did not meet criteria for reliable change. Additionally, no differences were observed for the Digit Symbol Test. [+] Self-reported cognitive functioning improved for verbal and visual memory (based on the Multiple Abilities Self-Report Questionnaire).	Inconclusive
Riggs (2017)	[+/0] Independent of training, fractional anisotropy and hippocampal volume increased over time. [+] Training resulted in increased fractional anisotropy across the corpus callosum, cingulum, and superior longitudinal fasciculi bilaterally, and the right corticospinal tract and inferior frontal occipital fasciculus; a carryover effect was also observed (increases in fractional anisotropy continued even 12 weeks after training had ended). [+/0] Training resulted in increased hippocampal volume in the group setting, but not in the combined group/home setting; a carryover effect was also observed (increases in fractional anisotropy continued even 12 weeks after training had ended). [+/0] Time, training, and carryover effects were observed for reaction time (but not accuracy) in the group setting, but not in the combined group/home setting; that is, reaction time increased over time, training was associated with a decreased reaction time, and participants continued to show decreased reaction time 12 weeks after training had ended. *Results from analyses involving non cancer age- and sex-matched controls are omitted.*	Inconclusive
Rogers (2009)	[0] No group, time, or time-by-group interaction was noted for cognitive function (based on FACT-Cog Total nor subscales).	Inconclusive
Rosero (2020)	[+] Self-reported cognitive functioning (based on the Mini-Mental State Examination) increased in the intervention group but not in the control group; group difference in change was observed. [0] Self-reported cognitive functioning (based on the EORTC QLQ-C30) did not change in either group; no group difference in change was observed. [0] Verbal fluency and TMT-A scores did not change in either group; no group difference in change was observed.	Inconclusive
Saarto (2012)	[+] Improvements in cognitive functioning in the intervention group as compared to the control group.	Positive
Sabel (2017)	[0] No change in sustained attention, disinhibition, mean reaction time, selective attention, visual attention, general working memory, verbal working memory, complex word span, immediate memory, simple spatial span, complex spatial span, general spatial working memory, verbal learning, immediate recall, delayed	Inconclusive

	recall, information, copying capacity, copying time, recognition, psychomotor processing speed/implicit learning, verbal phonemic fluency, verbal semantic fluency, interference, nor intelligence quotient from baseline to post-intervention.	
Salerno (2019)	[+] A time-by-session effect for reaction time was observed such that participants were faster from pre- to post-exercise as compared to no change from pre- to post-rest. [+/0] A time-by-session-by-MVPA effect was observed (faster reaction time from pre- to post-exercise in women with at least 45 min of MVPA/day as compared to slower reaction time from pre- to post-rest and no change in reaction time after either session (e.g., exercise, rest) for women engaging in less than 45 mins of MVPA/day. Additionally, no time-by-session effect for accuracy. [0] No time-by-session effect on spatial working memory (3- and 4-item response accuracy) and analyses for MVPA were not significant.	Inconclusive
Salerno (2020)	[0] No time-by-group-by-duration on incongruent Flanker Test accuracy nor incongruent reaction time, nor for accuracy or reaction time on the congruent task; main effect of time was observed for reaction time on the incongruent task such that participants performed slower over time regardless of whether they walked or sat. [0/+] No time-by-group-by-duration for spatial working memory, but time-by-group effect was observed for reach time on 2-dot trial (i.e., shorter reaction time after exercise compared with rest, irrespective of assigned duration group). [0/+] No time-by-group-by-duration on reaction time nor accuracy on the single task block; time-by group effect was observed in the 10-min duration group for reaction time (i.e., slower performance after sitting), a main effect for time for both accuracy and reaction time (i.e., more accurate but slower over time across walking and sitting conditions), and time-by-group effect for reaction time (i.e., slower performance after the sitting condition regardless of duration group). [0/+] No time-by-group-by-duration for reaction time on the processing speed task nor a time-by-group condition in either the 10- or 30-min duration groups; time-by-group effect was observed in the 20-min duration group (i.e., faster performance after walking compared with after sitting), time effect for accuracy (i.e., increased regardless of activity or duration group), and a time-by-group condition for reaction time (i.e., women performed faster after walking regardless of how long they walked)	Inconclusive
Schmidtt, M (2015)	[0] No intervention effect on cognitive fatigue (based on the Fatigue Assessment Questionnaire) nor cognitive function (based on the EORTC QLQ-30). [+/0] Objective cognitive function (based on the TMT) improved within the exercise group; however, no between-group difference was found.	Inconclusive
Schmidtt, T (2015)	[+/0] Resistance training, endurance training, and standard care groups all showed improvement in objective cognitive function (based on the D2 Test of Attention). [+/0] Resistance training and standard care groups (but not the endurance group) showed improvements in subjective cognitive function (based on the EORTC QLQ-30).	Inconclusive
Schwartz (2002)	[-/0] Exercise only group declined in cognitive function from baseline to 4 months, whereas those who took methylphenidate (in addition to exercise) maintained a stable level of function (based on the TMT-A). [-/0] Exercise only group declined in cognitive function from baseline to 4 months, whereas those who took methylphenidate (in addition to exercise) improved performance at 4 months (based on the TMT-B).	Inconclusive
Spreafico (2021)	[0] Cognitive fatigue did not differ between the exercise and no-exercise groups.	Inconclusive
Steindorf (2014)	[0] No change in cognitive fatigue (based on the Fatigue Assessment Questionnaire) nor cognitive function (based on the EORTC QLQ-30). [+/0] Objective cognitive performance improved in the exercise and relaxation groups (based on the TMT); however, no between-group differences were observed.	Inconclusive
Trinh (2021)	[+/0] Between group differences in mean change (adjusted for baseline values and months since treatment) for the Auditory Verbal Learning Test-Raw score, but not for the Picture Vocabulary Test-Fully Corrected, Oral Reading Recognition-Fully Corrected, Flanker Task-Fully Corrected, Dimensional Change Card Sort Test -Fully Corrected, Picture Sequence Memory Test-Fully Corrected, List Sorting Working Memory Test-Fully Corrected, Pattern Comparison Processing Speed Test-Fully Corrected, Oral Symbol Digit Test-Raw score, Fluid Cognition Composite Score-Fully Corrected, Crystallized Cognition Composite Score-Fully Corrected, nor Cognitive Function Composite Score-Fully Corrected. [0] No clinically meaningful changes observed in self-reported cognitive function (based the FACT-Cog and its subscales.	Inconclusive
Vadiraja (2009)	[+] Improvement in cognitive function in the yoga intervention group (but not in the control group) following the intervention; improvements were greater as compared to controls.	Positive
Van Weert (2010)	[+] Mental fatigue (based on the Multidimensional Fatigue Index) decreased in the physical training plus Cognitive Behavioural Therapy and physical training groups, but not in the waitlist group [+/0] Decreases in mental fatigue were greater for the physical training group in comparison to waitlist group, but no difference in decrease between physical training and Cognitive Behavioural Therapy and waitlist groups was observed. [+] No difference in reduction in mental fatigue was found between the physical training and physical training plus Cognitive Behavioural Therapy groups.	Positive
Vaquero (2020)	[0] No significant main effect, pre–post, or between-group differences found for any of the neuropsychological measures. [+] Main effect of group in two clusters in the bilateral hippocampi; secondary analyses revealed intervention group presented greater grey matter volume in the left hippocampus across time compared to the non-intervention group. Additionally, a time-by-group effect was found for grey matter volume in the left	Inconclusive

	hippocampus (i.e., intervention group started with greater grey matter volume and showed an increase in grey matter volume after the intervention, whilst non-intervention group showed a grey matter volume decrease). [0] No effects were found for grey matter volume in the right hippocampus. [0] Grey matter volume values at T1 in both left and right hippocampi negatively and significantly correlated with the T2-T1 difference the Active-Q scores (patients with greater grey matter volume bilaterally at baseline started and ended the experiment with almost the same level of daily PA).	
Wiskemann (2011)	[0] No effects shown for mental fatigue (based the Multidimensional Fatigue Index) nor on cognitive function (based on the EORTC-QLQ30).	Inconclusive
Wurz (2021)	[0] No notable differences in executive functioning during task performance from pre- to post-intervention (based on the Letter N-Back and Go/No Go tests). [+] Neural activity (as detected by the BOLD signal) increased from pre- to post-intervention when completing the Letter N-Back test; the largest increases were seen in a cluster of 132,060 voxels and included the left inferior frontal operculum, supplementary motor area, left precentral gyrus, and middle cingulate gyrus. [+] Neural activity increased in several brain regions from pre- to post-PA intervention while completing the Go/No Go test; the most significant increases were observed in two large clusters including the right cerebellum, supplementary motor area, precentral gyrus, and right superior frontal gyrus.	Positive
Zimmer (2018)	[+] Cognitive functioning significantly improved from baseline (T0) to 8 months post-intervention (T1). [+] Cognitive functioning was associated with reduced mental fatigue at T1.	Positive

Notes. CCSS=Childhood Cancer Survivor Study; CNS=central nervous system; DMS=delayed match-to-sample; EORTC QLQ-C30=European Organization for Research and Treatment of Cancer Quality of Life Questionnaire–Core 30; FACT-Cog=Functional Assessment of Cancer Therapy–Cognitive Function; fMRI=functional magnetic resonance imaging; LPA=light physical activity; MET=metabolic equivalent; MPA=moderate physical activity; MVPA=moderate-to-vigorous physical activity; NIH=National Institutes of Health; PA=physical activity; PCA=perceived cognitive abilities; PCI=perceived cognitive impairment; PROMIS=Patient-Reported Outcome Measurement Information System; QoL=quality of life; RVP=rapid visual processing; TEA=Test of Everyday Attention; TMT=Trail Making Test; VPA=vigorous physical activity; VVLT=Visual Verbal Learning Test; WAIS=Wechsler Adult Intelligence Scale; WASI=Wechsler Abbreviated Scale of Intelligence; WISC=Wechsler Intelligence Scale for Children; WMS=Wechsler Memory Scale

[a]Assessed the effect of cognition on PA.

Article Title: A scoping review of studies exploring physical activity and cognition among persons with cancer

Journal Name: Journal of Cancer Survivorship

Authors: Jennifer Brunet, PhD[1,2,3*] & Sitara Sharma, MA[1]

***Correspondence should be addressed to:**

Jennifer Brunet, Full Professor

[1] School of Human Kinetics, University of Ottawa

125 University (MNT 339), Ottawa, ON Canada K1N 6N5

[2] Institut du savoir Montfort, l'Hôpital Montfort, Ottawa, ON Canada

[3] Cancer Therapeutic Program, Ottawa Hospital Research Institute, Ottawa, ON Canada

Email: jennifer.brunet@uottawa.ca

Tel.: 613-562-5800 (3068)