### Abstracts From the 2022 North American Society for Pediatric Exercise Medicine Conference: The Child’s Right to be Fit
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#### Evaluation of the Body Composition of Children With Congenital Heart Disease in Comparison to Healthy Peers

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**Background:** Congenital heart disease (CHD) is among the world’s leading birth abnormalities. Despite improvements in treatment and steady rise in survival rates, children with CHD face significant health challenges in both the short- and long-term. This is highlighted by high obesity, morbidity, and health care costs in adults with CHD. Understanding body composition in childhood will ensure better understanding of its impact, while also allowing us to discover new ways to mitigate health disparities in this population. Therefore, the purpose of this study was to evaluate the body composition of children with CHD compared to healthy age and sex matched controls using Dual Energy X-Ray Absorptiometry (DXA). **Methods:** Forty-five children with CHD (age = 11.3 ± 2.5, n = 20 females) and twenty-five healthy age- and sex-matched controls (age = 11.6 ± 2.5, n = 13 females) were examined using full body DXA. Demographics such as age, height, weight, and physical activity were examined using independent sample t-tests. Body composition measurements (fat mass, lean mass, bone mineral content, bone mineral density, and bone area) were assessed by ANCOVA with age, sex, height, weight, and physical activity included as covariates. All analyses were performed using SPSS version 28 and significance was set at p<0.05. **Results:** No significant differences between groups for age (11.31 ± 2.5 vs 11.6 ± 2.5), height (145.3 ± 15.8 vs 149.4 ± 16.5), weight (41.9 ± 19.1 vs 43.7 ± 15.4), waist circumference (69.0 ± 13.0 vs 67.0 ± 10.0), and BMI (19.0 ± 4.5 vs 18.9 ± 3.6) were found (p>0.05) (CHD vs control). However, control participants reported significantly higher levels of physical activity (p<0.05). When comparing CHD and control participants there were no significant differences in any of the body composition measures between the groups. **Discussion:** Our preliminary findings suggest that there is no difference in body composition of children with CHD and their healthy counterparts. Future studies should focus on increasing the sample size and examining sex differences between groups as these could have important implications. **Funding:** Saskatchewan Health Research Foundation and Jim Pattison Children’s Hospital Foundation.

#### Safety and Efficacy of Exercise Training in Children and Adolescents With Congenital Heart Disease: A Systematic Review and Descriptive Analysis

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**Background:** While exercise training is beneficial in the prevention and management of many chronic diseases, the role of exercise training in children and adolescents with congenital heart disease is less understood. We sought to determine the safety and efficacy of exercise training in children and adolescents with congenital heart disease. **Methods:** We conducted a systematic search of the following databases: PubMed, CINAHL, EMBASE, Web of Science and SportDiscus. We included randomised controlled trials that incorporated an exercise intervention compared with a non-exercising comparator group and examined safety and efficacy in children and adolescents with congenital heart disease. A descriptive analysis of the included trials was then conducted. **Results:** A total of nine articles from six trials (642 participants with varying conditions and disease severity) were included. Significant variability of study participants and outcomes were observed across the trials. No adverse events linked to the exercise interventions were stated. The articles reported numerous positive changes to clinically relevant fitness measures. Exercise capacity improved with exercise training in three of four trials in which it was measured. Cardiorespiratory fitness showed improvements in three of four trials. Neuromuscular fitness increased in one of two trials. Physiological and metabolic parameters were improved, or negative changes were not observed to several clinically important measures (e.g., muscular oxygenation, cardiac measures) in two of two trials. Physical activity increased in one of three trials. No articles reported on changes in measures of body composition. Outcomes are varied with little consensus on measurements or assessment.
methods. Discussion: Exercise training appears to be safe and efficacious for improving physical fitness in certain (e.g., lower-risk) children and adolescents with congenital heart disease. However, the certainty of the evidence for these findings is low to moderate. Funding: No funding to disclose.

The Canadian Report Card on the Physical Activity of Children and Youth With Disabilities

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Background: In Canada, the ParticipACTION Report Card on Physical Activity for Children and Youth (‘Report Card’) is a tool for synthesizing best available data, and identifying gaps, opportunities, and recommendations for promoting physical activity (PA) in children and youth. A long-standing gap within the research informing the Report Card is the paucity of data for the approximately 4.6% of Canadian children and 13.0% of youth with disabilities (CYD). The limited inclusion of data from CYD in previous Report Cards challenges the appropriateness of the grades and recommendations for this population of children and youth who face significant barriers to PA. This research provides an overview of the inaugural Report Card on PA for Canadian CYD.

Methods: Using an established grading process, 13 indicators were graded by disability and PA researchers, organizations, and parents of CYD using benchmarks of the Active Healthy Kids Global Alliance’s Global Matrix 4.0 and the Canadian 2020 ParticipACTION Report Card. Four national population-level datasets comprised the available data sources, along with government documents and surveys on accessibility infrastructure, legislation, and investments. Results: Assigned grades ranged from B+ (Sleep) to F (Active Play, 24-Hour Movement Behaviours). Incomplete grades were given to: Physical Literacy, Physical Fitness, Household, School, and Community and Environment. Recommendations for enhancing the reporting, monitoring and promotion of PA for CYD include: the establishment of disability-specific PA guidelines based on research evidence specific to CYD; reconsideration of the Global Matrix grading guidelines for ‘objective’ measures of PA and the existing ableist language used in many of the benchmarks; having representative and statistically powered population-level data for diverse impairment types; and the creation of policy action frameworks and dedicated budgets to prioritize the rights of CYD to accessible and inclusive PA at school and within the community. Discussion: This inaugural Canadian Report Card on PA for CYD highlights the many gaps in information, programming, and policy perpetuating the incidence of inactivity among Canadian CYD. The provided recommendations can help to better tailor the Report Card grading benchmarks and improve practice for promoting and supporting PA for CYD. Funding: Canadian Tire Jumpstart Charities.

An Assessment of Inflammation and Physical Activity in Children With a Chronic Inflammatory Disease

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Background: Children with chronic inflammatory disease (CID) are at an increased risk for health complications including mental health issues, cancer, and cardiovascular disease. These complications have been linked to elevated levels of pro-inflammatory cytokines and lifestyle behaviours including low physical activity. Physical activity may represent a simple and effective strategy to modulate inflammation and subsequently improve health outcomes. However, the link between cytokines and physical activity in children with a CID remains poorly understood. This exploratory analysis examined the relationships between physical activity and inflammation in children with a CID and healthy controls. Methods: Boys and girls with a CID and controls wore an ActiGraph GT3X accelerometer around the waist during waking hours for 7 days. Outcomes of interest included axis 1 counts per minute, sedentary time, time spent in light physical activity (LPA), moderate-to-vigorous PA (MVPA), and total PA (TPA), determined using Evenson cut-points. After one week a fasted blood sample was collected to determine serum cytokines (TNFa, IL-23, IL-113, IL-12, IL-6, IL-17, TGFI3, IL-10) by multiplex assays. Median splits on PA outcomes were assessed for differences in inflammation using independent samples t-tests. Results: A total of 13 participants (54% girls; mean±SD, age: 13.1±3.5 years), including juvenile idiopathic arthritis (N=2), inflammatory bowel disease (N=3), cystic fibrosis (N=1), type 1 diabetes mellitus (N=2) and healthy controls (N=5), completed the study. Children in the below median TPA group (110-212 mins/day TPA) had significantly less LPA (285±14 mins/day TPA) than the above median TPA group (222-280 mins/day). The below median group also engaged in significantly less LPA (114±25.9 vs. 183±28.2 mins/day, P=0.019) than the above median TPA group (222-280 mins/day). The below median group also engaged in significantly less LPA (114±25.9 vs. 183±28.2 mins/day, P=0.001) but similar levels of MVPA than the above median group. No differences were observed between physical activity groups for other cytokines. Discussion: Children with a CID and healthy counterparts, those engaging in fewer minutes of TPA also demonstrated higher levels of circulating TNFa. Our findings suggest the potentially modulating role of TPA may be driven by LPA. On-going work aims to achieve a larger sample size and consider covariates (e.g., age, sex,
puberty) that may confound our findings. **Funding:** Heart & Stroke Foundation of Canada.

**Sport for Tall: Measures of Maturation Matter (Invited Speaker: Bar or Lecture)**

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Many sports organizations have adopted the idea of “sport for all” to encourage sports participation; however, in many youth sports, it is the tallest or most mature who dominate. Problems arise when attributing growth differences to physical training even though young athletes are likely to have been selected as much for physique as for skill. Size matters from the time of birth when birth weight is used to predict adult health problems. It is also apparent that size matters in sports throughout childhood, as physical size often translates into physical superiority and athletic dominance. This highlights the dilemma for many coaches and youth sports practitioners who work with children during periods of rapid growth when there are great variations in growth, maturation, and development. To understand why some children are tall for their age and others are small for their age, an understanding of how children grow and mature is required. There is wide variation amongst children both within and between genders as to the exact timing and tempo of maturation. When considering how to assess maturation it is important to understand that one year of chronological time does not equal one year of maturational time. So rather than consider comparisons between chronological age and biological age, comparisons should be thought of as between years from birth and years from maturity. To adequately control for maturity, an indicator of maturity needs to be assessed. The maturity indicator chosen should be any definable and sequential change in any part of the body that is characteristic of the progression of the body from immaturity to maturity. Today, there is a great deal of interest in estimating rather than measuring maturation. In this presentation various methods of somatic maturation are compared and discussed in terms of accuracy and validity. **Funding:** Canadian Institute of Health Research, Canadian Foundation for Innovation, and Saskatchewan Health Research Foundation.

**Is There an Association Between Critical Growth Periods in Childhood and Adolescence and Adulthood Obesity?**

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**Background:** The increasing rates and prevalence of obesity is a growing concern; especially related to short- and long-term health consequences. It has been suggested that fat mass accrual during critical periods of growth contributes to overweight and/or obesity (OWO) status later in life. Critical periods include intrauterine growth (indexed by birth weight), post-natal catch-up growth (the period of adiposity rebound), and adolescence (period of accelerated maturation). Previous research suggests that birthweights are associated with maturational timing. This is important as maturity timing (early, average, or late) is a risk factor for adiposity in adulthood. These previous studies have relied mostly on cross-sectional data to retrospectively address this question. The objective of this longitudinal study was to determine if there was an association between birthweight, early biological maturation, and weight status in adulthood. **Methods:** Participants were drawn from the University of Saskatchewan’s Pediatric Bone Mineral Accrual Study (PBMAS; 1991-2017). The study used a mixed longitudinal cohort design recruiting, between 1991-93, 251 children into 8 age-cohorts (8 to 15 years) and measuring them serially between 1991 to 2017. Demographic data was collected including birth weight and at each measurement occasion, anthropometrics (including BMI and Peak Height Velocity [PHV]) and DXA scans (measuring body composition) were obtained. Multiple categories were then created including birthweight (BWCat), maturational timing (MatTiming), and BMI status. **Results:** Males born with low birth weight attained PHV at a later age (p<0.05) compared to those born with normal or high BW, in contrast females with low birth weight obtained PHV at earlier ages (p<0.05). Normal weight and obese adult males tended to be early or average maturers while no relationship between maturity and adult weight status was observed in females. **Discussion:** Although some trends aligned with those from previous research, results in this cohort were ambiguous. Future research should continue to focus on the causal effects between critical growth periods and adulthood weight status to generate future intervention strategies to prevent adulthood obesity. **Funding:** Canadian Institute of Health Research (CIHR), Saskatchewan Health Research Foundation, Dairy Farmers of Canada.

**A Comprehensive, Mixed Methods Inquiry into the Physical Literacy Development of 8- to 12-Year-Old Children Living With Chronic Medical Conditions**

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**Background:** Physical literacy describes the abilities needed to achieve an active lifestyle. Developing physical literacy is particularly relevant for children living with chronic medical conditions (CMCs), who face unique physical activity barriers and an increased risk for long-term complications from sedentary behaviour. Targeted research focusing on physical literacy development among children with CMCs is scarce. **Methods:** An explanatory,
sequential research design investigated physical literacy development among outpatients 8 to 12 years old recruited from tertiary care Cardiology, Respiriology/Cystic Fibrosis, Neurology, Hematology, and Endocrinology clinics. Participants completed the Canadian Assessment of Physical Literacy, Second Edition (CAPL-2), which measured physical competence, motivation/confidence, knowledge/understanding, daily behaviour and total physical literacy. Among every 12 participants, those whose total scores were in the highest or lowest quartiles were invited to a semi-structured interview. A deductive-inductive thematic analysis using Whitehead’s (2010) conceptualization of PL was applied to the qualitative data. Results: Eighty-six children completed the CAPL-2 (age=10.0±1.3 years, 50% girls). Among them, 80.2% (n=69) were beginning/progressing in their physical literacy development. Children scored highly on motivation/confidence (mean=23.3/30) but obtained low physical competence (mean=11.4/30) and daily behaviour scores (n=68, mean=14.8/30). Interview participants with the highest scores (n=11 of 21 eligible, age=10.0±1.5 years, 58% girls) described how they were introduced to a wide variety of activities through family/peers and communicated a strong desire to try new things. Interview participants with the lowest scores (n=10 of 21, age=9.7 years±1.7, 50% girls) framed their physical activity within school-based programs and unstructured play. These participants recognized their strengths, but often found it difficult to apply them and navigate game constraints. Discussion: Most children with CMCs require support to develop recommended levels of physical literacy. They are motivated to be active but have limited physical competence. Interventions for those who are in the beginning stages of their development should engage family/community members in planning and educate participants on how to apply their skills/strengths to a wide variety of activities. Funding: The first author received funding from the government of Ontario, the Children’s Hospital of Eastern Ontario, and the North American Society of Pediatric Medicine (Marco Cabrera award) to conduct her PhD research.

Pandemic-Related Restrictions Significantly Impact the Physical Literacy Development of Children Living With Chronic Medical Conditions

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Background: Active lifestyles are essential for children’s health and quality of life. Physical literacy provides a comprehensive understanding of physical activity capacity and is often developed through diverse experiences. Children living with chronic medical conditions (CMCs) face a higher risk for severe COVID-19 illness, emphasizing the importance of understanding how the pandemic has impacted their physical literacy. Methods: Children with CMCs (8-12 years old) were recruited between December 2020-2021, from 3 female, mean age 7.3 ± 2.25 years) and 10 parents (8 mothers, 2 fathers) participated in audio-recorded interviews, which were transcribed verbatim. An inductive thematic analysis was applied. Results: For many children with heart disease, the integrated camp was their first experience participating in a traditional summer camp. The camp experience was described by all parents as a valued opportunity which should continue. Most children (7/9) had a positive perception of the camp while parent opinions were mixed (5 positive, 5 negative). Two themes emerged from the perceptions of the integrated camp: 1) important experiences that were afforded by the activities/design and 2) whether expectations were met. Opportunities for greater independence and confidence (“He liked being able to challenge himself”), personal choice to disclose cardiac diagnoses (“It wasn’t an obvious thing because it was so well concealed”), and more diverse social connections (“To get new friends, to meet new people. . . to expand her experience with other people”) were valued camp experiences. Enjoying a typical camp experience, meeting local children with cardiac disease, and perceived safety precautions were expectations held by participants that were not always met (“I felt that if something happened to [child], there was gonna be a delay”). Discussion: Participants valued the opportunity for a typical camp experience where children with cardiac disease could safely attend with siblings/friends. Most children perceived their experience as positive. More effectively addressing preconceived expectations for camp participation and optimizing positive development opportunities are recommended when implementing integrated camps. Funding: No funding to disclose.

Pediatric Cardiology Patients and Their Parents Value the Opportunities Afforded By an Integrated Summer Camp

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Background: Summer camps offered exclusively for children with cardiac diagnoses can impact perceived competence and psychosocial well-being while promoting physical activity participation. Unfortunately, such camps face logistical barriers (i.e., geographical constraints) and require extensive resources (i.e., medical staff on-site). Integrated day camps, where children with cardiac diagnoses participate alongside otherwise healthy children, require fewer resources but knowledge about the safety and inclusion of children with cardiac diagnoses is limited. Methods: A retrospective, qualitative descriptive design investigated how children with cardiac disease and their parents perceived an integrated camp experience. From 26 eligible families, 9 children
outpatient Endocrinology, Hematology, Respirology/Cystic Fibrosis, Cardiology and Neurology clinics. Participants completed the Canadian Assessment of Physical Literacy – Second edition (CAPL-2). Those scoring in the highest/lowest quartiles were invited to a semi-structured interview. Participants were matched 1:1 by age, gender, and clinical group with children assessed before March 2020. One-way ANCOVAs compared CAPL-2 scores between groups, adjusting for season of assessment. Interview data were analysed inductively to identify common pandemic experiences and influences. Results: The post-pandemic group (n=43, age=10.1±1.3 years, 53% girls) had significantly lower total CAPL-2 scores than matched children (mean difference=9.3±16.0, F[1,83]=15.27, p<0.001). There was a significant deficit in physical competence (F[1,81]=10.18, p<0.01), but not motivation and confidence (F[1,83]=0.183, p=0.67). Interview participants (n=21, 52% girls) emphasized fewer opportunities to engage with others (“I need to see people”). Many noted how safety protocols limited opportunities for play (“...we didn’t get to play because everyone would have to touch the same ball”). Participants whose health status changed during the pandemic (i.e., surgery, new diagnosis) described how lockdowns made it more difficult for them to resume physical activities. Discussion: Participants with CMCs assessed during COVID-19 had decreased physical competence compared to matched peers assessed before the pandemic. Interview findings suggest that constraints of social distancing and added health burdens inhibited their physical activity, decreasing opportunities for physical literacy development. Existing deficits in physical competence observed before the pandemic (Do et al., 2021), suggest current children with CMCs may be falling even further behind in their development. Funding: The first author received funding from the government of Ontario, the Children’s Hospital of Eastern Ontario, and the North American Society of Pediatric Medicine (Marco Cabrera award) to conduct her PhD research.

Sex as a Moderator in the Relationship Between Cardiovascular Health Indicators and Physical Activity in Youth With a Chronic Inflammatory Disease

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Background: Existing evidence suggests that adult females with a chronic inflammatory disease (CID) demonstrate worse cardiovascular (CV) health compared to male counterparts. Physical activity is a modifiable CV risk factor with clear sex-based differences; on average females take part in significantly less moderate-to-vigorous physical activity (MVPA) compared to males. Although physical activity is a well-established, independent predictor of CV health in healthy children, we know less about its role in modifying CV health in female and male children with a CID. The aim of this study was to examine sex as a moderator of the relationship between MVPA and CV health indicators in children with a CID. Methods: Children ages 7-17 years with a single diagnosis of cystic fibrosis, juvenile idiopathic arthritis, inflammatory bowel disease, or type 1 diabetes were recruited. Ultrasound was used to measure carotid artery intima-media thickness (cIMT). Arterial stiffness was assessed as carotid artery β-stiffness index and whole-body wave velocity (PWV). Endothelial function was assessed using flow-mediated dilation (FMD) of the brachial artery. Resting blood pressure (BP) was used to calculate systolic BP and diastolic BP percentiles. Participants then wore an accelerometer for 7 consecutive days to estimate physical activity, reported as time spent in MVPA. Multiple linear regression was used to examine the relationship between CV health indicators and MVPA, with self-reported sex as a moderator. Results: Eighty participants (45 females mean±SD, age: 13.0±2.8 years) completed this study. Males engaged in significantly more MVPA than females (59.2±19.9 min/day v. 39.1±16.2 min/day, p<0.01). MVPA was positively associated with systolic BP percentile (F (4,64)=2.603, r²=0.148, p=0.045). In this model female sex was a significant moderator of systolic BP percentile (MVPA: B=0.672, SE=0.333, p=0.048). Subgroup analysis revealed that this relationship was driven by participants with juvenile idiopathic arthritis. We found no significant relationships between other CV health indicators and MVPA. Discussion: These findings conflict with established research demonstrating higher levels of MVPA are associated with lower BP. Further research is needed to explore factors such as medication usage that might influence this relationship, particularly in those with juvenile idiopathic arthritis. Funding: Heart & Stroke Foundation of Canada.

Physical Activity and Mental Health: Is There Still a Role for Movement Competence? (Invited Speaker: Don Bailey Lecture Series)

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Previous research has shown that physical activity predicts both mental health (well-being) and psychological distress (depression, anxiety) such that higher levels of activity are associated with better mental health and lower levels of distress. Research has also shown however that mental health predicts physical activity, with better mental health predicting increased participation. This complex, bidirectional relationship is clearly influenced by several conditioning variables, including motor competence. The Environmental Stress Hypothesis for example, hypothesises that poor motor coordination predicts poor mental health through multiple psychosocial and physical mediating and moderating pathways, including physical activity. What is the current state of evidence on the links between motor competence (coordination), physical activity and mental health? What role does motor competence play in interventions designed to improve mental health through physical activity? These questions and future research directions are discussed in this lecture.

Evaluation of the Build Our Kids Success After-school Program During the COVID-19 Pandemic in Nova Scotia, Canada: Lessons Learned and Recommendations

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What Built and Social Environment Factors Influenced Children and Youth’s Movement Across the COVID-19 Pandemic? A Canada-Wide Repeated Cross-Sectional Study

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Background: During the COVID-19 pandemic, many opportunities for physical activity and sport were unavailable or restricted. As a result, children and youth’s physical activity levels declined and their well-being was negatively impacted. The purpose of this evaluation study was to determine the impact of the Build Our Kids’ Success (BOKS) after-school physical activity program on children’s physical activity and well-being from the perspectives of children, parents/guardians, and BOKS program leaders. Methods: BOKS programming was implemented in after-school programs in Halifax, Nova Scotia in Fall 2020. Parents completed questionnaires about children’s physical activity, sleep, and well-being in October 2020 (n=159) and December 2020 (n=75). In December 2020, child participants (n=14) completed questionnaires about their physical activity, physical literacy, physical activity enjoyment, and well-being. Children (n=7), parents/guardians (n=5), and program leaders (n=3) completed interviews about the BOKS programming and content was analyzed for themes inductively. Results: Parental reports of child physical activity and well-being were within normal limits (Adjusted T-Scores: 46.7±7.2 to 50.0±7.1) and were not different between baseline and follow-up (p=0.06-0.76). Following BOKS programming, children reported moderate physical activity levels, moderate physical literacy, and all well-being measures were within or slightly below normal limits (Adjusted T-Scores: 41.2±3.6 to 51.5±10.6). Thematic analysis of parent, child, and program leader interviews revealed five themes related to BOKS programming during the pandemic: children’s PA levels were impacted by the pandemic, BOKS positively impacts children’s physical well-being, BOKS participation positively impacts children’s cognitive and emotional health, BOKS provided an added confidence boost to children, and BOKS integrated well with school-based activities. Discussion: Results of child and parent proxy questionnaires and interviews with parents, children, and program leaders suggest that BOKS programming implemented in an after-school program had a protective effect and positive impact on children’s physical activity and well-being during the COVID-19 pandemic. It is recommended that the maintenance of child and youth physical activity programs be prioritized during periods of public health restrictions to protect health behaviours and well-being. Funding: Public Health Agency of Canada in partnership with Reebok Fitness Canada Foundation.

Does a Physical Literacy Focused Intervention Effect the Physical Activity Levels of Children?

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Discussion: Results suggest that neighbourhood built and social environment characteristics can support children and youth’s physical activity (PA). However, during the COVID-19 pandemic, children and youth’s access to neighbourhood spaces was adversely affected due to varying public health restrictions, and perceived risk of virus exposure. The purpose of this research was to explore associations between neighbourhood built and social environmental characteristics, and parent-reported level of moderate-to-vigorous physical activity (MVPA) at three time-points across the pandemic. Methods: We used data from three cross-sectional surveys. Parents of children and youth living in Canada (5-to 17-years-old) completed an online survey during the COVID-19 pandemic at one of three time periods (wave 1: Apr-2020, wave 2: Oct-2020, wave 3: Apr-2021). Parents reported number of days in the last week that their child participated in ≥60 minutes of MVPA and were categorized into low (0-2), moderate (3-5), and high (6+) levels of MVPA. Dwelling type and 6-digit postal codes were collected in the survey and locations were approximated to dissemination areas. Built environment variables included dwelling density and proximity to schools and parks; social environment measures included residential instability, material deprivation, dependency, and ethnicity (developed using the Canadian Marginalization Index). Ordinal logistic regression models were used to explore relationships between wave-specific correlates of participation and higher levels of MVPA. Results: Total respondents included in the 3 waves were 1,480, 1,552, and 1,183, respectively. In wave 2, participants in higher dwelling density had decreased odds of achieving higher-level MVPA, whereas participants in higher density neighbourhoods with access to parks had increased odds of higher-level MVPA. For social environment variables in waves 1 and 3, greater instability had increased odds of higher-level MVPA, while greater deprivation, and ethnicity in wave 3, had decreased odds of higher-level MVPA. Discussion: Results suggest that neighbourhood built and social environment characteristics were differentially associated with higher-level MVPA depending on pandemic-related restrictions between waves. Our findings support the importance of addressing both built and social environments as children and youth return to their neighbourhood environments and consider ways to be physically active in the recovery periods from COVID-19. Funding: Province of Nova Scotia, Dalhousie University; ParticipACTION.
Introduction: The majority of Canadian children do not meet the physical activity (PA) guidelines. The development of physical literacy (PL) has been proposed as a way to potentially increase PA participation. Therefore, the purpose of this study was to explore if a four-month multi-setting PL intervention would also influence PA engagement. Methods: Children in grades 4 through 8 from three communities (one intervention; two usual practice) in Saskatchewan were invited to participate in a four-month PL focused intervention. The intervention involved PL development opportunities at the home, school, and community levels. Although not the primary outcome, PA was measured in 59 (36 female) children in the intervention group and 75 (41 female) children in the usual practice group, using accelerometers (Actigraph wGT3X-BT). Over seven consecutive days pre- and post-intervention light PA, moderate-to-vigorous PA (MVPA), and total step counts were obtained from the accelerometers using Evenson et al., (2006) cut points. Percent change was calculated to evaluate change over time and the intervention effect was assessed using an ANCOVA while controlling for age, sex, and baseline PA. Results: Pre-intervention the usual practice group participated in greater MVPA than the intervention group. Both groups engaged in less light PA and MVPA after the four-months (-7% to -28%). ANCOVA analysis revealed that, children in the usual practice group had greater MVPA engagement after the intervention (p<0.05). There was no intervention effect on light PA engagement or step count (p>0.05). Discussion: While this intervention significantly improved aspects of participant’s PL post-intervention, we did not find an increase in PA engagement of children in grades 4 through 8. Additionally, neither group (intervention or usual practice) met the 24-hour PA guidelines for light or MVPA at baseline or follow-up, suggesting neither group (intervention or usual practice) met the 24-hour PA engagement of children in grades 4 through 8. Additionally, interventions may need to intentionally target PA levels of children to exist between PL and PA engagement, our findings suggest interventions may need to intentionally target PA levels of children to find significant improvements, or that the impacts on PA may take a longer time to manifest. Funding: No funding to disclose.

Sleep, Physical Activity, and Obesity in Children: Applications in Pediatric Exercise Science (Invited Speaker)

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High physical activity levels and healthy sleep have been associated with favourable health outcomes in the pediatric population. Physical activity and sleep do not only impact health outcomes, they also influence one another. Physical activity has been shown to improve sleep outcomes, while insufficient sleep has been reported to increase tiredness and make it less conducive to maintain a healthy active lifestyle. Not only that there is a bidirectional relationship between sleep and physical activity, but they both influence body weight regulation. Physical inactivity is a traditional risk factor for obesity while insufficient sleep is a novel determinant of obesity. Lack of sleep has been shown to contribute to weight gain and obesity predominantly via an increase in food intake. Assessing sleep health (e.g., duration, quality, timing) is important in pediatric exercise science because poor sleep health can undermine the success of exercise programs and/or weight loss interventions. Assessing sleep is time well spent and should be routinely done in pediatric exercise science.

Physical Literacy in Children With Congenital Heart Disease

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Background: Congenital heart disease (CHD) is the world’s leading birth defect. Children with CHD have been found to have low levels of physical activity and increased sedentary behaviour. Children with CHD are able to safely participate and meet daily physical activity guidelines in the same manner as their healthy peers. However, external factors related to physical literacy such as competence, confidence, and motivation, may be impacting children with CHD keeping them from performing motor skills and meeting the physical activity guidelines. Methods: Six participants, 7-14 years of age, with CHD were recruited and compared to a healthy reference sample (n=680). The battery of PLAY tools was used to examine physical literacy. PLAYfun was used to assess 18 different fundamental movement skills (motor competence) and PLAYself was used to assess the child’s perception of their physical literacy. Lastly, PLAY-parent was used to assess parental perception of their child’s physical literacy. Children with CHD were compared to a sex-matched healthy reference sample using one sample t-tests. Results: Children with CHD were found to have lower levels of physical literacy (PLAYfun) compared to controls. Specifically, females with CHD had lower overall physical literacy (p=0.04), while males had lower locomotor competencies (p=0.025). There were no differences in participants self-perceived physical literacy (PLAYself) between the CHD and control groups (p>0.05). However, parents of males with CHD reported their children to have lower physical literacy (p<0.001), while there was no difference in the parental perception for girls with CHD (p=0.05). Discussion: Though children with CHD (both female and male) had lower physical literacy compared to the healthy reference sample, self-confidence was similar between the two groups. The parents of girls with CHD perceived their children had similar physical literacy to the comparison group while the parents of males with CHD perceived their children had significantly lower physical literacy. Funding: Saskatchewan Health Research Foundation, Canadian Institute for Health Research.

Attitudes Toward Physical Activity as a Treatment Component for Adolescents With Anorexia Nervosa: An Exploratory Qualitative Study of Patient Perceptions

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Funding: No funding to disclose.
Using Linked Accelerometer and GPS Data for Characterizing Children’s Schoolyard Physical Activity: Impact of Hot Spot Analytical Decisions

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Background: Accelerometry and Global Positioning System (GPS) data can be used to identify schoolyard locations where children are physically active and ultimately inform or assess activity-promoting interventions. Several researchers have relied on hot spot analysis to identify areas of high/low activity in the schoolyard, which requires processing decisions that often go unreported. Our purpose was to illustrate the potential impact of a suite of methodological decisions when conducting hotspot analysis of child physical activity on the schoolyard using linked accelerometer and GPS data, including i) accelerometer metric; ii) monitor epoch; iii) number of recess periods/days and level of aggregation; iv) sample size; v) distance band; vi) weighting scheme; and vii) time band. Methods: Children (n=91; 7-9 y) from three elementary schools wore an accelerometer and GPS at the right hip for up to two regularly scheduled twenty-minute recess periods per day for four school days. Spatial and spatiotemporal hot spot analyses were conducted while varying analytic parameters including accelerometer metric (vector magnitude counts, vertical axis counts, mean amplitude deviation, Euclidean norm minus one, vector magnitude of the raw acceleration), epoch (1, 5, 15, 60 s), level of aggregation (e.g., individual recess periods vs. combining all data), sample size (n=3-37), distance band (1, 3, 5, 7, 10 m), weighting scheme (spatial vs. spatiotemporal), and time band (3, 5, 10, 15 min). Results: Count-based and raw acceleration-based metrics resulted in different clustering patterns. Longer epochs resulted in a less detailed picture of children’s schoolyard behavior. Level of data aggregation impacted cluster patterns due to inter-period and inter-day differences, but patterns were consistent with increasing sample size. Use of spatiotemporal weight matrices resulted in better separation of hot and cold spots compared to the spatial-only approach and revealed important temporal clustering patterns. Increasing the distance band clarified the resulting clusters but increasing the time band minimally changed cluster patterns. Discussion: Overall, hot spot analysis decisions can impact the resultant clustering patterns and should be carefully considered and reported in future studies. We conclude with key recommendations for reporting in studies of schoolyard physical activity using hotspot analysis of linked accelerometer and GPS data. Funding: No funding to disclose.

Survival of the ‘Fit Test’: A Brief Glimpse at the Fate of Fitness Testing in Youth (Invited Speakers)

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Fitness testing has a long, storied history in the areas of physical education, sport, health and wellness, and development in youth. While there are staunch supporters of routine fitness testing in these settings; others have questioned the utility and application of these assessments. The term “fitness” encompasses a diverse set of constructs and includes a variety of psychometric properties integral to appropriate construct assessment. Beginning in 1995, Dr. Tom Rowland, began a series of friendly debate editorials with the paper “The horse is dead; Let’s dismount.” Over the past 27 years, other researchers have published debate articles to continue this conversation and to work towards identifying assessments that truly meet the needs of the youth and the assessment teams. This symposium will provide an overview of fitness testing, including the constructs of health- and performance-related fitness and motor development and competence. We will also explore tensions that have developed between researchers and practitioners and
proposed solutions to these debates. Additionally, we will discuss current fitness testing practices, how data are utilized, and the relevance of the assessments to the youth and associated programs. Finally, the presenters conclude the symposium with a summary of the pros and cons of fitness testing and a discussion on future directions of fitness testing in terms of health and wellness, development, and physical activity participation of youth.

Physical Activity Intensity Levels, Types, and Context During Indoor and Outdoor Free Play in Toddlers Attending a Childcare Center

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Background: Childcare centers have been identified as settings that can provide opportunities for young children to accumulate physical activity (PA). Studies show that toddlers spend most of their time in sedentary behaviors both indoors and outdoors. However, little is known about the context of the sedentary and activity behaviors. The purpose of this study was to determine the PA levels and the behavior types and context during indoor and outdoor free play in toddlers attending a childcare program.

Methods: Participants were 25 toddlers (2.9±0.6y; 12 male) from a university-based childcare center. PA was assessed using ActiGraph GT3X+ accelerometers worn on the right hip. The Trost toddler cutpoints were used to classify activity intensity (sedentary, light, moderate, and vigorous). All participants were video-recorded during two indoor and two outdoor free play segments (20 minutes each). In the Noldus Observer XT system, videos were retrospectively coded using the Observational System for Recording Physical Activity in Children–Preschool (OSRAC-P). The OSRAC-P focal variables were activity type (sit/squat, stand, walk, crawl, etc.) and context (game, sociodramatic, manipulatives, portable equipment, etc.). Data were averaged for indoor and outdoor segments. Means, standard deviations, and percentage of time for activity intensities and behavior types and contexts were calculated.

Results: The toddlers spent the majority of free play being sedentary (59.8±14.9% indoors; 53.6±21.6% outdoors), followed by light (20.1±6.3% indoors; 19.5±17.9% outdoors), moderate (15.3±7.3% indoors; 19.7±12.6% outdoors), and vigorous activity (4.8±6.0% indoors; 7.2±10.9% outdoors). In both environments, the children spent most of the time engaged in sedentary activities (sit/squat (44±12.8% indoors; 28.5±12.1% outdoors) and standing (30.3±10.5% indoors; 35.5±9.6% outdoors). Predominant contexts of the activity varied by environment (indoors [20.7±18.4% sociodramatic, 19.8±13.2% manipulatives, 14.5±13.3% wheeled toys]; outdoors [31.5±21.0% open space, 26.8±23.4% portable equipment, 12.9±13.3% fixed equipment]).

Discussion: Although the toddlers were sedentary for most of their free play, the context of their activity revealed engagement in active play as evidenced by sociodramatic play (indoors) and the use of manipulatives and toys (indoors) and portable equipment (outdoors). These contexts indicate that the toddlers are engaging in cognitive and social play, which are crucial to their development, despite being classified as sedentary.

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Physical Activity Volume and Intensity in Relation to Bone, Lean and Fat Mass in Children: The Physical Activity and Nutrition in Children (PANIC) Study

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Background: Considering physical activity (PA) volume and the distribution of PA intensity may provide novel insights into the relationships between PA with bone mineral content (BMC), lean mass (LM), and fat mass (FM). This study aimed to assess the associations between novel accelerometer metrics for PA volume and intensity distribution with total-body-less-head BMC, LM, and FM in pre- and early-pubertal children.

Methods: This cross-sectional study used a population sample of Finnish children (290 children [158 females] aged 9 to 11 years) from the Physical Activity and Nutrition in Children Study. Average-acceleration (a proxy metric of PA volume) and intensity-gradient (a metric of PA intensity distribution) were calculated from accelerometer-assessed PA. Linear regression was used to examine the independent associations of PA volume and intensity with dual-energy X-ray absorptiometry assessed total-body-less-head BMC, LM, and FM in pre- and early-pubertal children.

Results: In females, PA volume was positively associated with BMC when adjusting for LM and FM (unstandardised \( B = 0.26, p = 0.035 \)), though not when adjusting for LM only. In females, PA volume was not associated with LM or FM. PA intensity was not associated with BMC, LM or FM in females. In males, PA volume was positively associated with BMC when adjusting for LM and FM (unstandardised \( B = 0.47, p = 0.002 \)), though not when adjusting for LM only. In males, PA volume was positively associated with BM (\( B = 7.33, p = 0.014 \)), and negatively associated with FM (\( B = -0.62, p = 0.013 \)). PA intensity was negatively associated with BMC in males (\( B = -0.13, p = 0.015 \)), but was not associated with LM or FM.

Discussion: A higher volume of PA may be associated with improved BMC in females and males, and with improved LM and reduced FM in males. Adjusting for LM and FM altered the
relationships between PA with BMC, emphasising the importance of considering LM and FM alongside bone. The high-volume PA profiles included short periods of high intensity activity, with several hours of light activity, suggesting that increasing PA volume at any intensity aid bone development in pre- and early-pubertal children. Funding: Ministry of Social Affairs and Health of Finland, Ministry of Education and Culture of Finland, Finnish Innovation Fund Sitra, Social Insurance Institution of Finland, Finnish Cultural Foundation, Juho Vainio Foundation, Foundation for Paediatric Research, Doctoral Programs in Public Health, Paavo Nurmi Foundation, Paulo Foundation, Diabetes Research Foundation, The Finnish Medical Society Duodecim, Orion Research Foundation sr, Research Committee of the Kuopio University Hospital Catchment Area, Kuopio University Hospital, UK Medical Research Council (MC_UU_12015/3), NIHR Cambridge Biomedical Research Centre (IS-BRC-1215-20014).

Physical Fitness: A Right of Every Child (Invited Speaker: Tom Rowland Lecture)

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The COVID-19 pandemic has shed light on the devastating effects of health care disparities on physiologic, immunologic, and behavioral resilience of children and adolescents. Physical inactivity and obesity, most prominent throughout the US in lower income communities, exacerbate disease severity and outcomes not only of COVID-19 but also of virtually every chronic pediatric disease. In 1989, the United Nations approved the Convention on the Rights of the Child (CORC), the most widely ratified human rights treaty in history. The Convention elevated often marginalized notions of child health and well-being to international issues of major concern requiring actionable changes in health, legal, and social policies. Physical fitness is a uniquely integrative indicator of child health and resilience. It is a quantifiable, bellwether, health phenotype and can only be achieved when a myriad of factors, e.g., nutrition, access to play, safety, and social determinants, are optimally aligned. It is time to add the right of every child to be physically fit to the Convention.

Old Friends and New Beginnings: How Play and Exercise Train the Immune System in Early Life Child (Invited Speaker)

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Many of the health benefits of regular physical activity are directly related to activation, modulation, and conditioning of the immune system. The immune system is a dynamic and complex set of cells and mediators capable of reacting rapidly to pathogens and environmental threats. New insights reveal that immune cells can also play significant roles in growth and tissue repair. We present the idea that physical activity, like exposure to pathogens, is a critical feature of immune conditioning throughout childhood and adolescence. We review genomic responses of key innate immune cells such as neutrophils and monocytes to exercise and how these responses mold early life development and prevention of adult diseases like atherosclerosis. The concept of immune conditioning, the “old friend” hypothesis, is highlighted with an emphasis on the dual role of immune and inflammatory activation and inhibition, mechanisms responsible for homeostasis and self-tolerance. We outline the relevant immune and inflammatory pathways that can enhance our ability to promote healthy exercise in childhood diseases like asthma. We present a new look at the role of immune conditioning during childhood highlighting the need to consider environmental factors like exercise and the role of social determinants of health in these processes. The critical need to address the many gaps in our understanding of the mechanisms that govern immune and inflammatory responses to exercise is a major theme of this talk.

Left Ventricular Myocardial Performance During Exercise in Healthy Children and Adolescents

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Introduction: The purpose of this study was to evaluate left ventricular (LV) myocardial contractile reserve and efficiency in response to maximal exercise in healthy children and adolescents. A secondary aim was to assess sex differences in the LV response to exercise. Methods: Forty-nine healthy children aged 8–18 years underwent a comprehensive echocardiographic assessment at baseline and during a progressive semi-supine exercise test to volitional fatigue. LV dimensions, volumes, and 2-dimensional images were obtained for the determination of stroke volume and cardiac index (SVI, CI). LV myocardial contractility was assessed by calculating the ratio of wall stress at peak systole to heart rate–corrected velocity of circumferential fiber shortening (MVCFe/WS), ventricular elastance (ElvI), SBP/end-systolic volume, and diastolic longitudinal strain rate. The ratio of arterial to ventricular elastance was calculated as an outcome of cardiac efficiency. Results: Cardiac index increased from 2.8 to 7.9 L/min and was lower in females at all stages of exercise (p<0.001). Stroke volume index started higher in boys than girls, yet decreased to similar values, resulting in a greater SVI reserve in boys (p<0.001). Diastolic longitudinal strain rate and MVCFe/WS revealed a sex x time interaction where girls had a greater increase than the boys from rest to peak exercise (p<0.028). The index of myocardial reserve was associated with the ratio of arterial to ventricular elastance (r=0.30, p=0.04). Discussion: This study comprehensively evaluated LV performance and efficiency in healthy children in response to progressive peak exercise. Rates of change were similar for many indices, yet subtle differences were found for myocardial contractility where girls experienced a greater increase than boys. Despite the enhanced contractility by the girls, CI remained lower than the boys at all workloads due to a smaller SVI. Funding: We acknowledge the support of the Natural Sciences and Engineering Research Council of Canada (NSERC) funding reference #2018-06848.
Parental Typologies of Physical Activity Parenting Practices Are Associated With Different Physical Activity Levels Among Children

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Background: Our knowledge of how physical activity parenting practices (PAPP) relate to children’s physical activity (PA) is limited as most studies have examined the effect of individual practices; however, evidence suggests that parents use multiple practices to regulate their child’s behavior. Thus, it is important to understand how parental patterns of PAPP are related to children’s activity levels. This cross-sectional study aimed to: 1) identify parental typologies based on their use of PAPP; 2) explore whether sociodemographic variables varied across parental typologies; and 3) examine whether parental typologies were differentially associated with children’s involvement in PA. Methods: Parents (n=618) of children aged 5-12 years completed a validated PAPP item-bank assessing their use of nine PAPP (i.e., coercive control, nondirective support, supportive expectations, facilitation, restriction of inside PA, allowing unsupervised outdoor PA, autonomy support, guided choice, rewards), and reported the number of days their child accumulated at least 60 minutes of PA the previous week. Latent Class Analysis (LCA) was used to identify distinct PAPP typologies. Regression analyses evaluated whether parental typologies differed by sociodemographic factors or were differentially associated with children’s involvement in PA. Results: LCA revealed four PAPP typologies: Involved (19%) – parents using most of the PAPP examined; Controlling (23%) – parents using coercive control and rewards, Structured Autonomy (28%) – parents using supportive expectations, nondirective support, and autonomy support, and providing guided choices for PA; and Uninvolved (30%) – parents with low use of most PAPP examined. Compared to their non-White counterparts, White parents were more likely to be in the Controlling typology. No other sociodemographic difference emerged. Finally, parents from the Structured Autonomy typology reported significantly higher frequency of child PA compared to the other typologies, whereas parents from the Controlling typology reported significantly lower frequency of child PA compared to the other typologies. Discussion: Our results showed that PAPP typologies exist among Canadian parents and are differentially associated with children’s involvement in PA. Future longitudinal research is needed to assess whether the consistent use of structured and autonomy supportive practices promote adequate PA levels and prevent obesity among youth. Funding: Canadian Institutes of Health Research, BC Children’s Hospital Research Institute (BCCHRR), BCCHR salary awards, Brain Canada and Kids Brain Health Network Developmental Neurosciences Research Training Award, Sunny Hill Foundation for Children, US Department of Agriculture (USDA/ARS), Children’s Nutrition Research Center, Department of Pediatrics, Baylor College of Medicine.

The Effect of a Forearm Loading Intervention on Bone Health: A 3-Year Longitudinal Study

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Background: Of the lifestyle factors that influence bone health, weight-bearing physical activity (PA) during the growing years may have the greatest potential to influence adult skeletal health. Previous studies examining PA and bone development have focused on lower limb bone health, despite the wrist being the most common site of fracture during the growing years. We conducted an 8-month forearm loading (FAL) intervention and found it was beneficial in increasing bone accrual at the wrist in males but not females. However, it is unknown if this benefit is maintained during adolescence when bone accrual accelerates. Therefore, the purpose of this study was to assess the longer-term impact of the FAL intervention. Methods: The FAL study used a longitudinal cohort design, with 47 children (21 boys) between 10 and 11 years of age at study entry followed prospectively for up to 3 years. Data is presented on 43 children (22 controls) who were assessed between 1 and 4 occasions giving a total of 144 measurements. Participants underwent repeated anthropometry, PA, dietary, and high resolution peripheral quantitative computer tomography (HRpQCT) scans. Multilevel modeling was used to assess the impact of the intervention on bone outcomes controlling for confounders of growth, maturation, and PA. Results: No sex effect was found (p>0.05) so data was analysed together. Once the effects of growth (height and weight), maturation (years from peak height velocity), and PA were controlled it was found that the intervention did not have a significant independent effect (p>0.05) on total bone mineral density (BMD) (-13.5 ± 12.2 mg/cm3), cortical BMD (-15.6 ± 15.3 mg/cm3), trabecular BMD (-7.0 ± 8.3 mg/cm3), cortical thickness (-0.03 ± 0.04 mm) or bone volume ratio (-0.006 ± 0.007). Discussion: While the 8-month forearm loading intervention was effective at increasing trabecular bone density and bone volume fraction post intervention in males, the benefit was not maintained longer-term. This suggests that when bone accrual accelerated as males approached adolescence the previously observed benefit was washed out. Therefore, loading may need to occur during adolescence when bone is being rapidly laid down to have a long-term effect. Funding: Saskatchewan Health Research Foundation.

Recreational Gymnasts’ Bone Accrual From 4 to 16 Years of Age

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Background: Bone development in childhood and adolescence is important because the bone that is accrued during the early years can have a profound impact on bone health throughout the lifespan.
Bone responds to mechanical loading such as that from physical activity (PA). Gymnastics creates forces to the bone at various locations and magnitudes, due to being a weight bearing activity. Competitive gymnasts are known to increase bone strength, but in recreational gymnastics the effects are less known. It has been shown, in the present cohort, that between 4 and 12-year-old recreational gymnasts’ increase their distal radius’s total bone area and total bone content. No differences were observed at the radial shaft or tibia. The purpose of this study was to identify if the positive effects of recreational gymnasts’ bone development in childhood were maintained into adolescence. **Methods:** In 2006 recreational gymnasts and non-gymnasts, between the ages of 4 and 6 years, were recruited into the Saskatchewan’s Young Recreational Gymnast Study (YRGs); mixed longitudinal study. One hundred and twenty-six children underwent repeated anthropometry, physical activity, dietary and peripheral Quantitative Computer Tomography (pQCT) scans (distal radius and shaft/tibia and shaft). At the last measurement occasion (2016) children were aged between 11 and 16 years. Multilevel modeling was used to assess the effect of gymnastics exposure on area, density, content, and estimated strength controlling for confounders of growth, maturation, PA, and diet. **Results:** Gymnastics exposure was a significant independent predictor at the distal radius (4%) on T0A (25.43 ± 6.95mm²), T0C (9.58 ± 2.42mg/mm²), total density (14.19 ± 6.46mg/cm³), Trabecular Density (13.07 ± 6.21mg/cm³), and estimated strength (3.17 ± 1.07mg2/mm²) with a confidence interval of 95% (p<0.05). Gymnastic exposure had no significant effect on the radial shaft or locations at the tibia (p>0.05). **Discussion:** Exposure to recreational gymnastics, starting in early childhood, produces benefits to the distal radius that increases the size and strength of the bone. The positive effects of exposure to recreational gymnastics in childhood are maintained through to early adolescence. The results suggest that childhood recreational gymnastics exposure is advantageous to bone development at the wrist. **Funding:** Canadian Institute of Health Research, Canadian Foundation for Innovation and Saskatchewan Health Research Foundation.

A Routine Within a Routine: Can a Yoga-Based Bedtime Routine Improve Preschooler Sleep and Family Health?

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**Background:** Parents of young children often point to bedtime as a source of frustration in their home, yet early bedtimes and sufficient sleep are important for children’s development, learning, and behavior. The purpose of this pilot study was to evaluate the feasibility and preliminary effectiveness of a yoga-based bedtime intervention, compared to a story-based control, in a sample of parent-child dyads from a low-income rural community. **Methods:** Children aged 2-5 years and their parent visited to lab on 6 occasions. Using a waitlist control study design, families were randomized to either intervention (yoga) or control (bedtime story) groups. Pre- and post-intervention measures were obtained using the Confusion, Hubbub, and Order Scale (CHAOS), Children’s Sleep Habits Questionnaire (CSHQ), and Family Nutrition and Physical Activity tool (FNPA). Height, weight, and waist circumference were measured on children and parents by trained research staff. **Results:** Participants were 18 boys and girls (mean age 4.0 ± 1.0 y, 50% girls) and the parent identified as being most involved with bedtime (mean age 36.4 ± 4.8 y, 94% mothers). Of 16 dyads who completed all assessments, 13 (81.2%) completed at least 12 yoga sessions (mode = 20 sessions; 125.0% of target). Sleep score improved significantly in both groups (Cohen’s d 0.42 vs. 0.52 for intervention and control, respectively, p<0.001) and FNPA score improved in the intervention group, but not control (Cohen’s d=0.4, p<0.001 vs. 0.04, p=0.007). **Discussion:** Results of this pilot study suggest that implementation of a bedtime yoga routine is feasible for families of 2-5-year-old children, as evidenced by good adoption and adherence of the intervention. Findings suggest that children’s sleep habits and the family obesogenic environment are both improved by implementation of any bedtime routine, and that a yoga-based bedtime routine may be slightly more effective than a story-based routine. These data provide preliminary support for further research designed to refine and test a yoga-based bedtime routine in a larger sample. **Funding:** No funding to disclose.

Does Sports Training During Adolescence Effect Lung Function Development?

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**Background:** Most people agree that engaging in low levels of physical activity during adolescences is likely to negatively impact health. However, it has also been suggested that too much exercise, intensive training, may have negative effects on a child’s growth and development. Numerous studies have shown that adult athletes have larger pulmonary function values than their heigh-, age-, and sex-matched peers. Young swimmers undergoing intensive training have been shown to have larger lung volumes than other similarly aged-and-based athletes and non-athletes. However, to what extents these differences are the consequence of training or natural endowment is still under debate. The aim of this study was to examine pulmonary function and respiratory muscle strength development, in both sexes, from four sports. **Methods:** Participants were recruited from the Training of Young Athletes (TOYA) study. The study used a mixed-longitudinal cohort design (5 age cohorts 8-16 years) and ran from 1987 through to 1990. Participants were recruited from around the UK and were deemed to be involved in intensive training and had performances success at national and international levels. A total of 453 participants from four sports (gymnastics, swimming, soccer and tennis) were recruited and compared to a group of non-athletic controls. Body height and mass, and lung function (Forced Vital Capacity (FVC), Forced
This childhood to adolescence spanning cascade could form the basis of interventional strategies to mitigate this gender mistreatment. Funding: No funding to disclose.

Physical Literacy Enriched Communities Through a Shared Responsibility Intervention Approach

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Background: Physical literacy’s wholistic approach and emphasis on intrinsic valuation of movement provides an encouraging avenue for intervention among children, to develop competent and confident movers. Although there is existing research on physical literacy interventions, no evidence exists on the outcomes of multi-sectoral interventions involving a combination of home, school, and community contexts. As such, this study sought to discover the impact of a physical literacy intervention focused on actions in the home, school, and community contexts through a shared responsibility approach. Methods: This study utilized a quasi-experimental pre-post design to examine the impact of a five-month intervention on children’s physical literacy (PLAYfun and PLAYself) and physical activity (PAQ-C), along with parent (PLAYparent) and teacher (PLAYcoach) perceptions of children’s physical literacy compared to a comparison group. The intervention focused on enriching physical literacy opportunities in three contexts: home (e.g., infographics and newsletters), school (e.g., physical literacy enriched physical education lesson plans), and community (e.g., redesigned recreation plan). A repeated measures mixed model analysis was used to examine intervention effects. Results: A total of 686 children (344 female; 342 male) from the intervention (n = 397) and comparison (n = 289) groups with an average age of 10.5 ± 1.35 years, along with 429 parents (258 intervention; 171 comparison), and 53 teachers (representing data from 571 children; 329 intervention and 242 comparison) participated at both time points. Children’s average motor competence (PLAYfun) demonstrated a significant intervention effect (p < 0.001), whereas children’s self-perceptions (PLAYself) and physical activity (PAQ-C) demonstrated no significant intervention effects (p = 0.517; p = 0.407). Parent perceptions of their child’s physical literacy (PLAYparent) also had a significant intervention effect (p = 0.018), while teacher perspectives (PLAYcoach) did not (p = 0.424). Discussion: This multi-contextual and multi-sectoral intervention provides insight into successful strategies for developing children’s physical literacy at home, school, and community levels, suggesting that a shared responsibility approach to physical literacy development, as opposed to siloed approaches, can create positive and significant change. More research is needed to determine if this shared-responsibility approach can have an impact on all components of physical literacy, and to explore the potential downstream effects on the health and wellbeing of children. Funding: NEH was supported by a SSHRC doctoral scholarship.

Girls Just Want to Have Fun! The Competence-Confidence-Happiness Cascade

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Background: Using a physical literacy lens, the holistic development of children necessarily includes concurrent development of competence and psychological characteristics (confidence, motivation, happiness). Unfortunately, there is a strong and often singular focus on technical development in delivery sectors (sport, PE, recreation) with reported gender stereotypes present. Although research has demonstrated gaps in movement competence between boys and girls and has associated these with perceived competence (confidence) differences, there is an absence of research on the age-related changes in these gaps, and especially from a physical literacy perspective. This study aimed to identify the age-related sex differences in physical literacy of Canadian children. Methods: Age-related sex-based trajectories were derived (cross-sectional data, n = 11,331, 5 to 15 years) for average motor competence, and for each of the five categorical movement tasks (locomotor, transport, upper body manipulation, lower body manipulation, balance) derived from the PLAYbasic tool. Trajectories were also derived from the three subscales (environment, self-description and valuing literacies) and selected single construct items (confidence, motivation, happiness) of PLAYself. Sex differences were examined along the age trajectory using an alpha level of 0.05. Results: Significant sex differences were detected in motor competence starting at 6 which increased in magnitude with age. Environmental participation and physical literacy self-description revealed significant gaps starting at age 8 that persisted with age. Confidence erosion in females started at age 9 with a linear reduction through to 15 years. Happiness associated with physical activity declined for females relative to males commencing at age 11, and surpassed the unhappiness threshold by age 13.

Discussion: In a population-representative cross-sectional sample, a clear sequence of age-related sex differences were revealed for competence, confidence, and happiness commencing in childhood leading to major gaps evident by adolescence. We propose that this sequencing may represent a deleterious cascade which may partially explain observed sex differences in active participation and physical activity levels. It was particularly disconcerting to observe that the majority of females reported associating unhappiness with physical activity by adolescence.
Long Term Effects of Sport (de)Election in Adolescence on Sport Participation

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Background: Physical activity is known to have health benefits at all ages across the lifespan. Involvement in sports teams is one such physical activity. Sport initiation and sustained participation are influenced by many physical and psychosocial factors. One potentially important determinant of sustained participation is selection into age-banded teams. Deselection from a sports team can often have a negative effect on both continuation within a sport and overall physical activity levels. However, it is unclear whether deselection causes an athlete to continue at the competitive level or to drop down to recreational sport. The aim of the study was to identify the consequences of (de)selection on short- term participation. Methods: The Saskatchewan Sports Participation Study’s (SSPS) recruited 895 participants, aged 10-17 years, from 6 sports (basketball, baseball, football, hockey, soccer, volleyball). Data collected includes measures of anthropometry, maturity status, reasons for sports participation, perceptions of physical condition- ing, competence, coach’s attitudes, and parental involvement. Results: It was found that 84% of athletes who were deselected continued to play that sport at the competitive level 36 months later. Only 10% of athletes choose to continue that sport at the recrea- tional level. Discussion: These findings suggest that deselection from a sports team tryout during adolescence does not affect the level of competition an athlete chooses to continue with 36 months from a sports team tryout during adolescence does not affect the overall physical activity levels. However, it is unclear whether deselection causes an athlete to continue at the competitive level or to drop down to recreational sport. The aim of the study was to analyze the true effects of deselection more accurately on sports participation after 36-month, further research is needed over a longer time period.

Determinants of Outdoor Time in Children and Youth: A Systematic Review of Longitudinal Studies

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Background: Previous research shows that outdoor play contributes to children’s social and cognitive development, higher physical activity, better vision, and more pro-environmental behaviors. Our systematic review aimed to summarize the determinants of outdoor time (OT) based on the social- ecological model. Methods: We searched nine databases: MEDLINE, APA PsycINFO, Web of Science, Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL, SPORTDiscus, ERIC, SocINDEX, and ProQuest Dissertations and Theses. To be included, studies needed to be quantitative, longitudinal, including ≥1 potential determinant of OT among 0 to 17-year-olds, and be published in English, French, Japanese or Spanish. We extracted the lead author, publication year, country, design, sample size, OT mea- sures, follow-up period, potential determinants, main results, and potential moderators or mediators. We assessed quality of evidence with the Effective Public Health Practice Project tool. We present a narrative summary as methodological heterogeneity precluded meta-analyses. Results: We included 46 studies providing data on 130 potential determinants. OT was consistently higher in warmer seasons and tended to increase in early childhood followed by a decrease in late childhood and adolescence. 6 of 11 studies examining gender differences found boys to accumulate more OT with the remainder finding no differences. The effect of OT

Examining the Relationship Between Parent Support, Physical Activity, and Motor Development During Early Childhood

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Introduction: Physical activity (PA) and motor skill development during early childhood are interrelated and together impact health and development in children. Thus, efforts should be made to promote both PA and motor skills in the early years. Parent support for PA is a known determinant of PA among school-aged children, however, very few studies have examined the relationship between parent PA support and child PA in the early years and no studies have examined this relationship with respect to motor skill develop- ment. This study addresses these research gaps by examining the relationships between parent PA support, child PA and motor skills in children during early childhood. Methods: Participants (N=589, 250 girls, Mage=4.93±0.59 years) in the current study are part of a larger, longitudinal cohort study consisting of children with a diverse range of motor skills. Motor skills were assessed using the Movement Assessment Battery for Children - 2nd edition. Child moderate-to-vigorous PA (MVPA) was measured using ActiGraph accelerometers worn for 7 days. Five items were used to measure parent PA support frequency on a 5-point scale (1=none, 3=3-4 times, 5=daily). Two moderation models using the PROCESS macro in SPSS were conducted. Model 1 examined the relationship between parent PA support and motor skills and the moderating effect of child MVPA on this relationship. Model 2 examined the relationship between parent PA support and child MVPA and the moderating effect of motor skills. Both models controlled for child age and sex. Results: Parent PA support was significantly related to motor skills (B=14.45, p=0.007) and child MVPA significantly moderated this relationship (B=-0.16, p=0.021). Parent PA support was not significantly related to child MVPA (B=2.89, p=0.051), however, motor skills had a significant moderating effect (B=-0.08, p=0.023). Discussion: These findings provide insight into the role of parents in supporting PA and motor skill development during early childhood. The results from this study suggest that parent PA support may have differing effects on PA and motor skills, depending on the child’s current MVPA and motor skill levels. These results can help to inform future parent PA support interventions in the early years. Funding: CIHR.
interventions was mixed, but all three interventions which included both parent sessions and additional resources to promote OT (e.g., specific advice, community guides) were effective. Sun safety interventions discouraging midday outdoor activities led to less OT. Few determinants were examined in ≥3 studies, limiting our ability to draw conclusions about consistency of evidence. Quality of evidence was rated ‘weak’ for most studies (38/46). Only 3 studies included a cohort of participants aged ≥13 years at baseline, and only two studies were conducted in low- and middle-income countries (LMICs). Discussion: Our review emphasizes a need for more longitudinal studies investigating determinants of OT to inform future interventions. We identified a need for more studies among adolescents and in LMICs. Future studies should also consider using device-based measures of OT (e.g., light sensors). Interventions should promote OT throughout childhood and adolescence while considering seasonal variations and potential sex/gender differences. Funding: University of Lethbridge.

Children’s Right to Roam in Their Neighbourhood During the COVID-19 Pandemic: A National Survey of Correlates of Children’s Independent Mobility

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Background: Previous research shows that children who have greater independence mobility (IM; freedom to move around in their neighbourhood without adult supervision) are more physically active. Using baseline data from a national longitudinal study, we investigated the correlates of IM among Canadian children during the second wave of the COVID-19 pandemic (December 2020). Methods: A market survey firm (Léger) recruited 2,291 parents of 7- to 12-year-olds across Canada. Parents completed an online survey that captured potential correlates of IM corresponding to the individual, interpersonal, social, and built environment levels of influence of the social-ecological model. The concepts of parental tolerance to risk in play, social cohesion, and perceived safety from traffic and crime were assessed with validated scales. A validated IM index comprising Hillman’s six mobility licenses was used as the dependent variable. Multi-variable ANCOVA models controlling for child and parent gender, and household income were used to examine the correlates of IM. Results: Children who were older, had a mobile phone, had a dog, lived in Quebec (vs. the Atlantic provinces), whose parents owned a single vehicle (vs. ≥2) or had greater tolerance to risk, had higher IM. Conversely, children with a disability, who lived in a condominium, apartment, or townhouse (vs. a detached or semi-detached home), or whose parents used motorized travel modes to get to work, did not work full-time, or had greater concerns about COVID-19, safety from crime, or traffic, had lower IM. The final multi-variable model explained 34.3% of the variance in IM, and child and parent gender and household income were not significantly associated with IM. Discussion: Our findings suggest that future interventions aiming to increase IM should target multiple levels of influence and address concerns related to safety. Such interventions may include messaging to promote active transportation to school and work, alleviate parental concerns about risk and encourage dog ownership as potential contributors to children’s autonomy. Further research is needed to understand the role of phone ownership in facilitating IM and to examine how to support IM among children with disabilities. Funding: Heart and Stroke Foundation of Canada.

Do Mental Health Clinicians Address Lifestyle Issues Among Children and Youth Accessing Mental Health Services at a Pediatric Tertiary Care Center?

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Background: This study sought to understand how frequently sleep, physical activity or screen time was discussed/recommended to youth receiving outpatient mental health services, and the association with age, sex or diagnosis. Methods: Retrospective health record review for 100 children and adolescents (50 female, 12.1±3.3 years). Random sampling from all visits in 1 year, stratified by sex and age. Data extraction for discussions or recommendations in clinic notes. Descriptive statistics and evaluations of age group and sex impact (chi-square). Results: 95% of patients discussed lifestyle factors with their care provider (51% were treated by psychiatrists) during 5.9±5.2 visits. Sleep was most frequently addressed being discussed with 60% of patients and behavior changes recommended to 19% or 32% (1st/2nd or all visits, respectively). Exercise discussions and recommendations were respectively provided to 33% and 9% of patients initially, and 45% and 11% of patients overall. Screen time was discussed with 52% of patients, with screen use changes recommended for 13% of patients. Age group and sex were not associated with the lifestyle discussions/recommendations. Discussion: Given the demand for mental health services, exploring modifiable risk factors is critically important. Sleep, physical activity or screen time was discussed with 95% of children and adolescents, but few patients (23%) were engaged in discussions of all three behaviors. Although screening for or making lifestyle recommendations does not guarantee patient behavior change, discussion and encouragement of the lifestyle changes that support positive mental health may reduce mental health issues among at risk patients. Funding: No funding to disclose.

Body Fat Measurement in Adolescents: Comparison of Skinfold Equations With DXA

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Background: There are numerous methods to assess percentage body fat (PBF) in children and adolescents including: underwater weighing, and dual-energy X-ray absorptiometry (DXA). However, these laboratory methods are not suitable for field studies. Skinfold thickness is often used as a field method. Several equations exist to predict PBF from skinfolds, most are age and sex dependent. Adolescence is a critical period of growth when there is great variation in maturity status, which influences fat accrual. However, very few equations control for maturity when predicting PBF. The purpose of the present study was to compare commonly used equations and align them by a measure of maturation, namely years from peak height velocity (PHV).

Methods: Participants were drawn from the University of Saskatchewan’s Pediatric Bone Mineral Accrual Study (PBMAS; 1991-2017). Serial measures of anthropometry (height, weight, skinfolds, etc.) and DXA scans were collected. PHV was estimated by fitting cubic splines to height velocity data. A biological age was calculated as age at test minus age at PHV. Two equations of body composition were used: Slaughter et al (S) and Lean et al (L) to predict PBF from skinfold assessments. PBF was also obtained from a DXA scan. Data were aligned by biological age groupings and differences between equation estimates calculated.

Results: In males it was found that prior to PHV there was good agreement in PBF between the S equations and DXA scans (p<0.05); however, after PHV percentage body fat was systematically underestimated (p<0.05), a similar pattern was observed in females. Equation L underestimated percentage fat mass from -5 years from PHV (p<0.05) with the difference increasing with increasing biological age, in both males and females. Discussion: These results illustrate skinfold equations systematically underestimate PBF and the differences are biological age dependent. These results suggest that to improve accuracy in predictions in addition to being age and sex dependent they also need to be maturity dependent.

Funding: Canadian Institute of Health Research (CIHR)/Saskatchewan Health Research Foundation/Dairy Farmers of Canada/USask.

Investigating the Relationship of Daily Physical Activity and Social Development in Toddlers

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Background: Physical activity can have a positive impact on social development in preschoolers. For example, activity interventions in preschoolers have been shown to improve self-esteem and self-concept. It’s not clear if these positive effects emerge even earlier, in the toddler years. As such, the objective of this study is to examine the relationship between daily physical activity volume and social development in toddlers.

Methods: Parents of toddlers (12-36 months) completed the Ages and Stages Questionnaire (3rd edition; ASQ-3). Participant total raw scores on the personal-social subscale were calculated and participants were divided into typically developing or at-risk of poor social development (≥1SD below mean) groups using established ASQ-3 guidelines. Toddlers were outfitted with a waist-worn ActiGraph wGT3X-BT accelerometer and instructed to wear it for seven consecutive days, with the exception of water activities. Participants were included if they had ≥1 valid wear day (defined as ≥8 hours of total wear). The NHANES toddler cut-point (<25 counts/15-sec) was used to distinguish between sedentary and active time. Total physical activity (TPA) was calculated in minutes per hour for each individual then normalized to minutes per day (min/day) with the average wear time (hours/day) across all included participants. Kendall’s Tau-b was used to assess the correlation between the ASQ-3 personal-social subscale raw scores and TPA. Independent samples t-test was used to compare the average TPA between social development groups. Results: A total of 86 toddlers had complete accelerometer data, and of these, 84 participants (54% girls, mean age ± SD = 22.5 ± 7.1 months) had valid accelerometer data. Daily TPA demonstrated a weak positive correlation (tau-b = 0.26, p = 0.001) with social development. Toddlers with typical social development (n=70) accumulated significantly more TPA compared with the at-risk group (n=14; 174 ± 26 vs. 153 ± 32 min/d; t = 2.62, df = 82, p = 0.01). Discussion: These results suggest the emergence of a relationship between physical activity and social skills, and that physical activity interventions in the early years may support social development. Further research is needed to investigate if this association becomes stronger over time.

Funding: No funding to disclose.

Does Disability Influence Children’s Participation in Risky and Outdoor Play? A Scoping Review

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Background: Children and youth who participate in risky play and outdoor play tend to accumulate more daily physical activity. As a result, playing outdoors and engaging in risk has known positive health outcomes. While all children and youth have a right to play, children and youth with disabilities (CYWD) have fewer opportunities and experience more barriers to risky play and outdoor play. The aims of this scoping review were to summarize the literature that examines CYWD’s engagement in risky play and outdoor play, and barriers and enablers experienced by CYWD to participate in risky play and outdoor play.

Methods: We conducted a scoping review following Joanna Briggs Institute methodology for evidence synthesis.

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Developing a Novel Support Framework for Healthy Lifestyle Behaviours Among Youth With Mental Distress: A Lived Experience Partnership

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Background: Given the crisis in youth mental health, long waitlists leave most youth without mental health support. Lifestyle behaviours are known to positively impact youth mental health. This study developed novel, scalable sleep, physical activity and screen time supports for youth waiting for mental health services. Methods: An iterative development process, in conjunction with partners with lived experience of youth mental illness, was used. Interviews with youth, parents and clinicians identified desired resource content/format. Inductive qualitative analyses defined the lifestyle behaviour change e-health framework. Two e-modules per behaviour (screen time, sleep, physical activity) were created and feedback sought from lived experience partners. Module revisions and the creation of additional modules followed the same iterative process. Results: Interviews with 10 youth receiving inpatient care, 10 youth cared for as outpatients, 10 parents of youth receiving care and 10 mental health specialist clinicians initially defined the e-health resource framework. The website provides personalized feedback based on standardized behaviour questionnaire responses and separate resources for sleep, physical activity and screen time. Each behaviour resource provides information on the mental health link, activities for addressing ambivalence to change, SMART goal setting and addressing roadblocks, and 10-15 step-by-step plans for initiating behaviour change. 12 hospitalized youth, 33 youth receiving outpatient mental health services, 18 parents and 11 clinicians contributed to module development and revisions. Final versions of all modules were evaluated very positively (8/10 or higher), with interactive components in particular prompting further resource engagement. Adding narration features, segmenting modules into smaller components, simplifying language, use of age-appropriate images and adding information source citations and additional resource links were recommendations incorporated into the final e-health modules. Discussion: The youth mental health service demand, data indicating few youth achieve lifestyle behaviour recommendations, and the mental health→lifestyle behaviour link emphasized the need for scalable e-health resources for supporting improved youth sleep, physical activity and screen time behaviours. Engagement with lived experience partners throughout the iterative development process significantly impacted e-health resource format/content, resulting in high user satisfaction. The continued involvement of lived experience partners in research to evaluate e-health resource efficacy is recommended. Funding: No funding to disclose.
apparent role of nitric oxide was not different between boys and girls. It is suggested that the greater SkBF response in boys during exercise was related to greater relative heat production and dissipation needs at this exercise intensity. The response to body size-related workload should be further examined. **Funding:** No funding to disclose.

### Child–Adult Differences in Post-Activation Potentiation and Motor-Unit Activation Pattern in the Potentiated Knee Extensors – Preliminary Results

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**Background:** Post-activation potentiation (PAP) describes the enhancement of twitch force following a conditioning contraction in skeletal muscle. In adults, PAP is greater in muscles with a higher percentage of type-II fibres. Further, PAP-related augmented contractility is accompanied by a decrease in motor-unit (MU) discharge rates. Children may have lower PAP due to lower type-II muscle fibre composition and activation of their higher-threshold (type-II) MUs compared to adults. Changes in potentiated MU activation have not been examined in children. Therefore, the purpose of this study was to determine whether there are child-adult differences in PAP and MU activation of the potentiated knee extensors. **Methods:** 12 boys (10.4±1.7 years) and 12 men (21.8±1.9 years) completed familiarization and experimental sessions. In the experimental session, knee extensor maximal voluntary contraction (MVC) torque (Biodex System 3) was first determined. Maximal isometric evoked twitch torque (Digitimer stimulator, DS7AH) and MU activation patterns during submaximal contractions (20% and 70% MVC) were then recorded before and after a conditioning contraction (5s MVC). PAP was calculated as the percent-increase in evoked twitch torque before and after the conditioning contractions. MU activation patterns were examined during the submaximal contractions using Trigno Galileo surface electrodes (Delsys Inc) and mathematically decomposed into individual MU action potential trains. Recruitment threshold (RT) and MU firing rates (MUFR) were calculated from the most stable 2- and 1-s of the 20 and 70% MVC force traces, respectively. **Results:** PAP was higher in the men than the boys (101.3±41.2% vs. 71.0±20.7%, respectively p=0.036). In the 20% MVC contractions, the y-intercept of the MUFR-RT relationship decreased following potentiation (p=0.001). Although the group-by-potentiation interaction did not reach significance (p=0.18), this decrease was greater in men (ES=0.57). There was no reduction in MUFR with potentiation during 70% MVC contractions in either group. **Discussion:** These observations suggest that boys experience less PAP than men in the knee extensors. Potentiation is accompanied by lower MU discharge rates during low, but not high intensity contractions, and is less prominent in boys than men. The lower discharge rates may mitigate the development of fatigue, but the explanatory mechanism needs to be examined. **Funding:** Natural Sciences and Engineering Research Council of Canada (B. Falk).

### How Did the Pandemic Impact Children’s Physical Activity, Sedentary Behaviour, and Sleep? (Invited Speaker)

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**Background:** Healthy child development is fostered through ample physical activity, low levels of sedentary behaviour, and adequate sleep (i.e., 24-hour movement behaviours). Meeting 24-hour movement behaviour recommendations is associated with enhanced physical and mental health in children. However, most children do not meet the guidelines. On March 11, 2020, COVID-19 was declared a pandemic. A number of public health restrictions were put in place to curb transmission of COVID-19. Closures of schools, playgrounds, and cessation of recreation programs, all changed the way children engaged in movement. Across the pandemic, public health restrictions varied. Children experienced barriers to movement, and some children more than others (e.g., children with disabilities). **Methods:** To understand the impacts of the COVID-19 pandemic on children’s movement and play, we conducted two multi-methods studies. Through ParticipACTION, we distributed an online survey to Canadian parents in April 2020 (n=1,472), October 2020 (n=1,568), and April 2021 (n=1,601). Through the National Physical Activity Measurement (NPAM) study, we distributed an online survey to Canadian parents of children with disabilities (n=151) at two timepoints: May 2020 and November 2020. We conducted follow-up semi-structured interviews with parents in June-July 2020 (n=29) and June-July 2021 (n=45), and with parents of children and youth with disabilities in March-April 2021 (n=7) as a part of the ParticipACTION and NPAM studies, respectively. **Results:** Parents perceived their child to be less active and more sedentary during the COVID-19 pandemic compared with before the pandemic at all time points. Parents of children with disabilities also perceived their child’s physical activity to be lower and their screen time to be higher during the COVID-19 pandemic compared to before the pandemic at both time points. Parent support behaviours
Assessing the Relationship Between Physical Activity and Health-Related Quality of Life in Pediatric Inflammatory Bowel Disease

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Background: Pediatric-onset inflammatory bowel disease (IBD) is known to negatively affect quality of life and wellbeing. While medication management aims to treat inflammation of the gut, the overall burden of disease can still impact wellbeing. Physical activity may improve quality of life in children with and without chronic conditions, but there is limited research in the IBD population that directly evaluate this link. Therefore, the objective of this study is to assess the relationship between physical activity and quality of life in pediatric IBD.

Methods: Children and adolescents between the ages of 7-17 years with a confirmed diagnosis of IBD were recruited from McMaster Children’s Hospital Gastroenterology clinics. Participants completed the KIDSCREEN-27, a health-related quality of life questionnaire with subscales examining Physical Wellbeing (PHY), Psychological Wellbeing (PWB), Autonomy and Parents (PAR), Peers and Social Support (SOC), and School Environment (SCH). Raw scores in each subscale were calculated and converted into T-scores. Participants also completed a self-perceived global assessment of disease severity on a 10-cm visual analog scale. Finally, participants wore an Actigraph wGT3X-BT accelerometer during waking hours for 7 consecutive days to quantify average daily time spent in total physical activity (TPA), light (LPA), and moderate-to-vigorous physical activity (MVPA). Pearson and Spearman correlations were used to determine the relationship between physical activity and KIDSCREEN-27 total score and T scores by subscale. Results: Twenty-two children and adolescents completed the study (55% females; age: 14.4±2.0 years). Self-perceived disease severity was low (1.1±1.84, [0.0-6.50] out of 10). TPA and LPA were significantly correlated with total KIDSCREEN-27 score (TPA: r=0.460, p=0.041; LPA: r=0.521, p=0.019), PHY (TPA: r=0.602, p=0.005; LPA: r=0.536, p=0.015), and PWB (TPA: r=0.495, p=0.027; LPA: r=0.531, p=0.016). Physical activity outcomes were not related to PAR, SOC, or SCH.

Discussion: Children and adolescents with IBD that engaged in higher levels of physical activity, and specifically LPA, also presented with higher health-related quality of life, even when perceived disease severity was low. While these associations are promising, future research should explore the effectiveness of physical activity interventions to improve health-related quality of life in pediatric IBD.

Funding: Heart & Stroke Foundation of Canada.

Expiratory Flow Limitation at Mid-Childhood is Associated With Worse Lung Function and Increase Exertional Symptoms in Early Adulthood

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Background: Children born preterm, especially those with bronchopulmonary dysplasia (BPD) have impaired respiratory function at rest and during exercise, with increased exertional dyspnoea. Recent evidence shows lung function declines over time in this population and that adults born preterm have a greater risk of metabolic and respiratory disease such as Chronic obstructive pulmonary disease. We recently reported increased expiratory flow limitation (EFL) during exercise in school aged children born preterm; however, this was not related to respiratory symptoms or aerobic fitness. Whether EFL in childhood is correlated to adult respiratory disease is unclear, and we hypothesized that EFL in childhood would be associated with increased respiratory burden in early adulthood.

Methods: Preterm children (<32 weeks gestation) with and without BPD (>28 days supplemental O2, assessed at 36 w post menstrual age), and term born controls performed an incremental treadmill exercise test with exercise volume loops measured at 9-12 years. Follow-up spirometry and respiratory symptom questionnaires were performed at 16-23 years. Differences in lung function was assessed by paired T-test, Chi-square analysis was used for differences in proportion between those with and without EFL at school age. Results: 83 young adults (25 Term; 40 preterm with BPD; 18 preterm without BPD) with previous acceptable childhood exercise test and flow volume loops, attended a follow up visit at a mean (SD) age of 19.4 (±1.5) years. Those with EFL during childhood (30% of terms; 53% preterm with BPD; 26% preterm without BPD) were more likely to report wheeze on exertion (25% vs 8% p=0.02) as young adults. They also had lower FEV1 (-1.09 vs -0.05 p<0.001) and FEV1/FVC z-score (-1.59 vs -0.22 p<0.001) once accounting for baseline lung function at 9, there was no independent impact of EFL on lung function or symptoms at 19.

Discussion: In this preterm cohort, childhood EFL is associated with lower lung function and increased incidence of exertional wheeze. Understanding the long-term impact of EFL on physical activity and cardiopulmonary fitness will be key to understanding the life-long consequences of preterm birth.

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Measuring Physiological Variables During Exercise: The Black Box (Invited Speaker)

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Breath-by-breath (BxB) measurements of alveolar gas exchange has become the usual, standard method for metabolic measurements during exercise testing. However, this method remains a “black box” for most users, meaning that without considerable knowledge and understanding of how VO2 and VCO2 are computed, end-users may not recognize flawed or erroneous data; or worse, may question divergent results obtained by classical methods. Details and subtleties of such computations are reviewed and discussed in this presentation, for the express purpose of highlighting complexities inherent in this method, and prompting the reader or listener to return to “first principles” when attempting to explain and comprehend results obtained.

Molecular Transducer of Physical Activity Consortium (MoTrPAC) (Invited Speaker)

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The Molecular Transducer of Physical Activity Consortium (MoTrPAC) is the largest targeted National Institutes of Health (NIH) investment of funds (~$200M) into the mechanisms of how physical activity improves health and prevents disease. The overall goals of this U.S. national project are to generate a map of molecular responses to physical activity and exercise using omics technologies and create a user-friendly public data resource that any qualified researcher can access. The University of California Irvine Pediatric Exercise and Genomics Research Center is the sole pediatric center out of six clinical centers (10 sites) across the U.S. The Center recruits children (10-17y/o) from diverse racial and ethnic groups with a goal to map the molecular mechanisms through which exercise benefits health. Low and highly active participants perform an acute bout of endurance exercise with blood collection before, 20- and 40-min during exercise and 10 min, 0.5 h and 3.5 h into recovery. A subgroup of low active participants repeats the assessment following 12 weeks of supervised endurance training program. Nine chemical analysis sites and a bioinformatic data center will perform integrative multi-omics (genomics, proteomics, and metabolomics) analysis to create an accessible database for future research. This research will lay the foundation for a new era in which we can harness the molecular pathways of the exercise response to improve health across the lifespan.

Sex Differences in the Relationship Between Sedentary Time and Motor Skills Among Preschoolers

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Background: Preschool girls are likely to be more sedentary than boys, and low sedentary time (ST) levels are related to higher odds of having better motor skills (MS) compared to children with high ST levels. Little is known about sex-specific nuances in the relationship between ST and MS in preschoolers. The purpose of this study was to test the relationship between ST and MS difference by sex. Methods: One hundred seventeen girls and 114 boys (mean = 53.1±3.6 months) from a Midwestern city in the USA provided valid accelerometry data. Devices were worn on the non-dominant-wrist for 7-consecutive days to determine minutes in ST during childcare. Age and sex were parent-reported. Overall MS, locomotor skill, and ball skill raw scores were assessed with the TGMD-3. Product measures were used to obtain catch (balls caught out of 5-trials), average jump distance (cm), average run velocity (meters/sec), average throwing speed (mph), average kicking speed (mph), average of preferred- and non-preferred-leg hop velocity (meters/sec). Descriptive statistics were conducted for all continuous variables and frequencies were conducted for all categorical variables. Regression analyses were conducted for each sex separately to test the relationships between ST and each, separate dependent variable: (1) overall TGMD-3 MS raw score, (2) TGMD-3 locomotor skill raw score, (3) TGMD-3 ball skill raw score, (4) catch, (5) jump distance, (6) run velocity, (7) average throwing speed, (8) average kicking speed, (9) preferred-hop velocity, and (10) non-preferred-hop velocity. Results: Girls (159.5±33.7 min) had higher ST during childcare compared to boys (146.9±36.4 min; p=0.007). For girls, only ST and locomotor skills were related (F[1,115]=4.6, p=0.03; b=0.007 [-0.0133, 0.0005]); while for boys, there was a significant relationship between ST and non-preferred leg hop velocity (F[1,112]=4.9, p=0.03;b=0.0651 [0.0073,0.1229]). Discussion: Findings support that the relationship between ST and MS differs by sex, particularly locomotor skills. It seems that these differences are specific to the type of test (process vs product) or locomotor skills (run vs hop). Further research is needed to understand the detailed differences by sex in the relationship between ST and locomotor skills. Funding: R01HL-132979, National Heart, Lung, and Blood Institute at the NIH.

Physical Activity Among Children With Disabilities in the Early Years: A Systematic Review and Meta-Analysis

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Background: Physical activity in the early years is foundational for growth and development and is associated with numerous health benefits. However, the prevalence of physical activity among the pediatric population with disabilities is unclear. This systematic review and meta-analysis aimed to
synthesize existing literature on physical activity levels of young children (0-5.99 years) with disabilities. Methods: Empirical quantitative studies were collected from seven databases and reference hand-searching. Twenty-one studies were included in the review, and 11 were examined via meta-analysis. Results: Children with autism spectrum disorder had the highest amount of moderate-to-vigorous physical activity per day, but the values varied both across and within disability types. Physical activity levels also varied between measurement tools (i.e., accelerometers, observation, and proxy-report). The meta-analysis determined: 1) age and the device type used to assess activity levels were significant moderators for the percentage of time spent in moderate-to-vigorous physical activity; and, 2) children with disabilities were engaged in more light physical activity than moderate-to-vigorous physical activity per day. Discussion: Future research should develop and evaluate interventions designed to increase physical activity levels of young children with disabilities, employing multiple and more accurate measurement tools. The results of this review highlight the heterogeneity in measurement and reported levels of physical activity in young children with a disability and the need for standardized measurement methods. Physical activity guidelines should be further adapted for the early years to account for varying physical activity abilities, and the unique challenges encountered by children with different disabilities. Funding: No funding to disclose.

The LEAP to Understanding the Interactions of Disease, Physical Activity, Bone and Muscle Health in Canadian Children With Juvenile Idiopathic Arthritis: A Canadian Collaborative Research Team (Invited Speaker)

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Juvenile idiopathic arthritis (JIA) is among the most common chronic disabling conditions of childhood, and the most common of the rheumatic diseases affecting children. The chronic joint inflammation in children with JIA has broad consequences beyond joint stiffness and damage, and includes pain and functional disability. Exercise, and the ability to keep up with peers in physical activity (PA) is frequently identified as a concern of children with JIA and their families, and children with JIA are less active than peers. The Linking Exercise, Activity, and Pathophysiology in Juvenile Idiopathic Arthritis (LEAP) study is a multicentre Canadian prospective research program focused on studying physical activity related to disease factors, inflammation, and the relationships of these factors to development of bone and muscle in children with JIA. This study, involving 12 pediatric rheumatology centres across Canada, enrolled over 700 children with JIA, who were followed for two years, resulting in a robust set of data including disease characteristics, physical activity measures, biomarkers of inflammation and bone metabolism, patient reported quality of life measures, muscle function using jumping mechanography, and bone strength and geometry using pQCT/HRpQCT. Analysis of these data is beginning to provide important new understanding of the relationships between JIA disease characteristics to physical activity, bone and muscle development, with the aim to promote healthy activity and growth for children and teens with JIA. Dr. Tucker will describe the collaborative transdisciplinary development of the LEAP study, and discuss some of the early study result highlights.

Acceptability of the Sanford Fit Website for Use With Elementary Students

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Background: The Sanford fit initiative was developed to provide web-based healthy messaging and education around four principles (recharge, mood, food, move) to children and families, educators, and communities. The content is presented as lesson plans and other components. However, external evaluation of the acceptability of Sanford fit in elementary education has yet to occur. The purpose of this study was to evaluate the acceptability of Sanford fit by obtaining information from individuals who had opted to receive electronic communications from fit. Methods: Users from across the country were randomly selected to complete an online Qualtrics survey. Users (principals, teachers, and other types of school-based personnel) were asked questions regarding usage, which components of fit are helpful, and why and if changes should be made due to COVID-19. A $5 Amazon gift card was given as incentive for completing the survey. Most questions provided response choices, but reasons for liking or disliking components were asked via free response. Descriptive statistics were used to analyze quantitative data, and qualitative data were analyzed by two coders who used an inductive coding process to reach consensus. Results: 850 respondents submitted a survey. Some respondents (n=241; 28.6%) did not use fit, despite being subscribed. Most respondents were in teaching positions (i.e., academic or physical education; 64%), had been a user for less than a year (43.6%), and used the program weekly (31.1%). Most educators indicated they did not use fit videos (47.8%) and fit printables (53.6%). Users reported that fit helped students recharge (86.2%), manage mood (85.3%), make more nutritious food choices (71%), and increase physical activity (78.4%). Half of respondents (55%) reported that COVID-19 affected their usage. Discussion: The acceptability of Sanford fit was evaluated by a cohort of educators that had subscribed to electronic communication. Users reported components were easy to use and enjoyed by students. Similar acceptability was reported on Memphi FitKids, a website platform targeted at improving diet, activity, screen time, and sleep. Future research should assess website efficacy. We perceive high acceptability of the Sanford fit website in elementary education. Funding: No funding to disclose.

Child–Adult Differences in Motor-Unit Activation of the Upper- and Lower-Limb Muscles During Submaximal Contractions

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Background: Lower activation of higher-threshold (type-II) motor-units (MUs) has been suggested to be a primary mechanism underlying many child-adult differences in muscle performance. This hypothesis has been supported by studies using global surface electromyography (sEMG). However, data on discrete MU activation yield conflicting and inconsistent findings. Contradictory findings may be related to evaluating different muscles or contraction intensities. Thus, our purpose was to examine child-adult differences in discrete MU activation of two muscles characterized by different recruitment strategies (i.e., vastus-lateralis and flexor carpi-radialis), during isometric submaximal contractions at 25 and 70% of maximal voluntary contraction (MVC). Methods: Eleven boys (10.4±1.2 years) and 15 men (25.7±3.2 years) completed 3 sessions. Following a habituation session, knee extension and wrist flexion performance were assessed in randomized order on the subsequent visits. MVC was determined prior to completing trapezoidal contractions at 25 and 70% MVC. sEMG was captured by Delsys Trigno Galileo sensors and mathematically decomposed into individual MU action potential (MUAP) trains. MUAP amplitude (MUAPamp), recruitment threshold (RT), and MU firing rates (MUFR) were calculated from the most stable 3- and 5-s of the 25 and 70% MVC force traces, respectively. Slopes and y-intercepts were extracted from the linear MUAPamp–RT and MUFR–RT relationships. Group differences in MVC and MU variables were assessed using an ANCOVA and 3-way ANOVAs (age x muscle x intensity), respectively. Results: Knee extension and wrist flexion MVC were higher (p<0.001) in men (knee: 232.9±51.2 Nm; wrist: 11.0±2.7Nm) than boys (knee: 73.4±27.9Nm; wrist: 4.6±1.4Nm), even after accounting for differences in body size. The y-intercept of the MUFR–RT relationship was lower (p<0.001; group effect) in boys than men for the wrist and knee, reflecting lower firing rates among boys. No group differences were observed in the other MU activation variables. Discussion: These results demonstrate that, independent of contraction intensity or muscle recruitment strategy, MU activation, specifically MUFRs are lower in children compared with adults. Moreover, these findings suggest that children’s activation deficits occur at all recruitment levels and may not be specific to higher-threshold MUs. Funding: This work was supported by the Natural Sciences and Engineering Research Council of Canada (B. Falk). S. Woods holds a Queen Elizabeth II Graduate Scholarship in Science & Technology.

Fearless in Physical Activity: Fun, Family-Friendly Community-Based Physical Activity Interventions for Children, Adolescents, and Adults With Congenital Heart Disease

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Background: Physical activity is recommended for individuals with congenital heart disease (CHD) who are often less active than peers. One suggested explanation is fear or uncertainty about physical activity. Our previous research highlighted that individuals with CHD want to learn about the importance of physical activity, recommended activities and available resources. This study assessed community-based physical activity events (Fearless) aimed to address fear by introducing activities and resources appropriate for individuals with CHD and their families. Methods: Fearless community-based recreational events promoted safe, health-appropriate physical activity for individuals with CHD. Events, held in each season of the year, were hosted for a specific or combined age group based on local enrollment. Each 3-hour event included two education (e.g., self-awareness, goal setting) and two-to-three physical activity sessions. Event content catered to participant age and available facilities. Participants were recruited through congenital heart disease clinics and support networks across Ontario. Participants with CHD (age 5+) and their family members were asked to complete a written feedback form at the end of each event. A reflexive, inductive thematic analysis was used to analyze the feedback provided. Results: 31 Fearless events were hosted by community partners in five cities across Ontario, Canada. The participants (n=274) were 117 individuals with CHD and 157 family members (183 youth, 38 adults, 53 all age registrants). Three main themes emerged from the end-of-event feedback: (1) Fearless is fun and inclusive, “A very friendly and accessible program” (2) Fearless helps establish healthy behaviours, and (3) Fearless fosters a sense of connection, “Emphasizes the need to keep active. Great opportunity to meet families sharing similar issues.” Overall, Fearless events were viewed positively by individuals with CHD and their families. Recommendations for changes focused on having events more often and offering events specific to young children, school-age children and teens as well as adults. Discussion: Participant feedback indicated that Fearless offered fun, family-friendly events for children, adolescents, and adults with CHD to participate in activity “without fear.” The Fearless event framework provides sport and recreation leaders with opportunities to promote physical activity amongst individuals with CHD. Funding: Government of Ontario, Ministry of Tourism, Culture and Sport, 2017.

The Odds of Mot Meeting the Physical Activity Guidelines is 3 Times Greater in Children With Type 1 Diabetes: A Meta-Analysis

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Background: Physical activity (PA) is associated with better glycemic control, body composition and cardiovascular risk factors in children with type 1 diabetes (T1D). However, there are barriers to PA (such as the fear of post-exercise hypoglycemia) that may explain lower self-reported PA in children with T1D. However, it is unknown if objectively measured daily PA would differ between children with T1D and typically developing children (TDC).
Therefore, we aimed to synthesize evidence comparing the objectively measured PA outcomes, including the ratio of children not meeting moderate-to-vigorous PA (MVPA) recommendation (≥ 60min/day) and sedentary time between children with T1D and TDC. **Methods:** We comprehensively searched databases in PubMed, Ovid MEDLINE, Embase, SPORTDiscus, Scopus and Web of Science (inception to Dec 6, 2021). We included 11 studies with accelerometer recorded PA between children with T1D (N=540) and TDC (N=508) in meta-analysis. We performed meta-analysis with random-effects model to calculate pooled standardized mean differences (SMD) for daily light PA, MVPA, vigorous PA, and sedentary time, as well as odds ratio (OR) of not meeting MVPA recommendation with 95% confidence intervals (95%CI). **Results:** There were no differences on light PA (SMD: -0.1, 95%CI -0.5 to 0.3), MVPA (SMD: -0.1, 95%CI -0.4 to 0.1) and vigorous PA (SMD: -0.0, 95%CI -0.3 to 0.3) or sedentary time (SMD: 0.3, 95%CI -0.0 to 0.6) between children with T1D and TDC. Children with T1D had higher odds of not meeting the daily MVPA recommendation than TDC (OR: 3.0, 95%CI 1.4 to 6.4). **Discussion:** Fewer children with T1D achieved daily MVPA recommendation while daily PA and sedentary time did not differ from TDC. Wide confidence intervals indicated a need for additional evidence and identification of facilitators and barriers to PA in children with T1D. **Funding:** SHRF CID and Diabetes Canada operating grant.