

**CONSENSUS STATEMENT**

**SINGAPORE INTEGRATED  
24-HOUR ACTIVITY  
GUIDELINES  
FOR CHILDREN & ADOLESCENTS  
(7 TO 18 YEARS)**

**JANUARY 2021**



**ACADEMY OF MEDICINE  
SINGAPORE**



**COLLEGE OF PAEDIATRICS AND  
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## INTRODUCTION

Statistics from the Ministry of Education revealed that the proportion of overweight children has increased from 11% in 2013 to 13% in 2017. (1) Studies on Singaporean children and adolescents have previously shown that they could only meet up to 40% of the recommended physical activity level and above 70% of adolescents exceeded more than 2 hours of electronic screen time daily. (2-3) However, a study published in 2015 by Ting et al involving 233 adolescents showed that none of the participants achieved the recommended 60 minutes of moderate-to-vigorous physical activity and engaged in excessive amount of sedentary behaviour. (4) Furthermore, screen time has increased due to the COVID-19 pandemic and introduction of home-based learning. (5-6) These developments have prompted healthcare professionals to provide guidance for Singaporean children and adolescents towards better health.

For children and adolescents, physical activity is encouraged for leisure (e.g. play, sports or planned exercise), as part of physical education or through transportation (e.g. walking, running and cycling) in the context of home, school or community settings. (7-8) Children and adolescents should have access to safe and equitable opportunities to participate in varied physical activities that are enjoyable and age- and ability-appropriate, either individually or in groups. (9-10)

Periods of sedentary behaviour and recreational screen time should be kept to a minimum. (11-12) These periods can be improved by setting boundaries (e.g. duration) or interrupted with regular breaks for physical activity. (13-14) Establishing a consistent bedtime routine is important to help children and adolescents achieve regular and adequate sleep time. (15-16)

## GUIDELINE SUMMARY

Our objective is to provide guidance to encourage Singaporean children and adolescents to adopt a holistic approach towards integrating all types of activity within a daily 24-hour period. These activities (including light, moderate and vigorous physical activity, sedentary behaviour, sleep and eating activity) are closely inter-related in terms of health benefits and time consumption. It is equally vital to understand the importance of each type of activity and to organise these activities throughout a day (and night) schedule for the best health outcomes.

These guidelines to follow are for all healthy children and adolescents (aged 7 to 18 years old), irrespective of gender, cultural background or socioeconomic status. Children and adolescents with special needs or medical conditions should consult a qualified medical professional for additional guidance.

## EVIDENCES

Current national and international physical activity and movement guidelines for children and adolescents, including recommendations from the World Health Organization, were reviewed. Relevant evidence on this topic was searched electronically. Only results in English language were considered and the quality of the evidence was rated. We have presented the process using the GRADE Evidence to Decision framework (17).

These guidelines are recommended for healthcare professionals providing holistic care of children and adolescents including educating, encouraging and promoting beneficial activities that, hopefully, will continue into their adulthood for a life-time of good health.

## CONSENSUS STATEMENTS

**1. For physical, mental and social health, children and adolescents should acquire a lifestyle that integrates regular physical activity, limited sedentary behaviour, adequate sleep and good eating habits within each 24-hour period.**

Physical activity is essential for healthy growth and development in children and adolescents. (18) Research shows that regular physical activity improves aerobic fitness, body composition, metabolic risks, musculoskeletal health, mental health and academic results in children and adolescents. (18-21) Emergent evidence shows that prolonged sedentary behaviour, particularly unregulated and unrestrained screen time, is associated with a range of adverse health outcomes including obesity. (22-24) Sleep duration and quality impact child- and adolescent-health significantly as shorter sleep duration is associated with childhood obesity. (25-26) The challenge is to incorporate adequate physical activity, low sedentary behaviours and adequate sleep duration for the best health outcomes in children and adolescents. (27)

**2. Accumulate at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity in a week, where more is better.**

The premise of a healthy lifestyle includes regular physical activity participation. In children and adolescents, regular physical activity or physical sport participation is associated with lifelong health benefits. (18,28-30) Activities of all types and performed across all intensity levels, should be encouraged to promote habitual physical activity or active play and physical sports engagement and development of health-related and skill-related fitness. (28,30-32)

To achieve substantive health benefits, children and adolescents should aim to accumulate an average of 60 minutes or more of physical activity (including play, games, sports, physical education, planned exercise or transportation) per day in a week and most of these activities should be of at least moderate intensity. (18-19,29-30) For greater health gains, vigorous intensity activities should be incorporated where possible. (18-19,30)

**3. Engage in muscle and bone strengthening exercises at least three times a week. This could be part of the daily minimum accumulation of 60 minutes of moderate-to-vigorous intensity physical activity.**

Muscle and bone strengthening exercises should be incorporated into a child's physical activity regime. (19,29-30,33) These exercises range from weight-bearing activities, resistance exercise using body or light weights, or light impact exercises such as skipping, hopping or jumping. (33-34) The inclusion of these activities promotes strength gains,

development of strong joints and healthy bones, which are vital for optimal growth and development. (33-35) Building an early foundation of good joint and bone health during childhood helps to prevent injuries, improve exercise performance and prevent the development of bone-related health issues in future. (34-35)

#### **4. Engage regularly in a variety of light physical activities throughout the day.**

Light physical activities can range from static (e.g. standing) to dynamic (e.g. slow walking). (36) Make every choice count - choose the more active option! (37) Light-intensity physical activity has health benefits too. (37-39) Stand and move about rather than sit. Take a walk, rather than drive. Take the stairs, rather than the lift or escalator. Encourage active play, rather than playing with screens. (37,40) Play outdoors, rather than indoors. (40) Setting a target of achieving an accumulated 12,000 steps per day also helps children and adolescents meet the daily physical activity recommendation. (31-32,41)

#### **5. Limit recreational screen time as much as possible.**

Recreational screen time activities include television viewing, computer, tablet or phone device use, physically inactive video games. (42-43) In children and adolescents, of all the sedentary activities, recreational screen time more than 2 hours daily is associated with the most adverse health outcomes. (23,43) The benefits of limiting this screen-based sedentary behaviour include reduced adiposity, improved motor and cognitive development and better psychosocial health. (23,44) Providers should address this behaviour by assessing the duration and use of recreational screen time and then suggest parenting strategies to limit use as much as possible. (23,42,44-45)

#### **6. Build in regular breaks to move around during times of prolonged sitting or inactivity.**

It is inevitable that there are times when children are remained seated for prolonged periods, be it during a classroom lesson or a long-distance trip. Prolonged sedentary behaviour is damaging to health, but when this is unavoidable, it is important to include regular breaks to encourage frequent movement and physical activity. While this contributes to a child's overall physical activity levels, (46) it is also beneficial for their mental and social health, (20) and these activity breaks help children to better concentrate in school. (47) Breaks need not be very long, but undertaking a few minutes of movement every 30-60 minutes of sedentary time, together with encouraging play during break times should help limit the impact of prolonged physical inactivity. (48)

#### **7. Have regular sleep of at least 9 hours (for 7-13 years old), at least 8 hours (for 14-17 years old) and at least 7 hours (for 18 years old).**

Sleep is a critical component of mental and physical health that is often sacrificed to make time for daytime activities. Achieving the number of recommended hours of sleep regularly is associated with better health outcomes in terms of attention, memory, learning, behaviour, emotional regulation, quality of life, mental and physical health. (49) Insufficient sleep

increases the risk of accidents and injuries, especially during physical activity, and in the longer term is associated with obesity, hypertension, diabetes and depression. (49-52) Children 7 to 13 years old should sleep 9 to 12 hours, teenagers 14 to 17 years old should sleep 8 to 10 hours and 18 years old should sleep 7 to 9 hours per 24 hours regularly. (49, 53)

**8. Take the necessary precautions before, during and after exercise and see a doctor if you feel unwell during the exercise.**

The benefits of physical activity outweigh its risks. Safety is key in minimising injuries during physical activities or in organized sports. This will ensure the child's well-being and continued participation in exercise and sports in the long term. (54) Use appropriate equipment and footwear for exercise or sport. Exercise in areas that are free of hazards like broken equipment and uneven surfaces. Avoid exercising outdoors in extremely hot and humid conditions. (55) Perform warm-ups before exercise and cool-down stretching post activity. (55) Ensure adequate hydration and apply protection against the sun and insects. (56-57)

For organised sports, understand and follow the rules of the game or sports. Practice the skills needed for the activities, like climbing, balancing and throwing, and adopt proper form and technique. (55) Ensure proper conditioning in fitness, strength and flexibility appropriate to the sports activities undertaken. (55,58) Do a variety of activities all year long and avoid specializing in a single sport at a young age. (58-59)

Avoid strenuous activities when unwell. (56-57) Take a rest if you experience any chest pain, breathlessness, palpitations, dizziness and seek medical attention if these symptoms are persistent. (60) If you have a pre-existing medical condition, discuss with your doctor if precautions and/or restrictions are necessary. (57)

**9. Have regular meals consisting of nutritionally-balanced foods and drinks to support daily activities, to optimise growth, maturation and development.**

The social and ecological environment can strongly influence the dietary choices of the individual and their families. (61) Through parental modelling, a regular household eating routine provides opportunities for coordinated family meals and regulation of appetite, therefore affecting the overall diet quality of children and adolescents. (61-62) Consuming a nutritious breakfast as part of daily routine has also been associated with positive outcomes, including better diet quality and healthy body weight, and is strongly encouraged. (62)

Part of achieving a healthy eating pattern requires a conscious selection of food and drinks in age-appropriate portions that support a child's activity levels and growth. Suitable portions can be planned using visual aids, such as My Healthy Plate. A variety of foods across, and within, all food groups are required to meet nutrient requirements. (62-63) Nutritionally-balanced foods and drinks comprise all vegetables, fruits, whole grains, lean meats and poultry, seafood, legumes, unsalted nuts, low-fat dairy products and foods free of saturated and trans fats, prepared with limited solid fats (e.g. butter), sugars and refined starches. (64) Limiting consumption of added sugars, sugars naturally present in honey, syrups, fruit juices

and fruit juice concentrates, and sugar-sweetened beverages to not more than 10% of total energy intake can curb the risk of increased adiposity and overweight in children, as well as the formation of dental caries. (65-66)

**10. Aim to achieve most or all recommendations on physical activity, sedentary behaviour, sleep and diet for the best results.**

These recommendations on physical activity, sedentary and sleep behaviours are of comparable importance and meeting more of these recommendations will correspondingly improve the health indicators in physical, mental and social health. (67-68) Therefore, children and adolescents who can meet all recommendations (i.e. high moderate-to-vigorous intensity physical activity, low sedentary behaviour, high sleep, age-and-intensity appropriate diet) have the best health outcomes. (69-72)

Similar health outcomes can be achieved by meeting the same number of recommendations in various combinations. (67) This means that comparable health indicators can be achieved by meeting high moderate-to-vigorous physical activity and low sedentary behaviour, high sleep and low sedentary behaviour, or high moderate-to-vigorous physical activity and high sleep. (67,69,73-74) In conclusion, children and adolescents can start with any of these recommendations with the eventual aim of meeting all recommendations for the best health outcomes.

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**College of Paediatrics & Child Health of Academy of Medicine Singapore**

**SINGAPOREAN INTEGRATED 24-HOUR ACTIVITY GUIDELINES FOR CHILDREN AND ADOLESCENTS**

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2. Accumulate at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity in a week, where more is better.
3. Engage in muscle and bone strengthening exercises at least three times a week. This could be part of the daily minimum accumulation of 60 minutes of moderate-to-vigorous intensity physical activity.
4. Engage regularly in a variety of light physical activities throughout the day.
5. Limit recreational screen time as much as possible.
6. Build in regular breaks to move around during times of prolonged sitting or inactivity.
7. Have regular sleep of at least 9 hours (for 7-13 years old), at least 8 hours (for 14-17 years old) and at least 7 hours (for 18 years old).
8. Take the necessary precautions before, during and after exercise and see a doctor if you feel unwell during the exercise.
9. Have regular meals consisting of nutritionally-balanced foods and drinks to support daily activities, to optimise growth, maturation and development.
10. Aim to achieve most or all recommendations on physical activity, sedentary behaviour, sleep and diet for the best results.

# PRACTICAL REFERENCE FOR PHYSICAL ACTIVITIES IN CHILDREN AND ADOLESCENTS

## Activity Guide

Examples of activity that involve large muscle groups of the chest, back, upper and lower limbs and the trunk. Intensity of activity may differ depending on individual fitness level and can be monitored using the physical activity intensity guide below. These activities may be done individually, in pairs or in groups. The classifications are not mutually exclusive and it is possible for examples of play, leisure or exercise activities to overlap.

<b>Activity category</b>	<b>Examples of Activity</b>
<b>Leisure (Play)</b>	<ul style="list-style-type: none"> <li>• Rope climbing</li> <li>• Climbing on playgroup equipment</li> <li>• Riding scooter</li> <li>• Chasing games (e.g. Catching, Tag)</li> <li>• Jumping</li> <li>• Hopping (e.g. Hop-scotch)</li> </ul>
<b>Leisure (Games or Sports)</b>	<ul style="list-style-type: none"> <li>• Ball games and/or Ultimate frisbee with throwing and catching</li> <li>• Dancing</li> <li>• Soccer</li> <li>• Basketball</li> <li>• Floorball</li> <li>• Hockey</li> <li>• Badminton</li> <li>• Squash</li> <li>• Tennis</li> <li>• Martial arts</li> </ul>
<b>Exercise (Planned or otherwise)</b>	<ul style="list-style-type: none"> <li>• Brisk walking</li> <li>• Running</li> <li>• Riding bicycle</li> <li>• Roller blading</li> <li>• Rope skipping</li> <li>• Dancing</li> <li>• Swimming</li> <li>• Flexibility or stretching exercise</li> <li>• Physical education</li> </ul>
<b>Lifestyle (includes Active Transportation)</b>	<ul style="list-style-type: none"> <li>• House work (e.g. Sweeping, Mopping)</li> <li>• Walking/cycling to train station</li> <li>• Stair climb or descent</li> </ul>
<b>Muscle and Bone strengthening exercises</b>	<ul style="list-style-type: none"> <li>• Resistance exercises (using Bodyweight, Resistance bands)</li> <li>• Modified push-up with knees on the floor</li> <li>• Full push-up</li> <li>• Sit-up</li> </ul>

	<ul style="list-style-type: none"> <li>Assisted pull up/Full pull up</li> <li>Games with rapid change in direction (e.g. Soccer, Basketball, Floorball, Hockey, Tennis)</li> </ul>
<p>References:</p> <ol style="list-style-type: none"> <li>Health Promotion Board Singapore. National Physical Activity Guidelines-Children and Youth Aged up to 18 Years. Available from: <a href="https://www.academia.edu/10443994/National_Physical_Activity_Guidelines_for_Children_and_Youth">https://www.academia.edu/10443994/National_Physical_Activity_Guidelines_for_Children_and_Youth</a>. (accessed September 2020)</li> <li>US Department of Health and Human Services. Physical Activity Guidelines for Americans, 2<sup>nd</sup> Edition. Available from: <a href="https://health.gov/our-work/physical-activity/current-guidelines">https://health.gov/our-work/physical-activity/current-guidelines</a> (accessed September 2020)</li> <li>National Health Service. Physical Activity Guidelines for Children and Young People. Available from: <a href="https://www.nhs.uk/live-well/exercise/physical-activity-guidelines-children-and-young-people/">https://www.nhs.uk/live-well/exercise/physical-activity-guidelines-children-and-young-people/</a> (accessed September 2020)</li> </ol>	

### **Physical Activity Intensity Guide**

Intensity	Breathing and heart rate	Talk test	Heart rate (HR) monitoring*
Light	Minimal increase in breathing and heart rate	Can talk in full sentences and sing	60-70% of max HR
Moderate	Noticeable increase in breathing and heart rate	Can talk in phrases or short sentences but cannot sing	70-80% of max HR
Vigorous	Large increase in breathing and heart rate	Can say a few words	>80% of max HR

\*Formula for maximum heart rate = 208 - (0.7 x age) beats per minute

References:

- Mahon AD, Marjerrison AD, Lee JD, Woodruff ME, Hanna LE. Evaluating the prediction of maximal heart rate in children and adolescents. Research quarterly for exercise and sport. 2010 Dec 1;81(4):466-71.
- Machado FA, Denadai BS. Validity of maximum heart rate prediction equations for children and adolescents. Arquivos brasileiros de cardiologia. 2011 Aug;97(2):136-40.

## REFERENCES

1. <https://www.moh.gov.sg/news-highlights/details/obesity-trend-and-programmes> (accessed September 2020)
2. Chia M. Physical inactivity among children and adolescents in Singapore: A paradoxical issue. *Acta Kinesiol.* 2008;2:7-15
3. Lee KS, Trost SG. Physical activity patterns of Singaporean adolescents. *Pediatric Exercise Science.* 2006 Nov 1;18(4):400-14.
4. Ting JL, Mukherjee S, Hwa MC. Physical activity and sedentary behavior patterns of Singaporean adolescents. *Journal of Physical Activity and Health.* 2015 Sep 1;12(9):1213-20.
5. Wong CW, Andrew TS, Jonas JB, Ohno-Matsui K, James CH, Marcus AN, Ting DS. Digital Screen Time During COVID-19 Pandemic: Risk for a Further Myopia Boom?. *American journal of ophthalmology.* 2020 Jul 30.
6. Xiang M, Zhang Z, Kuwahara K. Impact of COVID-19 pandemic on children and adolescents' lifestyle behavior larger than expected. *Progress in Cardiovascular Diseases.* 2020 Apr 29.
7. Jago R, Macdonald-Wallis C, Solomon-Moore E, Janice LT, Debbie AL, Simon JS. Associations between participation in organised physical activity in the school or community outside school hours and neighbourhood play with child physical activity and sedentary time: a cross-sectional analysis of primary school-aged children from the UK. *BMJ open.* 2017 Sep 1;7(9):e017588.
8. Cecchini JA, Fernandez-Rio J, Mendez-Gimenez A. Effects of Epstein's TARGET on adolescents' intentions to be physically active and leisure-time physical activity. *Health Education Research.* 2014 Mar 20;29(3):485-90.
9. Baranowski T, Bar-Or O, Blair S, Corbin C, Dowda M, Freedson P, Pate R, Plowman S, Sallis J, Saunders R, Seefeldt V. Guidelines for school and community programs to promote lifelong physical activity among young people. *Morbidity and Mortality Weekly Report.* 1997 Mar 7;50(RR-6):1-36.
10. Wang L, Tang Y, Luo J. School and community physical activity characteristics and moderate-to-vigorous physical activity among Chinese school-aged children: a multilevel path model analysis. *Journal of sport and health science.* 2017 Dec 1;6(4):416-22.
11. Nguyen P, Le LK, Nguyen D, Gao L, Dunstan DW, Moodie M. The effectiveness of sedentary behaviour interventions on sitting time and screen time in children and adults: an umbrella review of systematic reviews. *International Journal of Behavioral Nutrition and Physical Activity.* 2020 Dec;17(1):1-1.
12. Hegarty LM, Mair JL, Kirby K, Murtagh E, Murphy MH. School-based interventions to reduce sedentary behaviour in children: a systematic review. *AIMS public health.* 2016;3(3):520.
13. Wiecha JL, Sobol AM, Peterson KE, Gortmaker SL. Household television access: associations with screen time, reading, and homework among youth. *Ambulatory Pediatrics.* 2001 Sep 1;1(5):244-51.

14. Lee SJ, Bartolic S, Vandewater EA. Predicting children's media use in the USA: Differences in cross-sectional and longitudinal analysis. *British Journal of Developmental Psychology*. 2009 Mar;27(1):123-43.
15. Mindell JA, Williamson AA. Benefits of a bedtime routine in young children: Sleep, development, and beyond. *Sleep medicine reviews*. 2018 Aug 1;40:93-108.
16. Arora T. Sleep routines in children. *Journal of Clinical Sleep Medicine*. 2019 Jun 15;15(6):821-2.
17. Moberg J, Oxman AD, Rosenbaum S, Schünemann HJ, Guyatt G, Flottorp S, Glenton C, Lewin S, Morelli A, Rada G, Alonso-Coello P. The GRADE Evidence to Decision (EtD) framework for health system and public health decisions. *Health research policy and systems*. 2018 Dec 1;16(1):45.
18. Poitras VJ, Gray CE, Borghese MM, Carson V, Chaput JP, Janssen I, Katzmarzyk PT, Pate RR, Connor Gorber S, Kho ME, Sampson M. Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*. 2016;41(6):S197-239.
19. WHO guidelines on physical activity and sedentary behaviour. Geneva: World Health Organization; 2020.
20. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International journal of behavioral nutrition and physical activity*. 2010 Dec 1;7(1):40.
21. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, Hergenroeder AC, Must A, Nixon PA, Pivarnik JM, Rowland T. Evidence based physical activity for school-age youth. *The Journal of pediatrics*. 2005 Jun 1;146(6):732-7.
22. Carson V, Janssen I. Volume, patterns, and types of sedentary behavior and cardio-metabolic health in children and adolescents: a cross-sectional study. *BMC public health*. 2011 Dec 1;11(1):274.
23. Tremblay MS, LeBlanc AG, Janssen I, Kho ME, Hicks A, Murumets K, Colley RC, Duggan M. Canadian sedentary behaviour guidelines for children and youth. *Applied Physiology, Nutrition, and Metabolism*. 2011 Jan;36(1):59-64.
24. Veitch J, van Stralen MM, Chinapaw MJ, te Velde SJ, Crawford D, Salmon J, Timperio A. The neighborhood social environment and body mass index among youth: a mediation analysis. *International Journal of Behavioral Nutrition and Physical Activity*. 2012 Dec;9(1):1-9.
25. Chaput JP, Gray CE, Poitras VJ, Carson V, Gruber R, Olds T, Weiss SK, Connor Gorber S, Kho ME, Sampson M, Belanger K. Systematic review of the relationships between sleep duration and health indicators in school-aged children and youth. *Applied physiology, nutrition, and metabolism*. 2016;41(6):S266-82.
26. Fatima Y, Doi SA, Mamun AA. Longitudinal impact of sleep on overweight and obesity in children and adolescents: a systematic review and bias-adjusted meta-analysis. *Obesity reviews*. 2015 Feb;16(2):137-49.

27. Chaput JP, Carson V, Gray CE, Tremblay MS. Importance of all movement behaviors in a 24 hour period for overall health. *International journal of environmental research and public health*. 2014 Dec;11(12):12575-81.
28. Jakicic JM, Kraus WE, Powell KE, Campbell WW, Janz KF, Troiano RP, Sprow K, Torres A, Piercy KL, 2018 Physical Activity Guidelines Advisory Committee. Association between bout duration of physical activity and health: Systematic review. *Medicine and science in sports and exercise*. 2019 Jun;51(6):1213.
29. Chen P, Wang D, Shen H, Yu L, Gao Q, Mao L, Jiang F, Luo Y, Xie M, Zhang Y, Feng L. Physical activity and health in Chinese children and adolescents: expert consensus statement (2020). *British Journal of Sports Medicine*. 2020 May 29.
30. Health Promotion Board Singapore. National Physical Activity Guidelines-Children and Youth Aged up to 18 Years. Available from: [https://www.academia.edu/10443994/National\\_Physical\\_Activity\\_Guidelines\\_for\\_Children\\_and\\_Youth](https://www.academia.edu/10443994/National_Physical_Activity_Guidelines_for_Children_and_Youth). (accessed September 2020).
31. da Silva MP, Fontana FE, Callahan E, Mazzardo O, De Campos W. Step-count guidelines for children and adolescents: a systematic review. *Journal of Physical Activity and Health*. 2015 Aug 1;12(8):1184-91.
32. Tudor-Locke C, Craig CL, Beets MW, Belton S, Cardon GM, Duncan S, Hatano Y, Lubans DR, Olds TS, Raustorp A, Rowe DA. How many steps/day are enough? for children and adolescents. *International Journal of Behavioral Nutrition and Physical Activity*. 2011 Dec 1;8(1):78.
33. Faigenbaum AD, Kraemer WJ, Blimkie CJ, Jeffreys I, Micheli LJ, Nitka M, Rowland TW. Youth resistance training: updated position statement paper from the national strength and conditioning association. *The Journal of Strength & Conditioning Research*. 2009 Aug 1;23:S60-79.
34. Behm DG, Faigenbaum AD, Falk B, Klentrou P. Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents. *Applied physiology, nutrition, and metabolism*. 2008 Jun;33(3):547-61.
35. Committee on Sports Medicine and Fitness. Strength training by children and adolescents. *Pediatrics*. 2001 Jun 1;107(6):1470-2.
36. Carson V, Ridgers ND, Howard BJ, Winkler EA, Healy GN, Owen N, Dunstan DW, Salmon J. Light-intensity physical activity and cardiometabolic biomarkers in US adolescents. *PloS one*. 2013 Aug 9;8(8):e71417.
37. Tremblay MS, Chaput JP, Adamo KB, Aubert S, Barnes JD, Choquette L, Duggan M, Faulkner G, Goldfield GS, Gray CE, Gruber R. Canadian 24-hour movement guidelines for the early years (0–4 years): an integration of physical activity, sedentary behaviour, and sleep. *BMC public health*. 2017 Nov 1;17(5):874.
38. Fuezeki E, Engeroff T, Banzer W. Health benefits of light-intensity physical activity: a systematic review of accelerometer data of the National Health and Nutrition Examination Survey (NHANES). *Sports Medicine*. 2017 Sep 1;47(9):1769-93.
39. Carson V, Lee EY, Hewitt L, Jennings C, Hunter S, Kuzik N, Stearns JA, Unrau SP, Poitras VJ, Gray C, Adamo KB. Systematic review of the relationships between

physical activity and health indicators in the early years (0-4 years). *BMC public health*. 2017 Nov 1;17(5):854.

40. Tremblay MS, Gray C, Babcock S, Barnes J, Bradstreet CC, Carr D, Chabot G, Choquette L, Chorney D, Collyer C, Herrington S. Position statement on active outdoor play. *International journal of environmental research and public health*. 2015 Jun;12(6):6475-505.
41. Colley RC, Janssen IA, Tremblay MS. Daily step target to measure adherence to physical activity guidelines in children. *Medicine & Science in Sports & Exercise*. 2012 May 1;44(5):977-82.
42. Council on Communications and Media. Children, adolescents, and the media. *Pediatrics*. 2013 Nov;132(5):958-61.
43. Tremblay MS, LeBlanc AG, Kho ME, Saunders TJ, Larouche R, Colley RC, Goldfield G, Gorber SC. Systematic review of sedentary behaviour and health indicators in school-aged children and youth. *International journal of behavioral nutrition and physical activity*. 2011 Dec 1;8(1):98.
44. Twenge JM, Campbell WK. Associations between screen time and lower psychological well-being among children and adolescents: Evidence from a population-based study. *Preventive medicine reports*. 2018 Dec 1;12:271-83.
45. Schmidt ME, Haines J, O'brien, A, McDonald J, Price S, Sherry B, Taveras EM. Systematic review of effective strategies for reducing screen time among young children. *Obesity*. 2012 Jul;20(7):1338–54.
46. Drummy C, Murtagh EM, McKee DP, Breslin G, Davison GW, Murphy MH. The effect of a classroom activity break on physical activity levels and adiposity in primary school children. *Journal of paediatrics and child health*. 2016 Jul;52(7):745-9.
47. Ma JK, Mare LL, Gurd BJ. Classroom-based high-intensity interval activity improves off-task behaviour in primary school students. *Applied Physiology, Nutrition, and Metabolism*. 2014;39(12):1332-7.
48. McManus AM. Physical activity-a neat solution to an impending crisis. *Journal of Sports Science & Medicine*. 2007 Sep;6(3):368.
49. Paruthi S, Brooks LJ, D'Ambrosio C, Hall WA, Kotagal S, Lloyd RM, Malow BA, Maski K, Nichols C, Quan SF, Rosen CL. Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine. *Journal of Clinical Sleep Medicine*. 2016 Jun 15;12(6):785-6.
50. Zhou Y, Aris IM, Tan SS, Cai S, Tint MT, Krishnaswamy G, Meaney MJ, Godfrey KM, Kwek K, Gluckman PD, Chong YS. Sleep duration and growth outcomes across the first two years of life in the GUSTO study. *Sleep Medicine*. 2015 Oct 1;16(10):1281-6.
51. Dutil C, Chaput JP. Inadequate sleep as a contributor to type 2 diabetes in children and adolescents. *Nutrition & diabetes*. 2017 May;7(5):e266-.
52. Sparano S, Lauria F, Ahrens W, Fraterman A, Thumann B, Iacoviello L, Marild S, Michels N, Molnar D, Moreno LA, Tornaritis M. Sleep duration and blood pressure in children: Analysis of the pan-European IDEFICS cohort. *The Journal of Clinical Hypertension*. 2019 May;21(5):572-8.



53. Hirshkowitz M, Whiton K, Albert SM, Alessi C, Bruni O, DonCarlos L, Hazen N, Herman J, Katz ES, Kheirandish-Gozal L, Neubauer DN. National Sleep Foundation's sleep time duration recommendations: methodology and results summary. *Sleep health*. 2015 Mar 1;1(1):40-3.
54. Brenner JS. Sports specialization and intensive training in young athletes. *Pediatrics*. 2016 Sep 1;138(3).
55. Rössler R, Donath L, Verhagen E, Junge A, Schweizer T, Faude O. Exercise-based injury prevention in child and adolescent sport: a systematic review and meta-analysis. *Sports medicine*. 2014 Dec 1;44(12):1733-48.
56. Chen P, Mao L, Nassis GP, Harmer P, Ainsworth B, Li F. Returning Chinese school-aged children and adolescents to physical activity in the wake of COVID-19: Actions and precautions. *Journal of Sport and Health Science*. 2020 Apr 12.
57. Virgilio SJ. National Physical Activity Guidelines. *Teach Elem Phys Educ*. 1999;10(2):21. Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=sph&AN=6218383&site=ehost-live> (assessed September 2020)
58. Bergeron MF, Mountjoy M, Armstrong N, Chia M, Côté J, Emery CA, Faigenbaum A, Hall G, Kriemler S, Léglise M, Malina RM. International Olympic Committee consensus statement on youth athletic development. *British Journal of Sports Medicine*. 2015 Jul 1;49(13):843-51.
59. Merkel DL. Youth sport: positive and negative impact on young athletes. *Open access journal of sports medicine*. 2013;4:151.
60. Schmied C, Borjesson M. Sudden cardiac death in athletes. *Journal of internal medicine*. 2014 Feb;275(2):93-103.
61. Scaglioni S, De Cosmi V, Ciappolino V, Parazzini F, Brambilla P, Agostoni C. Factors influencing children's eating behaviours. *Nutrients*. 2018 Jun;10(6):706.
62. Wellington Ministry of Health (2012). Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years): A background paper. Partial revision February 2015. Available from: <https://www.health.govt.nz/publication/food-and-nutrition-guidelines-healthy-children-and-young-people-aged-2-18-years-background-paper> (accessed September 2020).
63. U.S. Department of Health and Human Services and U.S. Department of Agriculture (2015). 2015-2020 Dietary Guidelines for Americans. 8<sup>th</sup> Edition. December 2015. Available from: <https://health.gov/our-work/food-nutrition/2015-2020-dietary-guidelines/guidelines/> (accessed September 2020).
64. Wang DD, Li Y, Chiuve SE, Stampfer MJ, Manson JE, Rimm EB, Willett WC, Hu FB. Association of specific dietary fats with total and cause-specific mortality. *JAMA internal medicine*. 2016 Aug 1;176(8):1134-45.
65. Quah PL, Kleijweg J, Chang YY, Toh JY, Lim HX, Sugianto R, Aris IM, Yuan WL, Tint MT, Bernard JY, Natarajan P. Association of sugar-sweetened beverage intake at 18 months and 5 years of age with adiposity outcomes at 6 years of age: the Singapore

GUSTO mother–offspring cohort. *British Journal of Nutrition*. 2019 Dec;122(11):1303-12.

66. World Health Organisation (2015). Guideline: Sugars intake for adults and children. Available from: <https://www.who.int/publications/i/item/9789241549028> (accessed September 2020).
67. Janssen I, Roberts KC, Thompson W. Is adherence to the Canadian 24-Hour Movement Behaviour Guidelines for Children and Youth associated with improved indicators of physical, mental, and social health?. *Applied Physiology, Nutrition, and Metabolism*. 2017;42(7):725-31.
68. Sampasa-Kanyinga H, Standage M, Tremblay MS, Katzmarzyk PT, Hu G, Kuriyan R, Maher C, Maia J, Olds T, Sarmiento OL, Tudor-Locke C. Associations between meeting combinations of 24-h movement guidelines and health-related quality of life in children from 12 countries. *Public Health*. 2017 Dec 1;153:16-24.
69. Saunders TJ, Gray CE, Poitras VJ, Chaput JP, Janssen I, Katzmarzyk PT, Olds T, Connor Gorber S, Kho ME, Sampson M, Tremblay MS. Combinations of physical activity, sedentary behaviour and sleep: relationships with health indicators in school-aged children and youth. *Applied Physiology, Nutrition, and Metabolism*. 2016;41(6):S283-93.
70. Hjorth MF, Chaput JP, Damsgaard CT, Dalskov SM, Andersen R, Astrup A, Michaelsen KF, Tetens I, Ritz C, Sjödin A. Low physical activity level and short sleep duration are associated with an increased cardio-metabolic risk profile: a longitudinal study in 8-11 year old Danish children. *PloS one*. 2014 Aug 7;9(8):e104677.
71. Carson V, Chaput JP, Janssen I, Tremblay MS. Health associations with meeting new 24-hour movement guidelines for Canadian children and youth. *Preventive Medicine*. 2017 Feb 1;95:7-13.
72. Chaput and Dutil Lack of sleep as a contributor to obesity in adolescents: impacts on eating and activity behaviors. *International Journal of Behavioral Nutrition and Physical Activity* (2016) 13:103
73. Dalene KE, Anderssen SA, Andersen LB, Steene-Johannessen J, Ekelund U, Hansen BH, Kolle E. Cross-sectional and prospective associations between physical activity, body mass index and waist circumference in children and adolescents. *Obesity science & practice*. 2017 Sep;3(3):249-57.
74. Huang YW, Wong SH, He G, Salmon JO. Isotemporal substitution analysis for sedentary behavior and body mass index. *Medicine and science in sports and exercise*. 2016;48(11):2135.

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