



Canadian kids need to move more to boost their brain health

2018

The ParticipACTION Report Card on
Physical Activity for Children and Youth

The Brain + Body Equation

The 2018 ParticipACTION Report Card on Physical Activity for Children and Youth

is the most comprehensive assessment of child and youth physical activity in Canada. The Report Card synthesizes data from multiple sources, including the best available peer-reviewed research, to assign evidence-informed grades across 14 indicators. The Report Card has been replicated in over 50 cities, provinces and countries, where it has served as a blueprint for collecting and sharing knowledge about the physical activity of young people around the world.

The 2018 Report Card includes an **Expert Statement on Physical Activity and Brain Health in Children and Youth** — based on the findings of a team of experts in paediatric neuroscience and exercise science. This Statement was written after multiple reviews, discussions and consultations with stakeholders. The findings are applicable to all Canadian kids, regardless of gender, cultural background or socio-economic status, including those with disabilities.

This is the Highlight Report; to download the Full 113-page Report and corresponding citations, please visit

www.participACTION.com/reportcard.





The Science Is In

KIDS + STEPS + SWEAT = HEALTHIER BRAINS

Kids need to drop the phones, turn away from the screens, get off the couch and break a sweat. It's time for them to get moving more – for the sake of their brains.

For decades we've known that physical activity improves heart health, helps maintain healthy body weights and builds strong bones and muscles in kids across a range of skills and abilities.^{1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25} **Now we are taking a closer look at what physical activity does for one of their most vital and complex organs: the brain.**

The data around physical activity are alarming: on average, kids are still sitting too much and moving too little to reach their full potential.

Only 35% of 5- to 17- year-olds are reaching their recommended physical activity levels as outlined in the Canadian 24-Hour Movement Guidelines for Children and Youth. Just 62% of 3- to 4-year-olds are achieving the recommended activity levels for their age group. In addition, 51% of 5- to 17-year-olds and 76% of 3- to 4-year-olds are engaging in more screen time than is recommended by the Canadian 24-Hour Movement Guidelines for recreational screen-based sedentary behaviours.

Why does this matter? It's all about **the brain + body equation.**

There are important connections between the health of the body and of the brain, connections that must be fostered in order for kids to reach their mental, emotional and intellectual potential. Kids' bodies have to move to get the wheels in their brains turning. They need to be active. Their brain health depends on it. A growing body of evidence indicates that physical activity in childhood is essential for a healthy brain and leads to improved:

- thinking and learning
- emotional regulation and self-control
- problem-solving ability
- memory
- brain plasticity – the growth of new brain tissue
- stress management
- ability to cope with anxiety and depressive symptoms
- self-esteem and self-worth
- attention and focus

+ Adding more physical activity to kids' routines could be the missing part of the equation to support their success in the classroom, on the field, and with their friends.

Moving > Cramming

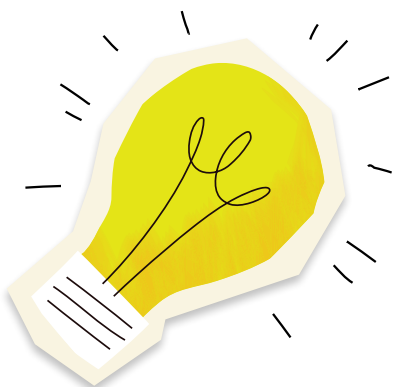
- Students who exercise before a test show stronger brain function than those who don't exercise before a test.²⁶ So, next time students feel the pressure to cram, encourage them to take an active break from studying: some heart-pumping physical activity may actually be the smarter study technique.
- When the body doesn't move enough, the brain can't perform to its fullest potential. Children with poor aerobic fitness appear to have more difficulty solving problems^{27,28,29} and are more likely to make mistakes when trying to sort out a challenge.³⁰

Busy Bodies = Bigger Brains

- Sections of the brain dedicated to memory and learning (hippocampus and basal ganglia) are larger in active children in comparison to their less active peers.³¹
- Being physically active can boost memory in children and youth,^{32,33} including children with brain-based disabilities (e.g., attention deficit hyperactivity disorder, autism spectrum disorder, cerebral palsy).^{34,35,36,37}

↑ Active Bodies = ↑ Innovative Ideas

- Active kids are better equipped to get creative.³⁰
- Even if they aren't artistic, creativity can manifest in think-on-your-feet scenarios such as strategizing for a game, leading a team project or solving a math problem. Without adequate physical activity, it's difficult for kids to tap into their full potential!



Zooming Around Helps Them Zoom In!

- Kids who participate in physical activity have more focus and longer attention spans, compared to their less active peers.^{32,33}
- This correlation appears to be consistent for all children and youth, including those with attention deficit hyperactivity disorder and autism spectrum disorder.³⁸

+ Boosting kids' physical activity levels could be the missing part of the equation in supporting their mental health.

Breaking a Sweat Releases Happy Hormones ∴ Kids Who Move Feel Great!

- Just like adults who love that "runner's high" from going the distance, kids who are active experience the same rush of feel-good brain chemicals (serotonin and dopamine).³⁷
- Children and youth who are fit benefit from this rush of chemicals and experience fewer depression-related symptoms than those who are not fit.^{35,36}
- Kids with brain-based disabilities are at an increased risk for mental health problems, so they have even more to gain from getting, and staying, active.³¹

↑ Movement = ↓ Symptoms of Anxiety

- Evidence suggests that physical activity may help lower feelings of anxiety in children and youth.^{39,40} Dance and team sports may be especially effective in children and youth with brain-based disabilities.^{41,42}
- Canadian kids are on the right track here, with **77% of 5- to 19-year-olds**^{2014-16 CANPLAY} and **46% of 3- to 4-year-olds**^{2012-13 and 2014-15 CHMS} participating in organized physical activities or sport.



↑ Movement = ↓ Stress

- Research suggests that physical activity is an effective tool in alleviating social and academic stress in young people; kids who are less active have measurably higher levels of the stress hormone cortisol in their bodies.⁴³
- Moreover, being active not only appears to bolster kids' resiliency when they are dealing with stress, but it appears to help them recover from stressful situations faster.⁴³
- Being active outdoors, even for a simple walk, is a powerful antidote for adolescents facing stress.⁴⁴ But with **only 37% of 11- to 15-year-olds in Canada playing outdoors for more than 2 hours per day (outside of school hours)**,^{2013-14 HBSC} we have a long way to go to ensure they are reaping these mental health benefits.

↑ Movement = ↑ Self-Esteem

- Social media plays a major role in self-esteem for many young people. Kids are subjected to never-ending online scrutiny from their peers. Getting active can be a protective tool to bolster kids' self-esteem, confidence and self-worth.²⁰

- Real-world physical activity can distract them from these virtual experiences that can erode how they perceive themselves.⁴⁵
- When children and youth get active, research shows that they have improved self-esteem, which in turn leads to better moods and an overall more positive sense of satisfaction with how they perceive themselves.^{46,47,48,49,50,51} Yet, **5- to 11-year-olds and 12- to 17-year-olds in Canada spend 2.3 and 4.1 hours per day, respectively, in recreational screen time pursuits**,^{2014-15 CHMS} leaving little time for offline, active movement.

We all want to see Canadian kids realize their potential physically, emotionally and cognitively. A healthy brain is one of their greatest resources – today and into the future. Engaging kids in daily physical activity may be the most accessible, but underutilized, way to support them on this journey. Let's work to balance the equation.

**THE SCIENCE IS IN.
KIDS + STEPS + SWEAT =
HEALTHIER BRAINS**

GRADE

D+

Overall Physical Activity

Canadian kids aren't active enough.

- 35% of 5- to-17-year-olds meet the physical activity recommendation within the Canadian 24-Hour Movement Guidelines for Children and Youth (2014-15 CHMS, Statistics Canada). [Custom analysis](#)
- 62% of 3- to 4-year-olds meet the physical activity recommendation within the Canadian 24-Hour Movement Guidelines for the Early Years (2009-11, 2012-13 and 2014-15 CHMS, Statistics Canada).⁵⁷



Daily Behaviours

D Active Play & Leisure Activities

- 20% of 5- to 11-year-olds in Canada spend several hours a day (> 2 hours) in unorganized physical activity, according to their parents (2014-15 CHMS, Statistics Canada).^{Custom analysis}
- 37% of 11- to 15-year-olds in Canada report playing outdoors for several hours a day (> 2 hours) outside of school hours (2013-14 HBSC, WHO/PHAC).^{Custom analysis}

D- Active Transportation

- Based on parent- and self-report data on 5- to 19-year-olds in Canada, 21% typically use active modes of transportation (e.g., walk, bike), 63% use inactive modes (e.g., car, bus) and 16% use a combination of active and inactive modes of transportation to travel to and from school (2014-16 CANPLAY, CFLRI).¹⁰⁶

B Organized Sport Participation

- According to parents, 77% of 5- to 19-year-olds participate in organized physical activity or sport (2014-16 CANPLAY, CFLRI).¹⁴⁵
- According to parents, 46% of 3- to 4-year-olds spend time in physical activity through participation in organized lessons, or league or team sports (2012-13 and 2014-15 CHMS, Statistics Canada).^{Custom analysis}

C- Physical Education

- According to school administrators who reported on physical education time, 33% of grade K-8 students in Canada are getting at least 150 minutes of physical education (PE) per week (2015 OPASS, CFLRI).^{Custom analysis}
- 72% of high school students in Canada are taking PE, according to school administrators (2015 OPASS, CFLRI).^{Custom analysis}
- 61% of students in grades 9 to 12 in Alberta, British Columbia, Nunavut, Ontario and Quebec are taking a PE class in the current school year (2016-17 COMPASS, University of Waterloo).^{Custom analysis}

D Sedentary Behaviours

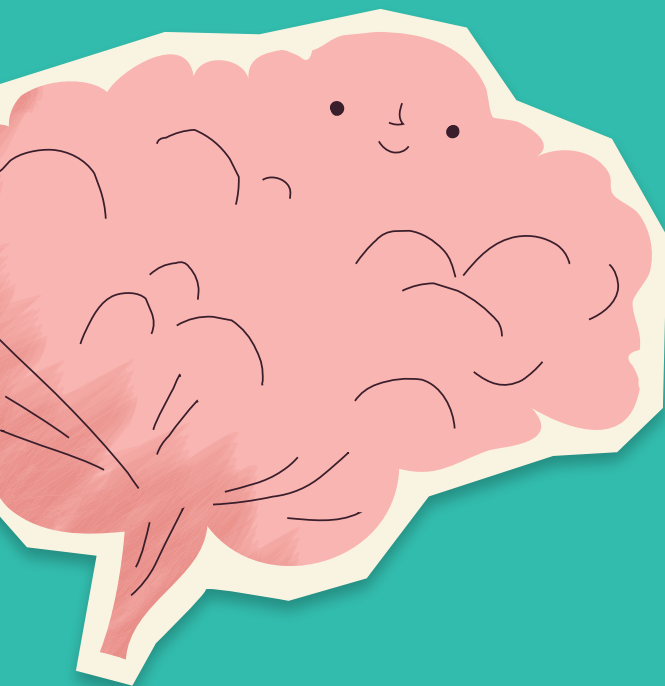
- The proportion of children and youth in Canada meeting the screen time recommendation within the Canadian 24-Hour Movement Guidelines for Children and Youth varies considerably (6-54%) by dataset and age group.
- 24% of 3- to 4-year-olds in Canada meet the screen time recommendation within the Canadian 24-Hour Movement Guidelines for the Early Years (2009-11, 2012-13 and 2014-15 CHMS, Statistics Canada).⁵⁷

B+ Sleep

- Approximately three quarters of 5- to 17-year olds in Canada meet the sleep recommendation within the Canadian 24-Hour Movement Guidelines for Children and Youth (2014-15 CHMS, Statistics Canada).⁵²
- 84% of 3- to 4-year-olds in Canada meet the sleep recommendation within the Canadian 24-Hour Movement Guidelines for the Early Years (2009-11, 2012-13, 2014-15 CHMS, Statistics Canada).⁵⁷

F 24-Hour Movement Behaviours

- 15% of children and youth in Canada meet all three recommendations within the Canadian 24-Hour Movement Guidelines for Children and Youth (2014-15 CHMS, Statistics Canada).^{Custom analysis}
- 13% of 3- to 4-year-olds in Canada meet all three recommendations of the Canadian 24-Hour Movement Behaviours for the Early Years (2009-15 CHMS, Statistics Canada).⁵⁷



Individual Characteristics

D+ Physical Literacy

- 36% of 8- to 12-year-olds in Canada assessed by the Canadian Assessment of Physical Literacy (CAPL) meet or exceed the minimum level recommended for physical literacy. (2014-17 CAPL, HALO).²³⁷

D Physical Fitness

- 9- to 12-year-olds in Canada are at the 28th percentile, on average, for cardiorespiratory fitness based on age- and sex-specific international normative data²⁵³ (2014-17 CAPL, HALO).^{Custom analysis}

Settings & Sources of Influence

C+ Family & Peers

- 92% of students in grades 9 to 12 in Alberta, British Columbia, Nunavut, Ontario and Quebec report having parents/step-parents/guardians who support them in being physically active (2016-17 COMPASS, University of Waterloo).^{Custom analysis}
- 36% of parents in Canada with 5- to 17-year-olds report typically playing active games with their kids (based on a subsample of the 2014-15 PAM, CFLRI).^{Custom analysis}

B- School

- 74% of school administrators in Canada report that they use a PE specialist to teach PE in their school (2015 OPASS, CFLRI).²⁹⁷
- 48% of school administrators in Canada report having a fully implemented policy to provide daily physical education to all students (2015 OPASS, CFLRI).²⁹⁶

B+ Community & Environment

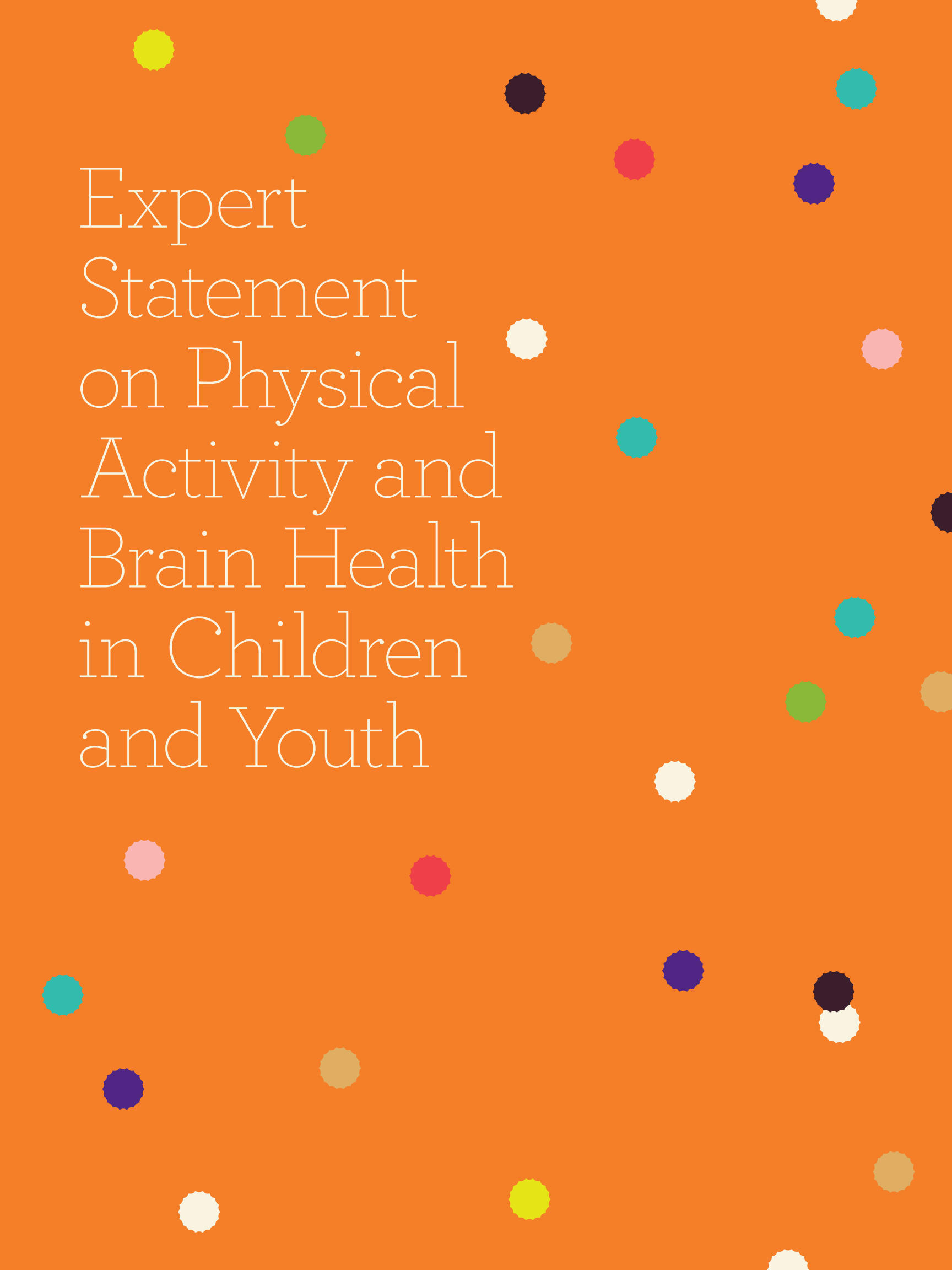
- Among municipalities with at least 1,000 residents, 35% have formal strategies for physical activity and sport opportunities (2015 SPAOCC, CFLRI).³¹⁷
- Less than 20% of parents report that crime, traffic or poorly maintained sidewalks are an issue in their neighbourhood (based on a subsample of the 2014-15 PAM, CFLRI).^{Custom analysis}

Strategies & Investments


C+ Government

- The 2018 federal budget highlighted the government's commitment to improving the country's physical activity levels by pledging to invest \$5 million per year for five consecutive years (totalling \$25 million) to ParticipACTION.³³⁹
- The federal budget also announced \$30 million over three years to support data, research and innovative practices to promote women's and girls' participation in sport. An additional \$47.5 million over five years, and \$9.5 million per year ongoing, was allocated to Indigenous sport.³³⁹





Expert
Statement
on Physical
Activity and
Brain Health
in Children
and Youth



For better brain health,
all children and youth
should be physically
active on a regular basis.
In addition to physical
health benefits, physical
activity also improves
cognition, brain function
and mental health.



BACKGROUND

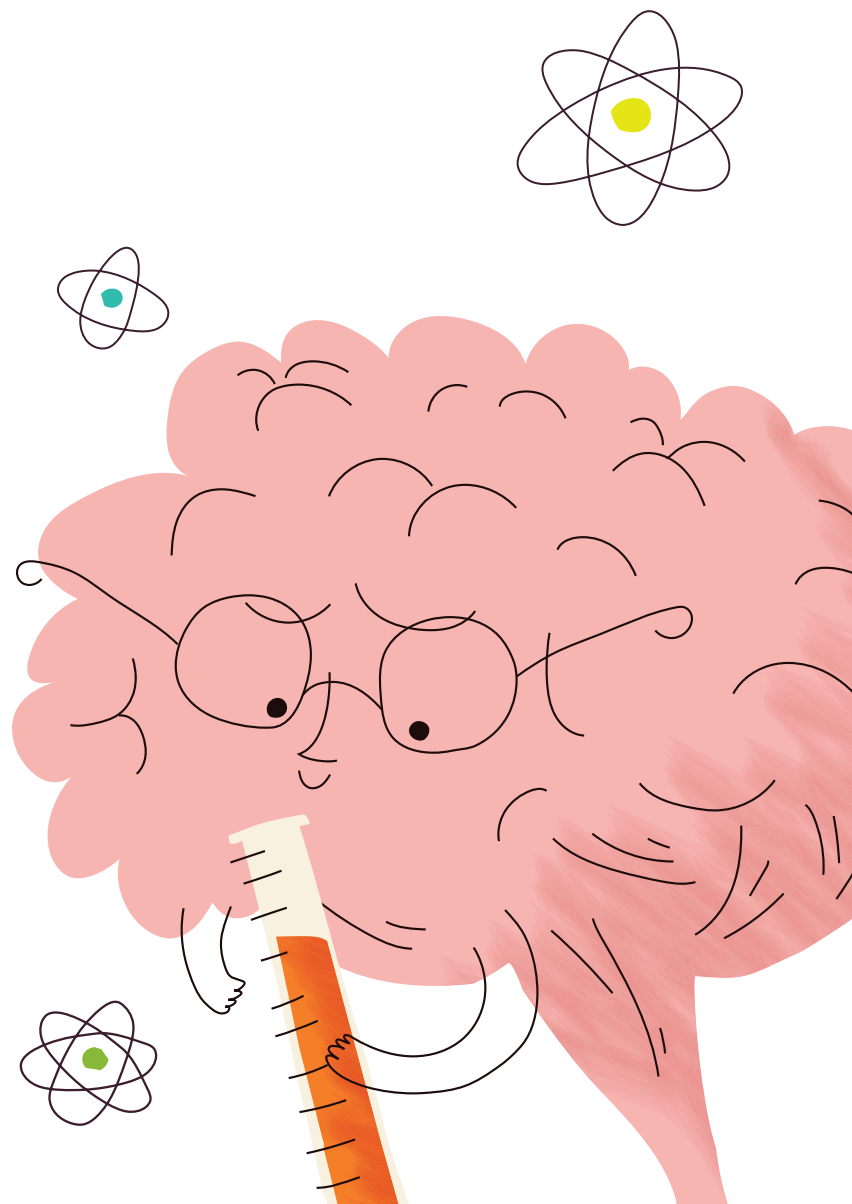
A team of experts in paediatric neuroscience and exercise science created this *Expert Statement*, looking at the relationship between **physical activity** and **brain health** in children and youth. The best available scientific evidence was used to inform the development of this report, and an expert advisory group provided feedback on its messaging. All members of the expert team approved this *Expert Statement*.


While the physical health benefits of childhood physical activity are well known (e.g., improved heart, bone and muscle health; prevention of type 2 diabetes),^{1,2,3} a growing body of research has begun to examine the benefits of childhood physical activity in relation to brain health. Emerging evidence suggests that physical activity in childhood and adolescence is associated with better **cognition** (i.e., thinking and learning), **brain function** (i.e., how the brain works) and **mental health** (i.e., emotional, psychological and social well-being).

The landscape of preventable chronic disease among children and youth is changing—and not for the better. The prevalence of overweight and obesity,⁴ diabetes,⁵ and use of health services for mental illness⁶ is high. These issues are more prominent in children and youth with **neurodevelopmental (brain-based) disabilities**,⁷ where physical activity participation can be challenging, and social inclusion is limited^{8,9,10} due to the initial diagnosis, inaccessible facilities, and financial constraints. Further, there is a lack of appropriate and modified equipment, as well as few professionals who are prepared or trained to promote physical activity among children and youth with brain-based disabilities.^{11,12,13} The majority of research in this population has focused on children and youth with Down syndrome and autism spectrum disorder; however, based on the evidence, it is anticipated that all children and youth, regardless of disability type, will benefit from physical activity.

Is inactive modern living hindering our children’s ability to develop optimally and perform well in all aspects of life? Have we created physical and social environments that no longer promote physical activity to the point that they are negatively impacting the brain health of our children and youth? This is something that society—parents, governments, healthcare professionals, non-profits—should seriously consider.

This *Expert Statement* applies to all children and youth (under 18 years), including those with brain-based disabilities, regardless of sex, cultural background or socioeconomic status.





How Does Physical Activity Help The Brain? The Evidence

COGNITION, BRAIN FUNCTION AND BRAIN STRUCTURE

Physical activity is broadly beneficial to how the brain controls thoughts and behaviours, and even how the brain is structured. These brain benefits occur after short bouts of physical activity and become more apparent with regular physical activity.

Improved Cognition and Behaviour

Participation in regular physical activity improves the ability of children and youth to meet academic expectations, with greater physical activity levels leading to better performance in subjects such as mathematics, reading/language, science and social studies.¹⁴ Active children and youth are better able to pay attention¹⁵ and to focus and concentrate on a given task for a longer period of time.¹⁶ This also appears to be true for children and youth with attention deficit hyperactivity disorder (ADHD)^{17,18} or autism spectrum disorder,¹⁹ with even a single bout of physical activity improving attention and focus.^{17,20} Physical activity has also been shown to be associated with better memory,²¹ both in typically developing children and youth and in children with ADHD.^{22,23,24,25}

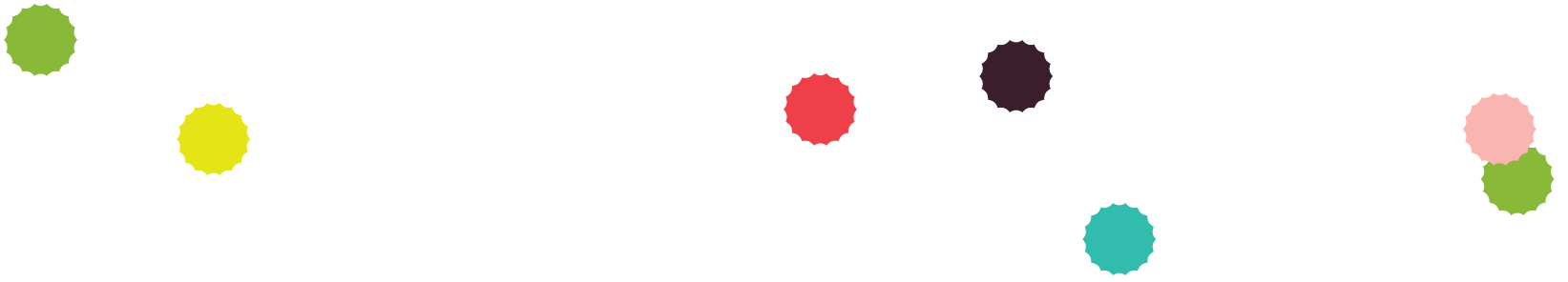
Physical activity also helps with **convergent** and **divergent thinking**,²⁶ leading to improvements in creative problem-solving and decision making.²⁷ Also, physical activity seems to beneficially impact the

cognitive aspects involved with behaviour regulation, known as **executive function**.^{24,28,29,30,31,32} Less active children and youth seem to have more difficulty than active children and youth in performing challenging and demanding tasks,^{33,34,35,36,37,38} and are also more likely to make more mistakes on these tasks.³⁹ It seems that children and youth who are less active or who have brain-based disabilities (such as autism spectrum disorder⁴⁰) experience the greatest benefits in executive function as a result of physical activity.^{17,34}

A primary goal for children and youth with brain-based disabilities is participation in regular physical activity. Physical activity has the potential to build the basic foundations to better communicate, socialize, increase self-control and maintain focus—leading to a healthier, higher **quality of life**.⁴¹

Enhanced Brain Function and Structure

Research suggests that physical activity can change the structure and function of the brain. Children and youth who are physically active have larger brain volumes in the areas involved with memory and executive functions, including the hippocampus (deals with memory and emotions)⁴² and basal ganglia (deals with routine/voluntary motor movements).⁴³ Physical activity can positively affect the amount of grey matter (i.e., the “living brain”)⁴⁴ as well as support better communication between grey and white matter (i.e., tissue that connects different parts of grey matter to each other).^{45,46,47} Active children and youth are also better able to “switch on” the brain regions responsible for high-level thinking.^{35,48} Markers of brain health appear to be sensitive to both single and repeated bouts of physical activity participation, with physical activity resulting in greater attention, motor skills and self-regulation.^{16,33,48,49,50,51}

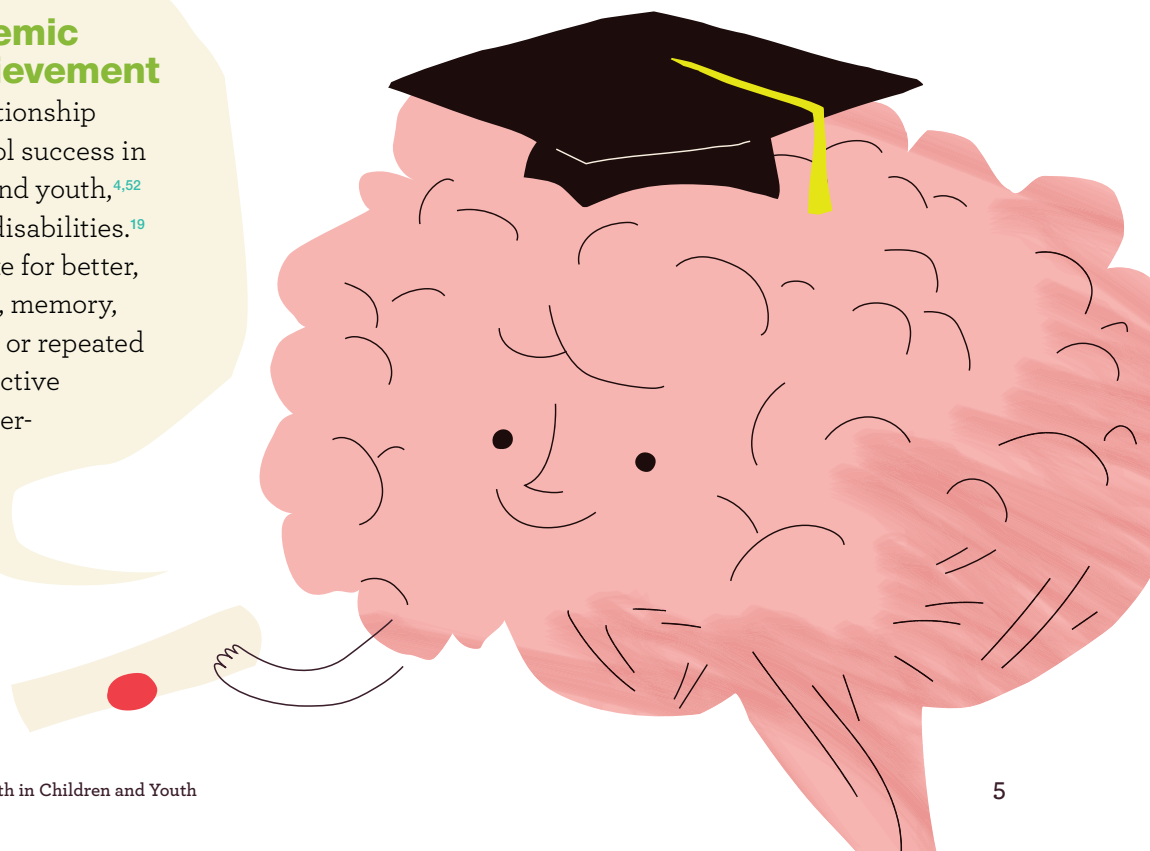


The current state of evidence highlights favourable relationships between physical activity and cognition. Many studies support a positive relationship between physical activity and brain function and structure.

Physical activity plays an important role in helping children and youth learn better, solve problems more creatively, and develop healthier brains. Children and youth who are least active or who have brain-based disabilities may have the most to gain.

A Tool for Academic and Scholastic Achievement

Research suggests a positive relationship between physical activity and school success in both typically developing children and youth,^{4,52} as well as children with brain-based disabilities.¹⁹ Many of the brain processes that make for better, more efficient learners—such as focus, memory, and recall—are enhanced after single or repeated bouts of physical activity. Overall, active children and youth make for better-achieving students.⁵³





MENTAL HEALTH

Physical activity can help support mental health and wellness among children and youth. It can help manage and prevent negative symptoms from occurring in the first place, and also promote positive emotions and self-esteem.

Reduction in Symptoms of Depression

Physical activity helps minimize **depressive symptoms** in children and youth.^{54,55,56,57,58,59,60}

Perceptions of control and the social nature of physical activity are two of the most understood reasons for how physical activity contributes to reduced depressive symptoms in children and youth. Additionally, research suggests that the rush in serotonin and dopamine—**neurotransmitters** or “feel-good” brain chemicals that are released while being physically active—may also play a role in promoting feelings of happiness in children and youth.⁶¹ Of note, children and youth with brain-based disabilities are at an increased risk for mental health problems,⁶² and potentially have more to gain from participating in physical activity. Long-term participation in physical activity may help with neurotransmitter release and improve emotional health.⁶³

While much of the published work highlights the effectiveness of physical activity in reducing depression,^{57,69} more evidence is needed to examine the impact of physical activity in preventing depression in children and youth.

Social Inclusion and Children with Disabilities

Children and youth with disabilities are less active.⁶⁴ Physical activity helps improve social integration which is a major challenge noted among children with brain-based disabilities.^{8,9,10,30,65,66} Physical activity provides opportunities for these children to enhance their interaction and communication skills,^{67,68} resulting in improved daily functions, health-related outcomes and quality of life.⁴¹

Decreased Feelings of Anxiety

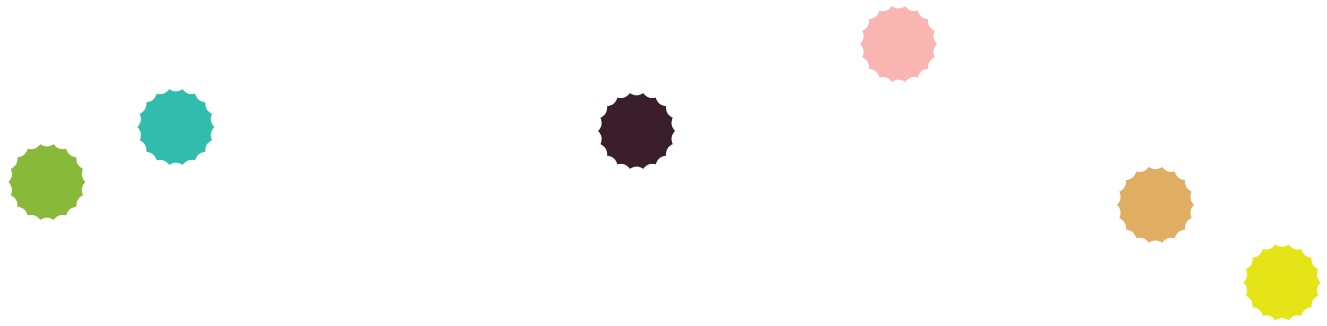
Though limited, preliminary evidence suggests that physical activity may play a role in the prevention and management of feelings of **anxiety** in children and youth,^{56,69} including children and youth with brain-based disabilities, such as ADHD and autism spectrum disorder.⁷⁰ Activities such as dance and team sports have specifically been highlighted in the literature as reducing feelings of anxiety in children and youth with brain-based disabilities.^{19,30} Physical activity can also serve as a short-term distraction from the anxious symptoms experienced by children and youth.⁷¹

Improved Stress Response

Although the mechanisms are largely unknown, higher levels of physical activity in children and youth are associated with lower stress and reduced **stress reactivity** (i.e., the body’s reaction to stress).^{72,73} Children and youth who have high levels of stress tend to spend more time being sedentary. In contrast, children and youth who participate in various types of physical activity seem to cope better with stress and display better resilience.^{73,74} The teenage years are a particularly vulnerable time of development, as various regions of the brain are undergoing many changes, which are negatively affected by stress. Fortunately, physical activity may improve these stress-induced changes.⁷⁵

Enhanced Self-esteem, Self-concept and Self-perception

Children and youth who engage in regular physical activity report better perceptions of themselves, including having higher **self-esteem**.^{69,76,77,78,79,80,81} Regular physical activity is associated with increased **self-concept** and **self-worth** in typically developing children and youth^{76,77,78,79,80,82} and in children with brain-based disabilities.^{83,84,85} Increased self-esteem can, in turn, promote better moods, increase life satisfaction, lessen symptoms related to anxiety and depression and shield children from the negative impacts of stress.



Collectively, the research indicates that physical activity plays a key role in preventing and reducing symptoms of depression and anxiety, in helping with stress management and in improving self-esteem in children and youth. Although initial evidence is promising, additional work is needed to clarify and confirm the relationship between physical activity and mental health in children and youth with brain-based disabilities.

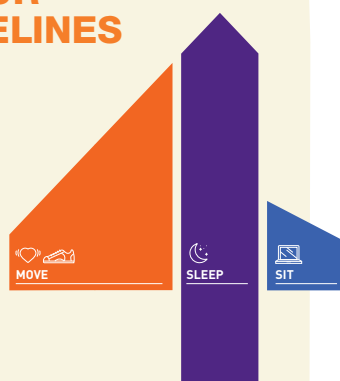
Overall, when it comes to mental health, physical activity can help children and youth who are experiencing low moods or stress, and can also provide benefits for all children and youth by helping them better manage stress and by promoting positive emotions. Physical activity supports and encourages mental and emotional wellness, with very little evidence suggesting harmful effects.

CANADIAN 24-HOUR MOVEMENT GUIDELINES

Physical Activity Recommendations

Under 1 Year

Being physically active several times daily in a variety of ways, particularly through interactive floor-based play—more is better. For those not yet mobile, this includes at least 30 minutes of tummy time spread throughout the day while awake.



1–2 Years

At least 180 minutes spent in a variety of physical activities at any intensity, including energetic play, spread throughout the day—more is better.

3–4 Years

At least 180 minutes spent in a variety of physical activities spread throughout the day, of which at least 60 minutes is energetic play—more is better.

5–17 Years

An accumulation of at least 60 minutes per day of moderate to vigorous physical activity involving a variety of aerobic activities. Vigorous physical activities, and muscle- and bone-strengthening activities, should each be incorporated at least 3 days per week.



csepguidelines.ca
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Physical Activity Recommendations for Brain Health

For healthy brain development, children and youth should be encouraged to participate in at least the daily minimum of physical activity recommended by the Canadian 24-Hour Movement Guidelines.^{17,34,86,87} However, some physical activity is better than none.

The benefits of physical activity can also build over time.⁸⁸ While some of the effects of physical activity are immediate, participation in regular physical activity supports long-term brain development and better mental health. In addition to immediately improving self-esteem, creativity and concentration, regular physical activity can increase **neuroplasticity** in children and youth,⁸⁹ creating new pathways in their brains and supporting better learning.^{14,17,21,44,70} It also improves brain blood flow, which increases the amount of oxygen flowing to the brain, and releases **neurotrophins** and neurotransmitters that support better brain function.^{61,63,90,91}

Children and youth with brain-based disabilities should be encouraged to engage in daily physical activity for improved brain health. With the prior approval of their healthcare provider, children and youth with brain-based disabilities should be encouraged to engage in a variety of activities at various intensities that are fun for them and appropriate for their skill-level and abilities. Supportive, accepting and modified environments, developmentally appropriate equipment, and trained coaching staff are essential.⁹² Most importantly, promoting daily physical activity among children and youth with brain-based disabilities will help foster feelings of happiness and mental wellness,^{93,94,95} as well as improve executive function.^{22,23,24,29,30,31,96,97,98,99,100} Physical activity can also improve sleep, a particular benefit to children and youth with brain-based disabilities, who often experience sleep problems that can greatly hinder their quality of life.^{101,102}



Tips to Promote Brain Health

Parents and Families

- Encourage children and youth to meet the daily physical activity guidelines for their age, and support them in their efforts.
- Promote age-appropriate outdoor play as a way of improving decision making, problem-solving and self-confidence.
- Become aware of sport and physical activities that are appropriate for the skill level and abilities of children and youth.
- Learn about funding opportunities for participation in sports and recreation activities by children and youth.
- Explain the child's strengths and needs to local physical activity and recreation providers so the instructors have the knowledge required to ensure an inclusive environment/experience.
- Be active as a family. This encourages physical activity, togetherness, social support and connectedness, which are all important for good mental health.
- Seek out quality programming with trained instructors that support **physical literacy**.

Healthcare Professionals

- Recommend children and youth meet the Canadian physical activity guidelines to promote good brain health.
- Recommend and/or “prescribe” physical activity to complement the prescribed medical course of treatment for anxiety, depression and focus-related conditions (such as ADHD) among children and youth.¹⁰³
- Be familiar with community-based inclusive programming (e.g., Special Olympics, ParaSport programs, disability-specific sporting organizations).
- Share information with community physical activity and recreation providers to help them better support children and youth with brain-based disabilities.
- Assist families with funding requests for specialized adapted sports equipment if required for independent participation.

Educators

- Provide daily opportunities for physical activity and active play during school and childcare hours.
- Include active learning strategies in daily school curriculum and childcare programming.
- Interrupt long periods of sitting with active breaks.
- Educate children, youth and families that regular physical activity is good for the brain as well as the body.
- Avoid using the removal of opportunities for physical activity and outdoor play as punishment.
- Be informed about adaptations/modifications to physical education curriculum (e.g., FUNdamentals through Special Olympics, Canadian Paralympics Committee FUNdamental resource, ParaSport education and awareness opportunities) to increase inclusivity and participation.
- Personalize physical activity programs for children and youth with brain-based disabilities using a strength-based approach.

Recreation, Coaching and Community Representatives

- Support the availability of specially trained staff and settings that facilitate physical activity for all children and youth, including those with disabilities.
- Encourage the development of inclusive and universally designed play opportunities, resources and spaces.
- Provide personalized, accepting and respectful play environments for all children and youth, including children with brain-based disabilities.
- Foster the growth and development of specialized and inclusive programming.
- Seek funding opportunities to support the development of inclusive and accessible programming for children and youth with disabilities.
- Provide programming during optimal timeslots for parents and their children and youth with disabilities.
- Create positive awareness and introductory events to introduce children and youth to available programming.

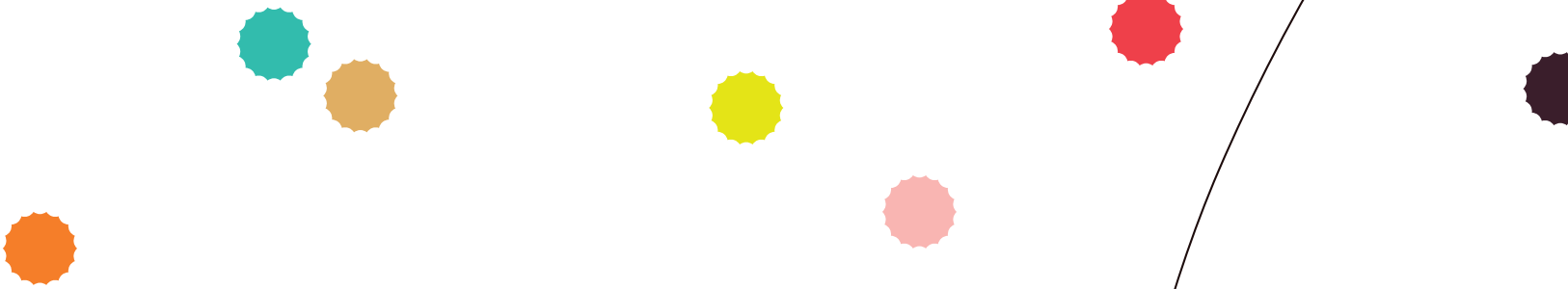
- Communicate with families and community members to ensure they are aware that children and youth with brain-based disabilities are welcome to participate in programs.
- Ensure instructors and coaches are trained in promoting physical literacy and strength-based programming.

Government Officials

- Recognize physical activity as both a physical, cognitive and mental health promotion strategy at a population level.
- Continue to legislate and create policies that encourage and/or mandate physical activity during school and childcare hours.
- Provide additional funding and subsidies for low-income families as well as families with children and youth with disabilities, to help decrease barriers to participation.
- Recognize the need for, and provide additional funding for, specialized staff training and increased programming options/resources (e.g., community organizations, healthcare facilities).
- Provide training opportunities for educators about active learning strategies.
- Allocate additional granting opportunities to service providers to increase inclusion and accessibility.
- Provide increased funding for inclusive indoor and outdoor play spaces and equipment.
- Support awareness and education campaigns about the benefits of physical activity for child and youth brain health across all levels of abilities.

Research Gaps and Future Directions

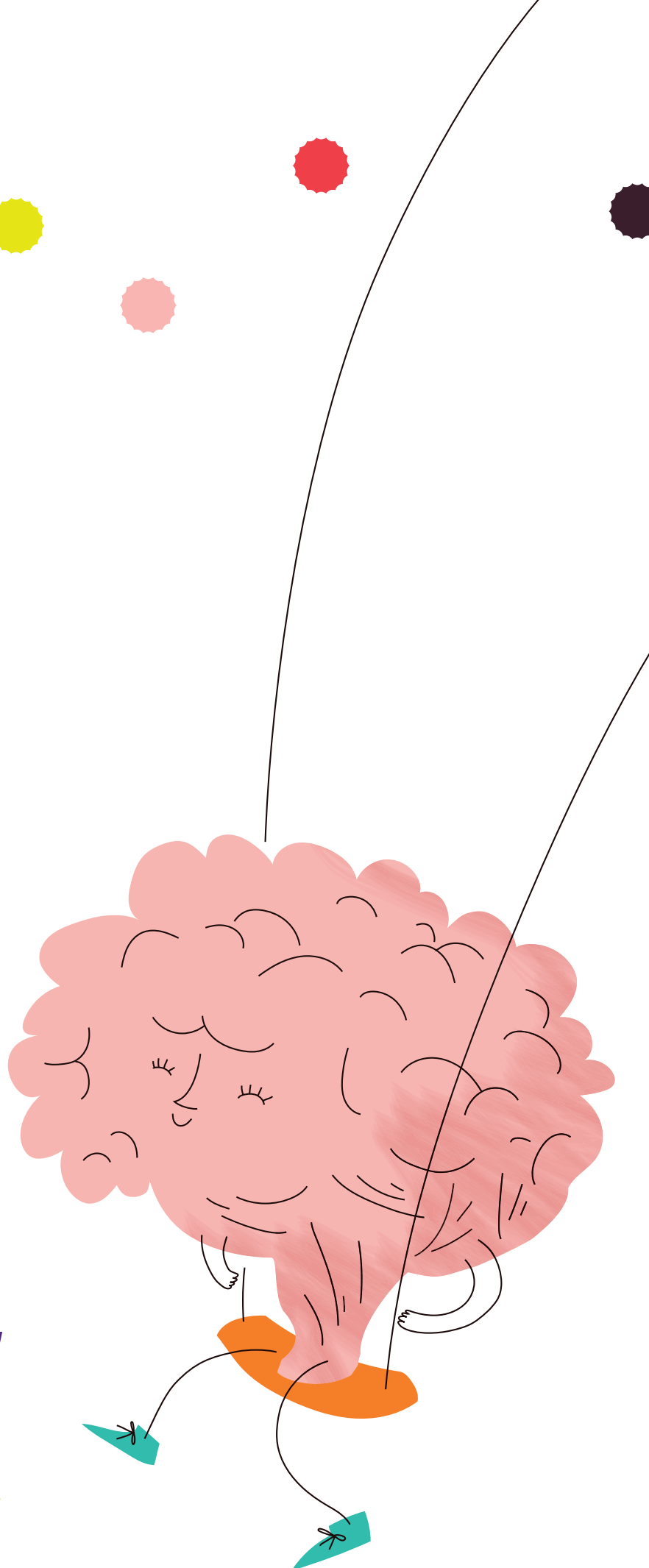
- More studies are needed to look at the long-term effects of physical activity on child and youth brain development.
- More investigations are needed to understand the amount and intensity of physical activity needed to improve and support positive brain health.
- More research examining the impact of physical activity on the mental health outcomes of children and youth with brain-based disabilities is needed.
- A more focused look at the relationship between physical activity and brain health across all disability categories is necessary.
- Further investigations into the development of physical literacy for long-term physical activity and its impact on brain health (especially cognitive function) are needed.
- Increased research is needed to understand the impact of physical activity on depression, anxiety, stress and stress reactivity.
- Additional research is needed to explore the impact of physical activity on social inclusion for children and youth with and without brain-based disabilities. This is especially important given that peer relationships become increasingly important from childhood to adolescence.¹⁰⁴
- More information is needed on the types of physical activities (e.g., individual activities, group activities, indoor/outdoor activities, activities with therapy animals, water-based activities) that are associated with the greatest benefits in children and youth with and without brain-based disabilities.
- More research is needed to explore the impact of physical activity on brain health in younger children (under 6 years).
- More research is needed to explore how physical activity and sport experiences should be structured and delivered to more reliably promote positive mental health outcomes in children and youth.
- More collaborations are required with end/knowledge users and front-line staff to bring research to practice, and practice to research (e.g., evidence-based programs, clinician training).



Our Expert Panel

- Dr. Mark S. Tremblay (Chair), Children’s Hospital of Eastern Ontario Research Institute
- Dr. Leigh M. Vanderloo (Co-Chair), ParticipACTION and The Hospital for Sick Children
- Dr. John Cairney, University of Toronto
- Louise Choquette, Best Start Resource Centre
- Dr. Jean-Paul Collet, Kids Brain Health Network
- Tom Davies, Special Olympics Canada
- Dr. Guy Faulkner, University of British Columbia
- Dr. Mojgan Gitimoghaddam, University of British Columbia
- Emily Glossop, Abilities Centre Ottawa
- Dr. Dan Goldowitz, Kids Brain Health Network
- Dr. Katie Gunnell, Carleton University
- Saskia Kwan, Ontario Brain Institute
- Dr. Jennifer Leo, Abilities Centre
- Chris Markham, Ophea
- Dr. Ali McManus, University of British Columbia
- Dr. Sarah Moore, Douglas College
- Dr. Matthew B. Pontifex, Michigan State University
- Dr. Jeremy Walsh, Children’s Hospital of Eastern Ontario Research Institute
- Dr. Jill G. Zwicker, University of British Columbia

Our Partners and Funders



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GLOSSARY OF KEY TERMS

Term	Definition / Description
Anxiety	Excessive worry (about school, friends, work, etc.) occurring more days than not, for at least 6 months. ¹⁰⁵
Brain function	How the brain works, and the processes and behaviours it controls.
Cognition	The mental action of acquiring knowledge and understanding (i.e., thinking and learning).
Convergent Thinking	The ability to solve standard problems with a single, correct answer.
Depression	Symptoms of depressed mood or loss of interest that have been present for at least 2 weeks (and represent a change from their usual selves). ¹⁰⁶
Divergent Thinking	The ability to solve problems with many possible solutions.
Executive Function	A set of cognitive skills that are critical for advanced development and the execution of complex tasks (e.g., planning, organization, judgment).
Mental Health	Emotional, psychological and social well-being.
Neurodevelopmental (brain-based) Disabilities	Brain-based disabilities such as problems with motor function, cognition, learning, language and/or communication. ¹⁰⁷ Examples include ADHD, autism spectrum disorder, cerebral palsy, fetal alcohol syndrome and developmental coordination disorder.
Neuroplasticity	The brain's ability to reorganize itself by forming new neural connections. ⁸²
Neurotransmitters	Brain chemicals that transmit signals from one neuron to the next across synapses (point of communication between two neurons).
Neurotrophins	Proteins that regulate the development, maintenance and function of the brain and spinal cord.
Physical Activity	Any movement that uses energy and increases heart rate and breathing. ¹⁰⁸
Physical Literacy	The motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life. ¹⁰⁹
Quality of Life	A multi-dimensional concept that includes physical, mental, emotional and social functioning.
Self-concept	An individual's belief about themselves, including belief about their attributes, and who and what the "self" is. ¹¹⁰ Often includes self-esteem and self-worth.
Self-esteem/Self-worth	The extent (either positive or negative) to which an individual likes/accepts/ approves/values themselves in relation to others.
Stress Reactivity	The capacity or tendency to respond to a stressor (e.g., blood pressure rising in response to a stressor). ¹¹¹



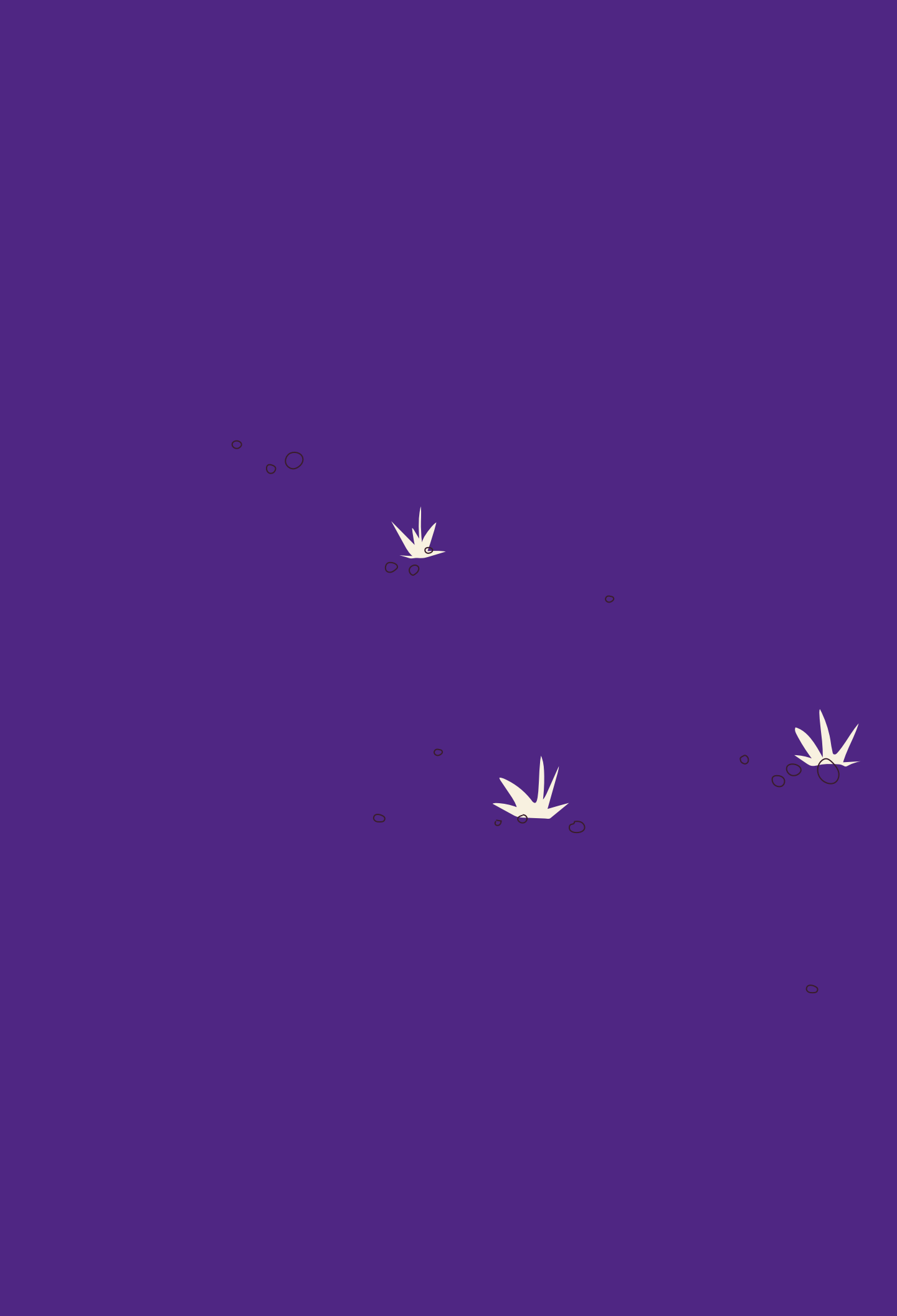
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