Asia-Pacific Consensus Statement on integrated 24-hour activity guidelines for children and adolescents

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ABSTRACT

Non-communicable diseases (NCDs) constitute a significant public health challenge and pose a great burden on health and social systems throughout the world. The Asia-Pacific region is in a vulnerable position as the prevalence of NCDs will inevitably increase with rapid socioeconomic transitions; yet it is ill prepared for this public health challenge as Asian children are among the most physically inactive in the world. Aligned with the WHO's global strategy to control NCDs via preventive measures and health promotion policies, representatives from the Asia-Pacific region came together to develop consensus statement on integrated 24-hour activity guidelines for children and adolescents. These guidelines apply to children and adolescents, aged 5–18 years, in the Asia-Pacific region, regardless of gender, cultural background or socioeconomic status. These guidelines aim to provide the latest evidence-based recommendations, taking a holistic approach to lifestyle activities and adopting a practical perspective by framing these activities within a 24-hour period. Eating and dietary elements were incorporated as they closely influence the energy balance of the movement behaviours and vice versa. By investing in the younger generations through advocacy for healthier lifestyles, we aim to reduce the burden of NCDs in the Asia-Pacific region.

PREAMBLE

The objective of the Asia-Pacific Consensus Statement on integrated 24-hour activity guidelines for children and adolescents was to provide all physicians and healthcare providers the latest evidence-based recommendations on beneficial lifestyle habits in children and adolescents. Children and adolescents are encouraged to adopt a holistic approach towards integrating different types of activity within a 24-hour period—physical activity, sedentary behaviour, sleep and eating habits.

These guidelines apply to children and adolescents, including those living with disability, aged 5–18 years, in the Asia-Pacific region, regardless of gender, cultural background, socioeconomic status. Children and adolescents living with chronic medical conditions should consult a health professional for additional guidance.

All participating members are encouraged to adopt and adapt the guidelines for their local populations of children and adolescents. Following these guidelines is associated with multiple health benefits, including better body composition, cardiovascular and metabolic health, musculoskeletal fitness and overall quality of life. By achieving these health benefits, we aim to reduce the risks of non-communicable diseases (NCDs) among children and adolescents in the Asia-Pacific region.

BACKGROUND

NCDs constitute a significant public health challenge and pose a large burden on health and social systems throughout the world.[1] NCDs are chronic medical conditions which include cardiovascular diseases, cancers, chronic respiratory diseases and diabetes.[2] These conditions often result from modifiable lifestyle risk factors, such as physical inactivity and unhealthy diet, resulting in metabolic risk factors, including obesity, raised blood pressure, increased blood glucose and raised blood lipids.[3]

Metabolic morbidities in children, especially obesity, are one of the more critical NCDs of today and are not only seen in developed countries but also affect low/middle-income countries in the Asia-Pacific region.[4 5] In 2018, the estimated prevalence of obesity (based on International Obesity Task Force definition) in Asian children and adolescents was 5.8% and 8.6%, respectively.[6] These figures are expected to increase as many Asian and Pacific countries undergo rapid socioeconomic transitions with urbanisation and growing influence of western lifestyles.[7]

In stark contrast, many children and adolescents in the Asia-Pacific region are not adequately active. Asian school-going adolescents showed lower physical activity levels compared with other parts of the world and published data revealed that only 6% met WHO's recommendation of 60 min of moderate- to vigorous-intensity physical activity (MVPA) daily.[8] Similarly, another study on school-going adolescents from Association of Southeast Asian Nations (ASEAN) countries showed that 80.4% of the samples achieved less than 60 min of MVPA on at least 5 days per week and 33.0% of the samples had significant sedentary behaviour, defined as 3 or more hours of sitting per day.[9]

The concept of integrating various forms of activities within a 24-hour period for children and adolescents was introduced in several national guidelines —Canada in 2016, Australia in 2019 and Singapore in 2021.[10–12] The integration of these activities (ie, physical activity, sedentary behaviour and sleep) is an acknowledgement of the lifestyle of a modern child or adolescent and recent evidence has shown that these activities exert health effects both individually and also in association with

each other.[13] As dietary patterns can affect a person's metabolic health such as obesity and cardiometabolic risk factors, we have included a statement on healthy eating habits into the guidelines.[14 15] Food habits, eating behaviours and movement behaviours closely influence each other in terms of energy balance.[16 17] For example, through increased opportunities for food and drink intake during prolonged periods of sedentary behaviour or longer wake periods (as a result of less sleep). Skipping meals such as breakfast may deprive children and adolescents of important energy requirements needed for participation in physical activity.[18] Framing these activities within a 24-hour period emphasises that the whole day matters and the importance of organising these activities, especially in contemporary fast-paced societies.

As children and adolescents in the Asia-Pacific region share common risk factors for NCDs which may be dissimilar to other regions, a set of region-specific recommendations can consolidate the Asia-Pacific nations' efforts in combating NCDs through health promotion. This report outlines the process and outcomes for the development of the 'Asia-Pacific Consensus Statement on Integrated 24-Hour Activity Guidelines for Children and Adolescents'.

METHODS

Literature reviews

The evidence reviews conducted for the development of the Canadian 24-hour movement guidelines for children and youth (conducted by Poitras *et al*, Carson *et al*, Chaput *et al* and Saunders *et al*),[13 19–21] the Australian 24-hour movement guidelines for children and young people (conducted by Okely *et al*),[22] and the Singapore integrated 24-hour activity guidelines for children and adolescents (conducted by Loo *et al*) were included in the literature review for the development of the Asia-Pacific guidelines.[12] We also reviewed the evidence used for international and regional eating and dietary guidelines. An update of the literature review up to November 2020 was conducted using MEDLINE and CINAHL databases. The searches included systematic reviews and cohort studies on physical activity, sedentary behaviour, sleep and the integration of these three behaviours and eating habits. Only studies published in English language were considered.

Grading of evidence and recommendations

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) method was applied to rate the quality of evidence and strength of recommendations.[23] The ratings from the Canadian, Australian and Singapore guidelines were also reviewed and updated. The evidence was rated as very low, low, moderate or high.[24]

The GRADE-Adaptation, Adoption, De Novo Development (ADOLOPMENT) framework was employed to provide a structured and transparent methodology for healthcare decisions and recommendations.[25] This framework included the formulation of the public health question, review of relevant resources, assessment of the evidence and drawing conclusions for healthcare recommendations.

We structured the public health question from the perspective of healthcare providers with the aim to improve the metabolic and general health of children and adolescents in the Asia-Pacific region against the background of the increasing prevalence of metabolic morbidities in this population. The conclusions based on the judgements for all criteria in the assessments showed that they were in favour of the recommendations and the overall evidence was at least moderately certain to support the recommendations. The full framework is included in online supplemental annex.

Additional considerations

National 24-hour integrated movement or activity guidelines were used as reference and these guidelines included the Canadian 24-hour movement guidelines for children and youth, the Australian 24-hour integrated movement guidelines for children and young people and the Singapore integrated 24-hour activity guidelines for children and adolescents.[10–12]

International and national guidelines for physical activity, sedentary behaviour, sleep or eating habits were used as reference and these guidelines included, but not limited to, the WHO guidelines on physical activity and sedentary behaviour,[26] the American Academy of Pediatrics policy on children, adolescents and the media,[27] the American Academy of Sleep Medicine consensus statement on recommended amount of sleep for paediatric populations[28] and the WHO guidelines on sugars intake for adults and children.[29]

Limitations

The limitations of the methodology include the selection of only studies published in English language. There is a small chance that some evidence published from the Asia-Pacific region in another language may have been overlooked. However, it is unlikely that these studies would be sufficient to change the wording of the statements. Another limitation of the GRADE method is the tendency to downgrade epidemiological observational evidence. The recommended durations for MVPA and sleep are based on current international guidelines and/or consensus and more evidence on the precise dose–response relationship between these behaviours and healthy outcomes is needed.

Expert panel voting

The Asia Pacific Maternal and Child Metabolic Health Conference and Integrated Platform for Research in Advancing Metabolic Health Outcomes of Women and Children International Meeting brought together clinicians, nurses and allied healthcare professionals to discuss metabolic diseases, such as obesity and diabetes, for women and children in the Asia-Pacific region. The theme for 2021 conference was the promotion of beneficial lifestyle habits for good metabolic and general health for children and adolescents in the Asia-Pacific region. Members of the Asia Pacific Pediatric Association and Federation of Asia and Oceania Perinatal Societies were invited and there were representatives from 13 Asia-Pacific countries—Australia, China, Hong Kong, India, Indonesia, Japan, Malaysia, Myanmar, Philippines, Singapore, Sri Lanka, Thailand and Vietnam.

The consensus session was conducted on 9 January 2021 through a virtual meeting platform. All representatives were eligible to vote and comment on the recommendations. For the consensus process, each recommendation was presented and read, followed by the online voting of which, there were three responses—'Agree', 'Disagree' or 'I have comments'. Each representative was given one vote per recommendation and a majority in agreement was considered when there were 70% or more votes for 'Agree'. The voting results for each recommendation was shown immediately and representatives were invited to comment on the recommendation. If there was no majority in agreement (ie, 69% or less votes for 'Agree'), the representatives would vote again on the revised recommendation. This process would be repeated until there was a majority in agreement,

before proceeding to the next recommendation. All 10 revised recommendations achieved a majority in agreement (ie, received 70% or more votes for 'Agree').

CONSENSUS STATEMENTS

Statement 1

Children and adolescents should integrate the recommended physical activity, sedentary behaviour, sleep and eating habits within each 24-hour period for good physical, mental and social health

Supporting paragraph

Physical activity is vital for children and adolescents to grow and develop healthily.[19] There are multiple benefits for children and adolescents who participate in regular physical activity, such as better aerobic fitness and body composition, improved musculoskeletal and mental health, lower metabolic risks and improved social health indicators.[19 26 30 31] More evidence has shown that prolonged sedentary behaviour, especially unsupervised and excessive screen time, can have detrimental impact on the child's or adolescent's health, including unfavourable effects on prosocial behaviour.[32–34] The quality and length of sleep also play an important role in metabolic health, as inadequate sleep is related to childhood obesity and hypertension.[21 35 36] Adopting healthy eating habits and choosing nutritious foods and drinks supplies energy to support daily activities, growth and development. Eating habits and movement behaviours also closely influence each other in terms of energy balance. Therefore, the goal is to assimilate recommended amount of physical activity, limited sedentary behaviours, sufficient sleep duration and healthy eating habits to promote the best health outcomes in children and adolescents.[37–39]

Statement 2

Accumulate a daily average of 60 min or more of MVPA.

Supporting paragraph

Adequate levels of physical activity in children and adolescents have health benefits in the present and future.[19 26] Some physical activity is better than none, and more activity is better than some activity. Emergent evidence suggests that higher levels of physical activity are associated with greater fitness and movement competencies.[40] The intensity of activities is important with strong evidence showing that MVPAs are beneficial for developing both health and skill-related fitness and movement competencies.[19 26] Vigorous-intensity activities should be included whenever possible for additional health benefits.[19 26] Physical activities for children and adolescents should be encouraged across different contexts—including at home, school and in the community. These activities could include active transportation (walking or cycling), household chores (washing or cleaning), recreational activities (active play or camping) and planned physical activities or sport programmes.[41 42] Regular physical education lessons are a mandated part of the school curricula in many Asia-Pacific countries and, along with school-based extracurricular activities, can provide a regular opportunity for children and adolescents to participate in physical activity. Based on the WHO guidelines on physical activity and sedentary behaviour (2020), a daily average of 60 min of physical activity was adopted in response to more studies reporting an average of 60 min of physical activity for health benefits, as opposed to a daily minimum of 60 min.[26] Outdoor activities also provide sunlight exposure, which is high in most Asia-Pacific countries, to increase levels of vitamin D. Replacing sedentary activity with light, moderate or vigorous physical activity on a daily basis is encouraged.[40 43]

Statement 3

Engage in muscle and bone strengthening activities at least three times a week.

Supporting paragraph

Resistance or muscle and bone strengthening activities should be part of children's range of physical activities.[26 41 42 44] These activities include movements that involve the carriage of body mass to an array of activities incorporating light weights or dynamic neuromuscular type activities such as jumping, skipping or hopping.[44 45] Performing these activities under proper supervision (such as in physical education and school sport) and on a regular basis (eg, twice a week) in the period of child growth and development improves markers of health, enhances physical performance, improves physical literacy (movement skills) and reduces injury risk in children and adolescents.[45–48] Learning and practising correct and safe resistance training principles under proper supervision, children and adolescents can improve muscle strength without a concomitant increase in muscle size or any negative impact on physical growth and development.[48]

Statement 4

Engage in a variety of light-intensity physical activities as often as possible throughout the day.

Supporting paragraph

Light-intensity physical activities spanning from static (eg, standing) to dynamic activities (eg, slow walking) have shown health benefits.[49 50] In regular daily routines, choose the more active option as much as possible, as every move counts. Active play over screen time, being outdoors rather than indoors, taking the stairs instead of the lift, are some everyday examples.[51] Step counts using pedometers have been used to track population-based physical activity and also to provide a step count target to achieve the recommended amount of physical activity daily.[52] Taking more steps per day is protective against obesity.[52]

Statement 5

Take the necessary precautions when engaging in physical activity and seek medical help if you feel any discomfort.

Supporting paragraph

In order to sustain long-term participation in physical activity and sports, injuries must be minimised.[53] Hence safety is a key consideration in any physical activity and in organised sports. Warm-ups should be performed before being active. One should also perform cool-down stretching post activity. Proper hydration must be maintained.[54] Footwear and equipment must be appropriate for the physical activity or sport.[54] Take precautions when being active in hot and humid conditions, such as regular breaks to drink water. Whenever possible, avoid high temperatures and extremely humid outdoor conditions. One should be active in hazard-free areas and avoid uneven surfaces. In addition, one should apply protection against the sun and insects when physically active outdoors.[55 56] The rules of the game must be fully understood and adhered to. There should be proper conditioning in the aspects of fitness, flexibility and strength.[54 57] Proper form, technique and skills relevant to the game should be adopted.[54] Avoid focusing and specialising in a single sport at a

young age by participating in a variety of sports throughout the year.[57 58]

Those with pre-existing medical conditions may need to consult a physician before participating in sports or physical activity.[56] Strenuous physical activities should be avoided when feeling unwell.[55 56] Seek medical attention if one experiences persistent dizziness, palpitations, chest discomfort or breathlessness during or after physical activity.[59]

Statement 6

Sedentary recreational screen time should be limited to 2 hours or less per day.

Supporting paragraph

Examples of recreational screen time activities include television viewing, electronic device use (eg, computer, tablet and phone) and playing physically inactive video games.[27 60] Like all tools, screen time can be both a friend and foe, and one should always be mindful how to reap benefits and minimise harm from these devices. They should be embraced for educational purposes and used for appropriate amounts of rest and relaxation. Excessive sedentary recreational screen time has shown to be associated with a variety of health harms, both physical and psychoemotional, such as adiposity, depressive symptoms and quality of life.[33 60 61] It also increases unhealthy dietary behaviours, which are significant risk factors for overall poor health.[61 62] Providers should address this behaviour by examining the child's or adolescent's pattern of sedentary recreational time and then suggest parenting strategies on how to limit its use.[27 33 63 64] Parents' behaviours are also important influencing factors.[62]

Statement 7

Take regular movement breaks when there is prolonged sitting or inactivity.

Supporting paragraph

The 2020 WHO guidelines on physical activity and sedentary behaviour acknowledged that sedentary behaviour among children and adolescents bore detrimental effects on their fitness, adiposity and behaviour or sleep.[65] There will be times when children are required to remained seated for prolonged periods, such as for educational activities, during long-distance journeys or some cultural and social recreational activities. During the COVID-19 pandemic, additional screen-time during lessons and social interactions added to sedentary behaviours among children and adolescents.[66] Thus, while sedentary time cannot be completely eliminated, the inclusion of regular breaks to encourage frequent movement or physical activity, is imperative. In addition to contributing to a child's cumulative physical activity levels,[67] it is also beneficial for their mental and social health,[30] and activity breaks have been found to aid concentration during school lessons.[68] Although the breaks need not be very long, having a few minutes of regular movement for every 30–60 min of sedentary time, together with active physical play during break times should help reduce the negative impact of prolonged inactivity.[69] Indeed, encouraging play, rather than additional screen time during recreational time, is an important contributor to overall movement.

Statement 8

Have daily sleep of 9–11 hours (for 5–13 years old) and 8–10 hours (for 14–18 years old).

Supporting paragraph

Sleep is an integral element of mental and physical health, but children in many Asian countries go to bed too late and accumulate too little night-time sleep.[70 71] According to the current evidence, adequate sleep duration is associated with better outcomes, including academic achievement, emotional regulation, well-being and mental health, while insufficient sleep increases the risk of accidents and injuries, obesity, diabetes, hypertension and depression.[21 28 36 72] To promote optimal health, children aged 5–13 years should sleep 9–11 hours and adolescents aged 14–18 years should sleep 8–10 hours regularly in each 24-hour period.[28 73] While some children may take naps in the day to accumulate the recommended duration of sleep, we would encourage achieving these recommendations through night-time sleep.

Statement 9

Take the recommended amounts of foods and drinks that are balanced and nutritious to support growth and daily activities.

Supporting paragraph

Nutrition recommendations for children should be specific to the population of interest, with the natural progression of increasing portions with age.[74] As the dietary choices of the individual and their families can be shaped by both social and ecological environments,[74–76] the knowledge of child-specific dietary guidelines alone is insufficient in effecting behavioural change.[74] Deliberate selection of food and drinks, in appropriate quantity for the respective age, is integral to achieving a healthy eating habit so as to support the child's or adolescent's growth, development and activity.

Appropriate meal portions can be planned through incorporating key food groups on a plate, where half the plate comprises vegetables and fruits, a quarter being brown rice and grains, and a quarter being protein-rich food.[77 78] A diverse range of foods from all food groups are required to fulfil nutrient requirements.[76 78–80] Nutritionally balanced foods and drinks consist of items from major food groups (eg, whole grains; lean meats, poultry, seafood; vegetables, fruits, legumes) and choosing options with low saturated fat (eg, low-fat dairy products, foods prepared with limited solid fat and foods free of saturated and trans fats).[79 81–83] To reduce the risk of adiposity and dental caries in children, the amount of added sugars in products that naturally contain sugars (eg, honey, fruit juices and concentrates) and in sugar-sweetened beverages should be limited to 10% or less of total energy intake.[82–86] In consideration of further limiting free sugars to less than 5% of total energy intake per day as an extended recommendation by WHO,[85] alternative recommendations of limiting free sugars to not more than six teaspoons per day (approximately 25 g per day) have also been suggested.[86 87]

Parents can set good examples during meal times and exert positive influence on the quality of their children's diet by having regular family eating habits.[75 76 82] While there is a positive relationship between frequency of family meals and the consumption of nutrient-rich foods among children and adolescents, nutritional benefits may be negated depending on the type of foods provided by parents. Covert control of healthier food and drinks made available to children, coupled with an authoritative style of parenting, is associated with an improvement in eating behaviour and lower risk of obesity.[75] Furthermore, having a nutritious breakfast daily is strongly recommended as it has beneficial health benefits, such as a healthier body weight and better diet quality.[76 80 82] A nutritious breakfast includes foods

from the major food groups with no added sugars (eg, whole grain bread with boiled eggs and milk, rolled oats with fresh fruit and yoghurt).[76] We encourage all readers to refer to local dietary guidelines for suggestions on sample meal plans for respective age groups.

Statement 10

Work towards meeting all the recommendations for physical activity, sedentary behaviour, sleep and eating habits for optimal health and development

Supporting paragraph

In order to achieve an overall improvement of health indicators in physical, mental and social health, it is imperative that more of the recommendations on physical activity, sedentary and sleep behaviours are met.[88 89] Sedentary behaviour, unhealthy diet, lack of physical activity and sleep are modifiable risk factors associated with metabolic disease such as obesity, hypertension, raised lipids and raised glucose, which are associated with NCD. For the best health outcomes, children and adolescents should strive to meet all the recommendations.[13 90–92]

All the recommendations are of comparable importance; attaining the same number of recommendations in any combinations (eg, high physical activity and low sedentary behaviour, high physical activity and adequate sleep, or low sedentary behaviour and adequate sleep) can deliver comparable health outcomes in terms of cardiometabolic health and adiposity.[13 88 93 94]

Cultivating healthy lifestyle behaviours in children and adolescents in the Asia-Pacific involves, but is not limited to, creating a cultural change in society through provision of architectural support and improvement of health education literacy in the community. Fundamental to this is the family unit where parents and guardians hold authoritative roles. Parents and guardians are well suited to guide and encourage their children towards gradually implementing the recommendations into their lifestyle with an eventual goal of meeting all the recommendations, which will greatly reduce the burden of NCDs in adulthood. Healthy habits inculcated in childhood lay a sound foundation to a healthy adult.

CONCLUSION

The Asia-Pacific region is in a vulnerable position as the prevalence of NCDs will inevitably rise with the rapid socioeconomic transitions, yet it is ill prepared for this public health challenge as Asian children are among the least physically active when compared with the rest of the world. These guidelines provide the latest evidence-based recommendations towards a holistic approach for beneficial lifestyle activities and adopt a practical perspective by framing these activities within a 24-hour period. Furthermore, eating and dietary elements were included to complete the energy cycle. By investing in the younger generations through the advocacy for a healthier lifestyle, we aim to reduce the burden of NCDs on the health and social systems in this region. Aligned with the WHO's global strategy to control NCDs, prevention through health promotion is the most feasible approach.

SUMMARY

Statement 1

Children and adolescents should integrate the recommended physical activity, sedentary behaviour, sleep and eating habits within each 24-hour period for good physical, mental and social health

Statement 2

Accumulate a daily average of 60 min or more of MVPA.

Statement 3

Engage in muscle and bone strengthening activities at least three times a week.

Statement 4

Engage in a variety of light-intensity physical activities as often as possible throughout the day.

Statement 5

Take the necessary precautions when engaging in physical activity and seek medical help if you feel any discomfort.

Statement 6

Sedentary recreational screen time should be limited to 2 hours or less per day.

Statement 7

Take regular movement breaks when there is prolonged sitting or inactivity.

Statement 8

Have daily sleep of 9–11 hours (for 5–13 years old) and 8–10 hours (for 14–18 years old).

Statement 9

Take the recommended amounts of foods and drinks that are balanced and nutritious to support growth and daily activities.

Statement 10

Work towards meeting all the recommendations for physical activity, sedentary behaviour, sleep and eating habits for optimal health and development.

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What are the recommendations to provide a holistic approach towards better metabolic and general health for children and adolescents in Asia-Pacific region?

(Health system and public health recommendation)

QUESTION

Question details

Problem: To improve the metabolic and general health of children and adolescents in Asia-Pacific region

Option :A set of consensus guidelines that provide holistic recommendations towards good metabolic and general health outcomes

Comparison: Separate guidelines in individual countries targeting different aspects of metabolic health

Main outcomes:

- Recommendations and health effects of Physical Activity
- Recommendations and health effects of Sedentary Behaviour
- Recommendations and health effects of Sleep
- Recommendations and health effects of Eating Activity
- Recommendations and relationships of Physical activity, Sedentary Behaviour, Sleep and Eating Activity

Setting: Asia-Pacific community

Perspective: Healthcare providers

Background

Non-communicable diseases (NCDs) constitutes a significant public health challenge and poses a great burden on the health and social systems throughout the world. Metabolic morbidities in children are one of the more critical NCDs of today and it is not only seen in first-world countries but also affecting low- and middle-income countries. Globally, the prevalence of overweight and obesity in children and adolescents (aged 5 to 19 years old) has increased by more than 4 times, from 4% in 1975 to over 18% in 2016. However, this is in stark contrast to the level of physical activity as 81% of adolescents (aged 11 to 17 years old) were not active enough in 2016. The advent of widespread, pervasive and promiscuous social media, internet and technological influences only seek to further exacerbate and compound the overall metabolic and mental health of our children, especially in developed and well-connected societies in the Asia-Pacific region.

ASSESSMENT

Problem

Is the problem a priority?

Judgement

☐ Yes

Research evidence

Metabolic morbidities in children, especially obesity, are one of the more critical NCDs of today and it is not only seen in developed countries but also affecting developing countries in the Asia-Pacific region. The prevalence of overweight and obesity in Asian children is 11.2% and 5.8% respectively; the prevalence of overweight and obesity in Asian adolescents is 14.6% and 8.6% respectively. Asian school-going adolescents showed lower physical activity levels when compared to other parts of the world and published data revealed that only 6% of the samples met World Health Organization's recommendation of 60 minutes of moderate- to vigorous-intensity physical activity (MVPA) daily. Similarly, another study on school-going adolescents from ASEAN countries showed that 80.4% of the samples achieved less than 60 minutes of MVPA on at least 5 days per week and 33.0% of the samples had significant sedentary behaviour, defined as 3 or more hours of sitting per day.

Desirable effects

How substantial are the desirable anticipated effects?

Judgement

☐
Moderate

Research evidence

Type of Outcome	Author	Type of Study	No. of Studies/Participants	Summary of Findings	Certainty of Evidence
Physical Activity	Poitras VJ et al. 2016	Systematic Review	162 studies (204171 participants)	Overall, total PA was favourably associated with physical, psychological/social, and cognitive health indicators. Relationships were more consistent and robust for higher (e.g., MVPA) versus lower (e.g., LPA) intensity PA. All patterns of activity (sporadic, bouts, continuous) provided benefit. LPA was favourably associated with cardiometabolic biomarkers; data were scarce for other outcomes. These findings continue to support the importance of at least 60 min/day of MVPA for disease prevention and health promotion in children and youth, but also highlight the potential benefits of LPA and total PA. All intensities of PA should be considered in future work aimed at better elucidating the health benefits of PA in children and youth.	⊕⊕⊕○

	Janssen I et al. 2010	Systematic Review	86 studies	Physical activity was associated with numerous health benefits. The dose-response relations observed in observational studies indicate that the more physical activity, the greater the health benefit. Results from experimental studies indicate that even modest amounts of physical activity can have health benefits in high-risk youngsters (e.g., obese). To achieve substantive health benefits, the physical activity should be of at least a moderate intensity. Vigorous intensity activities may provide even greater benefit. Aerobic-based activities had the greatest health benefit, other than for bone health, in which case high-impact weight bearing activities were required.	⊕⊕○○
	Strong WB et al. 2005	Systematic Review	850 studies	Most intervention studies used supervised programs of moderate to vigorous physical activity of 30 to 45 minutes duration 3 to 5 days per week. The panel believed that a greater amount of physical activity would be necessary to achieve similar beneficial effects on health and behavioral outcomes in ordinary daily circumstances (typically intermittent and unsupervised activity).	⊕⊕⊕○
	Jakicic JM et al. 2019	Systematic Review	29 studies	The literature review identified 29 articles that were pertinent to the research question that used either cross-sectional, prospective cohort, or randomized designs. One prospective cohort study (N=4,840) reported similar associations between moderate-to-vigorous physical activity (MVPA) and all-cause mortality when examined as total MVPA, MVPA in bouts ≥5 minutes in duration, or MVPA in bouts ≥10 minutes in duration. Additional evidence was identified from cross-sectional and prospective studies to support that bouts of physical activity <10 minutes in duration are associated with a variety of health outcomes. Randomized studies only examined bouts of physical activity ≥10 minutes in duration.	⊕⊕○○

	da Silva MP et al. 2015	Systematic Review	9 studies	With the exception of a single study, studies demonstrated a high risk of methodological bias in at least 1 of the QUADAS-2 domains. Guidelines ranged from 10,000 to 16,000 steps/day for the Health studies (5–16 years old), and from 9,000 to 14,000 steps/day for PA studies (6–19 years old). Due to the high risk of methodological bias, none of the Health Cohort guidelines were endorsed. The PA Cohort study with the lowest risk of methodological bias suggested 12,000 steps/day for children and adolescents irrespective of gender.	⊕⊕○○
	Tudor-Locke C et al. 2011	Systematic Review	35 studies	Controlled studies of cadence show that continuous MVPA walking produces 3,300-3,500 steps in 30 minutes or 6,600-7,000 steps in 60 minutes in 10-15 year olds. Limited evidence suggests that a total daily physical activity volume of 10,000-14,000 steps/day is associated with 60-100 minutes of MVPA in preschool children (approximately 4-6 years of age). Across studies, 60 minutes of MVPA in primary/elementary school children appears to be achieved, on average, within a total volume of 13,000 to 15,000 steps/day in boys and 11,000 to 12,000 steps/day in girls. For adolescents (both boys and girls), 10,000 to 11,700 may be associated with 60 minutes of MVPA. Translations of time- and intensity-based guidelines may be higher than existing normative data (e.g., in adolescents) and therefore will be more difficult to achieve (but not impossible nor contraindicated).	⊕⊕○○

	Carson V et al. 2013	Cross-Sectional	1731 participants	Adjusted for confounders, each additional hour/day of low light-intensity activity was associated with 0.59 (95% CI: 1.18–0.01) mmHG lower diastolic blood pressure. Each additional hour/day of high light-intensity activity was associated with 1.67 (2.94–0.39) mmHG lower diastolic blood pressure and 0.04 (0.001–0.07) mmol/L higher HDL-cholesterol. Each additional hour/day of moderate- to vigorous-intensity activity was associated with 3.54 (5.73–1.35) mmHG lower systolic blood pressure, 5.49 (1.11–9.77)% lower waist circumference, 25.87 (6.08–49.34)% lower insulin, and 16.18 (4.92–28.53)% higher HOMA-%S.	⊕⊕○○
	Fuezeki E et al. 2017	Systematic Review	40 studies	Overall, 37 cross-sectional studies and three longitudinal studies were included in the analysis, with considerable variation observed between the studies with regard to their operationalization of light-intensity PA. Light-intensity PA was found to be beneficially associated with obesity, markers of lipid and glucose metabolism, and mortality. Few data were available on musculoskeletal outcomes and results were mixed.	⊕⊕○○
	Colley RC et al. 2012	Cross-Sectional	1613 participants	Daily step counts were correlated with daily minutes of MVPA (r = 0.81, P G 0.0001). The step count equivalents to 60 min of MVPA ranged between 11,290 and 12,512 steps per day (R2 range = 0.59–0.74). A step count target of 12,000 steps per day resulted in closer population estimates of meeting the physical activity guideline (as measured as minutes of MVPA by accelerometer) as well as improved balance between sensitivity and specificity when compared with any cut point between 8000 and 15,000 steps per day, including the currently used daily step count target of 13,500 steps per day.	⊕⊕○○

	Cao et al. 2019	Systematic Review	17 studies (563 participants)	Enhancing cardiorespiratory fitness (CRF) can lead to substantial health benefits. Comparisons between high-intensity interval training (HIIT) and moderate-intensity continuous training (MICT) on CRF for children and adolescents are inconsistent and inconclusive. The pooled effect size was 0.51 (95% CI = 0.33–0.69) comparing HIIT to MICT. Moreover, intervention duration, exercise modality, work and rest ratio, and total bouts did not significantly modify the effect of HIIT on CRF. It is concluded that compared with endurance training, HIIT has greater improvements on cardiorespiratory fitness among children and adolescents.	⊕⊕○○
	Collins et al. 2018	Systematic Review	18 studies	Significant, small effect sizes were identified for body fat% (Hedges' $g = 0.215$, 95% CI 0.059 to 0.371, $P = 0.007$) and skinfolds (Hedges' $g = 0.274$, 95% CI 0.066 to 0.483, $P = 0.01$). Effect sizes were not significant for: body mass (Hedges' $g = 0.043$, 95% CI − 0.103 to 0.189, $P = 0.564$), body mass index (Hedges' $g = 0.024$, 95% CI − 0.205 to 0.253, $P = 0.838$), fat-free mass (Hedges' $g = 0.073$, 95% CI − 0.169 to 0.316, $P = 0.554$), fat mass (Hedges' $g = 0.180$, 95% CI − 0.090 to 0.451, $P = 0.192$), lean mass (Hedges' $g = 0.089$, 95% CI − 0.122 to 0.301, $P = 0.408$) or waist circumference (Hedges' $g = 0.209$, 95% CI − 0.075 to 0.494, $P = 0.149$). The results of this meta-analysis suggest that an isolated resistance training intervention may have an effect on weight status in youth.	⊕⊕○○

	Eddolls et al. 2017	Systematic Review	13 studies	This review found that high-intensity interval training in children and adolescents is a time-effective method of improving cardiovascular disease biomarkers, but evidence regarding other health-related measures is more equivocal. Running-based sessions, at an intensity of >90% heart rate maximum/100–130% maximal aerobic velocity, two to three times a week and with a minimum intervention duration of 7 weeks, elicit the greatest improvements in participant health. While high-intensity interval training improves cardiovascular disease biomarkers, and the evidence supports the effectiveness of running-based sessions, as outlined above.	⊕⊕○○
	Marque et al. 2018	Systematic Review	51 studies	Results from 11 studies were inconsistent regarding the relationship between objectively measured physical activity and academic achievement. Ten of the 16 articles reported positive associations between self-reported physical activity and academic achievement. From the 22 studies that analysed the relationship between cardiorespiratory fitness and academic achievement, it was verified that they all generally support the beneficial effect of cardiorespiratory fitness on students' academic achievement. Higher cardiorespiratory fitness may be important to enhance children and adolescents' health and, additionally, academic achievement.	⊕⊕⊕○

	Martin et al. 2017	Systematic Review	15 studies	Six studies reporting on physical activity levels were found to have medium-to-large effect sizes. All 4 studies reporting learning outcomes showed positive effects of intervention lessons. Teachers and students were pleased with the programs, and enhanced on-task behavior was identified (*n* = 3). Positive effects were also reported on students' body mass index levels (*n* = 3). Physically active academic lessons increase physical activity levels and may benefit learning and health outcomes. Both students and teachers positively received and enjoyed these teaching methods. These findings emphasize the need for such interventions to contribute toward public health policy.	⊕⊕⊕○
	Miguel-Berges et al. 2018	Systematic Review	36 studies	Most studies (30/36; 83%) were cross sectional and all used proxies for adiposity, such as body mass index (BMI) or BMI z-score as the outcome measure. Few studies (2/36; 6%) focused on preschool children. There was consistent evidence of negative associations between walking and adiposity; significant negative associations were observed in 72% (26/36) of studies overall. The present review supports the hypothesis that higher levels of walking are protective against child and adolescent obesity.	⊕⊕○○
	Pozuelo-Carrascosa et al. 2018	Systematic Review	19 studies (11988 participants)	School-based PA programs were associated with a significant small improvement in WC (ES = −0.14; 95% confidence interval [CI]: −0.22 to −0.07; *P* < .001), DBP (ES = −0.21; 95% CI: −0.42 to −0.01; *P* = .040), and fasting insulin (ES = −0.12; 95% CI: −0.20 to −0.04; *P* = .003). School-based PA interventions improve some cardiometabolic risk factors in children, such as WC, DBP, and fasting insulin.	⊕⊕⊕○

	Xue et al. 2019	Systematic Review	19 studies (5038 participants)	The results showed that chronic exercise interventions improved overall EFs (standardised mean difference (SMD)=0.20, 95% CI 0.09 to 0.30, p<0.05) and inhibitory control (SMD=0.26, 95% CI 0.08 to 0.45, P<0.05). In meta regression, higher body mass index was associated with greater improvements in overall EFs performance (β=0.03, 95% CI 0.0002 to 0.06, p<0.05), whereas age and exercise duration were not. In subgroup analysis by intervention modality, sports and PA programme (SMD=0.21, 95% CI 0.12 to 0.31, p<0.05) and curricular PA (SMD=0.39, 95% CI 0.08 to 0.69, p<0.05) improved overall EFs performance, but integrated PA did not (SMD=0.02, 95% CI −0.05 to 0.09, p>0.05). Interventions with a session length < 90 minutes improved overall EFs performance (SMD=0.24, 95%CI 0.10 to 0.39, p=0.02), but session length ≥ 90 minutes did not (SMD=0.05, 95%CI -0.03 to 0.14). No other moderator was found to have an effect. Despite small effect sizes, chronic exercise interventions, implemented in curricular or sports and PA programme settings, might be a promising way to promote multiple aspects of executive functions, especially inhibitory control.	⊕⊕○○

Sedentary Behaviour	Carson V et al. 2011	Cross-Sectional	2527 participants	Volume and patterns of sedentary behavior were not predictors of high CRS after adjusting for MVPA and other confounders (P > 0.1). For types of sedentary behavior, high TV use, but not high computer use, was a predictor of high CRS after adjustment for MVPA and other confounders. Children and adolescents who watched ≥4 hours per day of TV were 2.53 (95% confidence interval: 1.45-4.42) times more likely to have high CRS than those who watched <1 hour per day. MVPA predicted high CRS after adjusting for all sedentary behavior measures and other confounders. After adjustment for waist circumference, MVPA also predicted high non-obesity CRS; however, the same relationship was not seen with TV use	⊕⊕○○
	Veitch J et al. 2012	Cross-Sectional	544 participants	Cross-sectional and prospective regression analyses showed that a more positive social network and higher social trust/cohesion was related to lower BMI among children. There was no evidence that time spent in physical activity or sedentary behaviors mediated this relation, despite significant associations between social networks and screen-time and between screen-time and BMI.	⊕⊕○○

	Tremblay MS et al. 2011	Systematic Review	232 studies (983840 participants)	Television (TV) watching was the most common measure of sedentary behaviour and body composition was the most common outcome measure. Qualitative analysis of all studies revealed a dose-response relation between increased sedentary behaviour and unfavourable health outcomes. Watching TV for more than 2 hours per day was associated with unfavourable body composition, decreased fitness, lowered scores for self-esteem and pro-social behaviour and decreased academic achievement. Meta-analysis was completed for randomized controlled studies that aimed to reduce sedentary time and reported change in body mass index (BMI) as their primary outcome. In this regard, a metaanalysis revealed an overall significant effect of -0.81 (95% CI of -1.44 to -0.17, p = 0.01) indicating an overall decrease in mean BMI associated with the interventions. There is a large body of evidence from all study designs which suggests that decreasing any type of sedentary time is associated with lower health risk in youth aged 5-17 years. In particular, the evidence suggests that daily TV viewing in excess of 2 hours is associated with reduced physical and psychosocial health, and that lowering sedentary time leads to reductions in BMI.	⊕⊕⊕○

	Twenge JM et al. 2018	Cross-Sectional	40337 participants	After 1 h/day of use, more hours of daily screen time were associated with lower psychological well-being, including less curiosity, lower self-control, more distractibility, more difficulty making friends, less emotional stability, being more difficult to care for, and inability to finish tasks. Among 14- to 17-year-olds, high users of screens (7+ h/day vs. low users of 1 h/day) were more than twice as likely to ever have been diagnosed with depression (RR 2.39, 95% CI 1.54, 3.70), ever diagnosed with anxiety (RR 2.26, CI 1.59, 3.22), treated by a mental health professional (RR 2.22, CI 1.62, 3.03) or have taken medication for a psychological or behavioral issue (RR 2.99, CI 1.94, 4.62) in the last 12 months. Moderate use of screens (4 h/day) was also associated with lower psychological well-being. Non-users and low users of screens generally did not differ in well-being. Associations between screen time and lower psychological well-being were larger among adolescents than younger children.	⊕⊕○○
	Schimdt ME et al. 2012	Systematic Review	47 studies	Twenty-nine achieved significant reductions in TV viewing or screen-media use. Studies utilizing electronic TV monitoring devices, contingent feedback systems, and clinic-based counseling were most effective. While studies have reduced screen-media use in children, there are several research gaps, including a relative paucity of studies targeting young children (n = 13) or minorities (n = 14), limited long-term (>6 month) follow-up data (n = 5), and few (n = 4) targeting removing TVs from children's bedrooms. Attention to these issues may help increase the effectiveness of existing strategies for screen time reduction and extend them to different populations.	⊕⊕○○
	Drummy C et al. 2016	Randomised Control Trial	120 participants	Compared with the control group, the intervention group significantly increased weekday MVPA (+9.5 min) from baseline to post-intervention. There were no significant changes in BMI; however, an increase in sum-of-skinfolds of the intervention group was observed.	⊕⊕○○

	Ma JK et al. 2014	Single Cross-Over	50 participants	When comparing no-activity breaks with FUNtervals the grade 4 class demonstrated reductions in both passive (no activity = 29% ± 13% vs. FUNterval = 25% ± 13%, $p < 0.05$, effect size (ES) = 0.31) and motor (no activity = 31% ± 16% vs. FUNterval = 24% ± 13%, $p < 0.01$, ES = 0.48) off-task behaviour following FUNtervals. Similarly, in the grade 2 class, passive (no activity = 23% ± 14% vs. FUNterval = 14% ± 10%, $p < 0.01$, ES = 0.74), verbal (no activity = 8% ± 8% vs. FUNterval = 5% ± 5%, $p < 0.05$, ES = 0.45), and motor (no activity = 29% ± 17% vs. FUNterval = 14% ± 10%, $p < 0.01$, ES = 1.076) off-task behaviours were reduced following FUNtervals. In both classrooms the effects of physical activity were greatest in those students demonstrating the highest rates of off-task behaviour on no-activity days. These data demonstrate that very brief high-intensity bouts of exercise can improve off-task behaviour in grade 2 and 4 students, particularly in students with high rates of such behaviour.	⊕○○○
	Fang et al. 2019	Systematic Review	16 studies	When compared with the screen time <2 hr/day, an increased overweight/obesity risk among children was shown in the screen time ≥2 hr/day (OR = 1.67; 95% CI [1.48, 1.88], $P < .0001$). The subgroup analysis showed a positive association between the different types of screen time and overweight/obesity among children. Based on our study, increasing screen time could be a risk factor for being overweight/obesity in children and adolescents.	⊕⊕○○

	Koedijk et al. 2017	Systematic Review	17 studies	Several studies that used DXA or quantitative ultrasound suggested that objectively measured SB was negatively associated with lower extremity bone outcomes, such as femoral neck bone mineral density. The magnitude of this negative association was small and independent of moderate-to-vigorous physical activity. In contrast to the lower extremities, there was insufficient evidence for an association of lumbar spine bone outcomes with objectively measured SB. In high-quality studies that used DXA, no association was observed between objectively measured SB and total body bone outcomes. In studies using questionnaires, none of these relationships were observed.	⊕⊕⊕○
	Stanczykiewicz et al. 2019	Systematic Review	31 studies	Both the systematic review and meta-analysis indicated that overall average effects were small: higher levels of symptoms of anxiety were associated with higher levels of SB (weighted $r = .093$, 95% CI [.055, .130], $p < .001$). Moderator analyses indicated that trends for stronger effects were observed among adults, compared to children/adolescents ($p = .085$).	⊕⊕○○
Sleep	Chaput et al. 2016	Systematic Review	141 studies (592215 participants)	Overall, longer sleep duration was associated with lower adiposity indicators, better emotional regulation, better academic achievement, and better quality of life/well-being. The evidence was mixed and/or limited for the association between sleep duration and cognition, harms/injuries, and cardiometabolic biomarkers. The quality of evidence ranged from very low to high across study designs and health indicators. In conclusion, we confirmed previous investigations showing that shorter sleep duration is associated with adverse physical and mental health outcomes.	⊕⊕⊕○

	Fatima Y et al. 2015	Systematic Review	22 studies (24821 participants)	A review of 22 longitudinal studies, with subjects from diverse backgrounds, suggested an inverse association between sleep duration and BMI. Meta-analysis of 11 longitudinal studies, comprising 24,821 participants, revealed that subjects sleeping for short duration had twice the risk of being overweight/obese, compared with subjects sleeping for long duration (odds ratio 2.15; 95% confidence interval: 1.64–2.81). This study provides evidence that short sleep duration in young subjects is significantly associated with future overweight/obesity.	⊕⊕○○
	Dutil C et al. 2017	Narrative Review	23 studies	Notwithstanding the conflicting results found in these studies and despite being attenuated by adiposity level, maturity, sex and age, there is still some compelling evidence for an association between sleep duration (for both objective or subjective measurements of duration) and architecture with one or more T2D biomarkers in children and adolescents. The majority of the studies reviewed did focus on sleep duration and one or more T2D biomarkers in children and adolescents, but sleep architecture, more precisely the suppression of slow wave sleep and rapid eye movement sleep, has also been shown to be associated with insulin resistance. Only two studies looked at sleep quality, and the association between sleep quality and insulin resistance was not independent of level of adiposity	⊕○○○
	Sparano S et al. 2019	Cross-Sectional / Longitudinal	7974 participants / 5656 participants	Children reporting shorter sleep duration at T0 had significantly higher BP values (P for trend < 0.001) compared to those who slept more. Prospective analyses showed that shorter sleep duration at baseline predicted, over the 2-year follow-up, higher increases in systolic blood pressure and diastolic blood pressure, after adjustment for age, sex, country of origin, BMI z-score, parenteral education, physical activity, screen time, and T0 value of the examined outcome variables (*P* for trend < 0.001). Our findings reveal that shorter sleep duration is associated with higher BP in childhood, suggesting that sleep may be a potential risk factor for hypertension later in life.	⊕⊕○○

	Belmon et al. 2019	Systematic Review	45 studies	We found strong evidence for child age and moderate evidence for screen time, past sleep behavior, and a difficult temperament as determinant of sleep duration. For determinants of sleep quality, evidence was either insufficient or inconsistent. We found moderate evidence for week schedule as a determinant of sleep timing, with later bed- and wake times in weekends.	⊕⊕○○
Eating Activity	Scaglioni S et al. 2018	Narrative Review	88 studies	The family system that surrounds a child's domestic life will have an active role in establishing and promoting behaviours that will persist throughout his or her life. Early-life experiences with various tastes and flavours have a role in promoting healthy eating in future life. The nature of a narrative review makes it difficult to integrate complex interactions when large sets of studies are involved. In the current analysis, parental food habits and feeding strategies are the most dominant determinants of a child's eating behaviour and food choices. Parents should expose their offspring to a range of good food choices while acting as positive role models. Prevention programmes should be addressed to them, taking into account socioeconomic aspects and education.	⊕⊕○○

	Wang DD et al. 2016	Cohort Study	83349 participants	During 3 439 954 person-years of follow-up, 33 304 deaths were documented. After adjustment for known and suspected risk factors, dietary total fat compared with total carbohydrates was inversely associated with total mortality (hazard ratio [HR] comparing extreme quintiles, 0.84; 95% CI, 0.81-0.88; $P < .001$ for trend). The HRs of total mortality comparing extreme quintiles of specific dietary fats were 1.08 (95% CI, 1.03-1.14) for saturated fat, 0.81 (95% CI, 0.78-0.84) for polyunsaturated fatty acid (PUFA), 0.89 (95% CI, 0.84-0.94) for monounsaturated fatty acid (MUFA), and 1.13 (95% CI, 1.07-1.18) for *trans*-fat ($P < .001$ for trend for all). Replacing 5% of energy from saturated fats with equivalent energy from PUFA and MUFA was associated with estimated reductions in total mortality of 27% (HR, 0.73; 95% CI, 0.70-0.77) and 13% (HR, 0.87; 95% CI, 0.82-0.93), respectively. The HR for total mortality comparing extreme quintiles of ω-6 PUFA intake was 0.85 (95% CI, 0.81-0.89; $P < .001$ for trend). Intake of ω-6 PUFA, especially linoleic acid, was inversely associated with mortality owing to most major causes, whereas marine ω-3 PUFA intake was associated with a modestly lower total mortality (HR comparing extreme quintiles, 0.96; 95% CI, 0.93-1.00; $P = .002$ for trend).	⊕⊕○○
	Mattes et al. 2011	Systematic Review	12 studies	Meta-analysis of six studies that added NSBs to persons' diets showed dose-dependent increases in weight. Contrarily, meta-analysis of studies that attempted to reduce NSB consumption consistently showed no effect on body mass index (BMI) when all subjects were considered. Meta-analysis of studies providing access to results separately for subjects overweight at baseline showed a significant effect of a roughly 0.35 standard deviations lesser BMI change (i.e. more weight loss or less weight gain) relative to controls.	⊕⊕○○

	Morenga et al. 2013	Systematic Review	68 studies	Trials in children, which involved recommendations to reduce intake of sugar sweetened foods and beverages, had low participant compliance to dietary advice; these trials showed no overall change in body weight. However, in relation to intakes of sugar sweetened beverages after one year follow-up in prospective studies, the odds ratio for being overweight or obese increased was 1.55 (1.32 to 1.82) among groups with the highest intake compared with those with the lowest intake. Despite significant heterogeneity in one meta-analysis and potential bias in some trials, sensitivity analyses showed that the trends were consistent and associations remained after these studies were excluded.	⊕⊕○○
	Malik et al. 2013	Systematic Review	32 studies	In cohort studies, one daily serving increment of SSBs was associated with a 0.06 (95% CI: 0.02, 0.10) and 0.05 (95% CI: 0.03, 0.07)-unit increase in BMI in children and 0.22 kg (95% CI: 0.09, 0.34 kg) and 0.12 kg (95% CI: 0.10, 0.14 kg) weight gain in adults over 1 y in random- and fixed-effects models, respectively. RCTs in children showed reductions in BMI gain when SSBs were reduced [random and fixed effects: −0.17 (95% CI: −0.39, 0.05) and −0.12 (95% CI: −0.22, −0.2)], whereas RCTs in adults showed increases in body weight when SSBs were added (random and fixed effects: 0.85 kg; 95% CI: 0.50, 1.20 kg). Sensitivity analyses of RCTs in children showed more pronounced benefits in preventing weight gain in SSB substitution trials (compared with school-based educational programs) and among overweight children (compared with normal-weight children).	⊕⊕○○

	Mohammadi et al. 2019	Systematic Review	17 studies	As regards the effect of diet and PA on cardio-metabolic health, the intakes of energy (n = 4) and macronutrients (n = 3) and meal frequency (n = 5) were the most commonly studied dietary factors, while the PA score and level were the most commonly studied PA factors. In addition, BMI and body weight were the most common cardio-metabolic health outcomes. The studies showed that obese and overweight adolescents consume significantly more energy and macronutrients. They are also more likely to skip their daily meals compared to their normal weight peers. In most studies, the direction of the PA effect on body weight was unclear. Some studies found that higher PA is associated with a lower risk of overweight and obesity. However, the associations are often small or inconsistent, with few studies controlling for confounding factors.	⊕⊕○○
Relationships of Activity	Janssen I et al. 2017	Cross-Sectional	17000 participants	The findings indicating that participants achieving any given recommendation had preferable scores for the health outcomes compared with participants who did not meet the recommendations. There was a doseresponse pattern between the number of recommendations achieved and the health outcomes, indicating the health outcomes improved as more recommendations were achieved. When the number of recommendations achieved was the same, there were no differences in the health outcomes. For instance, health indicators scores were not different in the group who achieved the sleep and screen time recommendations, the group who achieved sleep and moderate-to-vigorous physical activity recommendations, and the group who achieved screen time and moderate-to-vigorous physical activity recommendations.	⊕⊕○○

	Sampasa-Kanyinga H et l. 2017	Cross-Sectional	6106 participants	: In the full sample, children meeting the screen time recommendation, the screen time þ sleep recommendation, and all three recommendations had significantly better HRQoL than children not meeting any of these guidelines. Differences in HRQoL scores between sites were also found within combinations of movement/non-movement behaviors. For example, while children in Australia, Canada, and USA self-reported better HRQoL when meeting all three recommendations, children in Kenya and Portugal reported significantly lower HRQoL when meeting all three recommendations (relative to not meeting any).	⊕⊕○○
	Saunders TJ et al. 2016	Systematic Review	14 studies (36560 participants)	Children and youth with a combination of high PA/high sleep/low SB had more desirable measures of adiposity and cardiometabolic health compared with those with a combination of low PA/low sleep/high SB. Health benefits were also observed for those with a combination of high PA/high sleep (cardiometabolic health and adiposity) or high PA/low SB (cardiometabolic health, adiposity and fitness), compared with low PA/low sleep or low PA/high SB. Of the 3 movement behaviours, PA (especially moderate- to vigorous-intensity PA) was most consistently associated with desirable health indicators.	⊕⊕○○

	Hjorth MF et al. 2014	Cross-Sectional / Longitudinal	723 participants	In the cross-sectional analysis, physical activity was negatively associated with the MetS-score (P,0.03). In the longitudinal analysis, low physical activity and high sedentary time were associated with an increased MetS-score (all P,0.005); however, after mutual adjustments for movement behaviors, physical activity and sleep duration, but not sedentary time, were associated with the MetS-score (all P,0.03). Further adjusting for fat mass index while removing waist circumference from the MetS-score rendered the associations no longer statistically significant (all P. 0.17). Children in the most favorable tertiles of changes in moderate-to-vigorous physical activity, sleep duration and sedentary time during the 200-day follow-up period had an improved MetS-score relative to children in the opposite tertiles (P = 0.005).	⊕⊕○○
	Carson V et al. 2017	Cross-Sectional	4157 participants	Compared to meeting all three recommendations, meeting none, one, and two recommendations were associated with a higher BMI z-score, waist circumference, and behavioral strengths and difficulties score and lower aerobic fitness in a gradient pattern (Ptrend < 0.05). Additionally, compared to meeting all three recommendations, meeting none and one recommendation were associated with higher systolic blood pressure and insulin (Ptrend < 0.05). Finally, compared to meeting all three recommendations, meeting no recommendations was associated with higher triglycerides and lower HDL-cholesterol (Ptrend < 0.05). Collectively, meeting more recommendations within the 24-hour movement guidelines was associated with better overall health. Since a small proportion (17%) of this representative sample was meeting the overall guidelines, efforts to promote adoption are needed.	⊕⊕○○

	Dalene KE et al. 2017	Cross-Sectional	4937 participants	Substituting 10 min per day of sedentary time with light PA was associated with higher WC (0.17 to 0.29 cm, $p \leq 0.003$)) in all age groups. Substituting 10 min per day of sedentary time with moderate PA was associated with lower WC in 6- and 9-year-olds (−0.32 to −0.47 cm, $p \leq 0.013$)). Substituting 10 min per day of sedentary time with vigorous PA was associated with lower WC in 9- and 15-year-olds (−1.08 to −1.79 cm, $p \leq 0.015$)). Associations were similar with BMI as the outcome. In prospective analyses, substituting sedentary time with light, moderate or vigorous PA at age 9 was not associated with BMI or WC at age 15.	⊕⊕○○
	Huang YW et al. 2016	Cohort	672 participants	Controlling for covariates and total behavior time, isotemporal substitution models indicated that the displacement of 30 minIdj1 of other sedentary behaviors with equal amounts of screen time (B = 0.12; 95% confidence interval, 0.04–0.20) or academic-related activities (B = 0.13; 95% confidence interval, 0.04–0.21) was associated with higher BMI. Reallocating 30 minIdj1 of MVPA with each of the sedentary behavior variables resulted in increased BMI.	⊕○○○

Additional considerations

Type of Outcome	Author/Organisation	Type of Paper	Name of Paper
Physical Activity	World Health Organization. 2020	Guidelines	WHO guidelines on physical activity and sedentary behaviour
	Chen P. 2020	Consensus	Physical activity and health in Chinese children and adolescents: expert consensus statement
	Health Promotion Board, Singapore. 2013	Guidelines	National Physical Activity Guidelines-Children and Youth Aged up to 18
	Faigenbaum AD et al. 2009	Position	Youth resistance training: updated position statement paper from the national strength and conditioning association
	Behm DG et al. 2008	Position	Canadian Society for Exercise Physiology position paper: resistance training in children and adolescents
	American Academy of Pediatrics. 2001	Policy	Strength training by children and adolescents
	Tremblay MS et al. 2015	Position	Position statement on active outdoor play. International journal of environmental research and public health
Sedentary Behaviour	Tremblay MS et al. 2011	Guidelines	Canadian sedentary behaviour guidelines for children and youth
	American Academy of Pediatrics. 2013	Policy	Children, adolescents, and the media
Sleep	Paruthi S et al. 2016	Consensus	Recommended amount of sleep for pediatric populations: a consensus statement of the American Academy of Sleep Medicine
	Hirshkowitz M et al. 2015	Guidelines	National Sleep Foundation's sleep time duration recommendations: methodology and results summary
Eating Activity	Wellington Ministry of Health. 2012	Guidelines	Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years): A background paper
	National Health and Medical Research Council. 2013	Guidelines	Australian Dietary Guidelines
	U.S. Department of Health and Human Services. 2015	Guidelines	2015-2020 Dietary Guidelines for Americans
	National Institute for Health and Care Excellence United Kingdom. 2015	Guidelines	Preventing excess weight gain
	World Cancer Research Funds. 2018	Guidelines	Diet, nutrition and physical activity: Energy balance and body fatness
	World Health Organization. 2015	Guidelines	Guideline: Sugars intake for adults and children

Undesirable effects

How substantial are the undesirable anticipated effects?

Judgement

☐ Small

Research evidence

Type of Outcome	Author	Type of Study	No. of Studies/Participants	Summary of Findings	Certainty of Evidence
Safety in Exercise	Rossler R et al. 2014	Systematic Review	21 studies (27561 participants)	The overall RR was 0.54 (95 % CI 0.45–0.67) [$p < 0.001$]. Girls profited more from injury prevention than boys ($p = 0.05$). Both prevention programs with a focus on specific injuries (RR 0.48 [95 % CI 0.37–0.63]) and those aiming at all injuries (RR 0.62 [95 % CI 0.48–0.81]) showed significant reduction effects. Pre-season and in-season interventions were similarly beneficial ($p = 0.93$). Studies on programs that include jumping/plyometric exercises showed a significant better ($p = 0.002$) injury preventive effect (RR 0.45 [95 % CI 0.35–0.57], $Z = 6.35$, $p < 0.001$) than studies without such exercises (RR 0.74 [95 % CI 0.61–0.90], $Z = 3.03$, $p = 0.002$).	⊕⊕⊕○

Additional considerations

Type of Outcome	Author/Organisation	Type of Paper	Name of Paper
Safety in Exercise	Brenner JS. 2016	Clinical Report	Sports specialization and intensive training in young athletes
	Chen P et al, 2020	Guidelines	Returning Chinese school-aged children and adolescents to physical activity in the wake of COVID-19: Actions and precautions
	Bergeron MF et al. 2015	Consensus	International Olympic Committee consensus statement on youth athletic development
	Schmied C et al. 2014	Review	Sudden cardiac death in athletes

Certainty of the evidence

What is the overall certainty of the evidence of effects?

Judgement

☐ Moderate

Research evidence

Type of Outcome	Author	Type of Study	No. of Studies/Participants	Certainty of Evidence
Physical Activity	Poitras VJ et al. 2016	Systematic Review	162 studies (204171 participants)	⊕⊕⊕○
	Janssen I et al. 2010	Systematic Review	86 studies	⊕⊕○○
	Strong WB et al. 2005	Systematic Review	850 studies	⊕⊕⊕○
	Jakicic JM et al. 2019	Systematic Review	29 studies	⊕⊕○○
	da Silva MP et al. 2015	Systematic Review	9 studies	⊕⊕○○
	Tudor-Locke C et al. 2011	Systematic Review	35 studies	⊕⊕○○
	Carson V et al. 2013	Cross-Sectional	1731 participants	⊕⊕○○
	Fuezeki E et al. 2017	Systematic Review	40 studies	⊕⊕○○
	Colley RC et al. 2012	Cross-Sectional	1613 participants	⊕⊕○○
	Cao et al. 2019	Systematic Review	17 studies (563 participants)	⊕⊕○○
	Collins et al. 2018	Systematic Review	18 studies	⊕⊕○○
	Eddolls et al. 2017	Systematic Review	13 studies	⊕⊕○○
	Marque et al. 2018	Systematic Review	51 studies	⊕⊕⊕○
	Martin et al. 2017	Systematic Review	15 studies	⊕⊕⊕○
	Miguel-Berges et al. 2018	Systematic Review	36 studies	⊕⊕○○
	Pozuelo-Carrascosa et al. 2018	Systematic Review	19 studies (11988 participants)	⊕⊕⊕○
	Xue et al. 2019	Systematic Review	19 studies (5038 participants)	⊕⊕○○

Sedentary Behaviour	Carson V et al. 2011	Cross-Sectional	2527 participants	⊕⊕○○
	Veitch J et al. 2012	Cross-Sectional	544 participants	⊕⊕○○
	Tremblay MS et al. 2011	Systematic Review	232 studies (983840 participants)	⊕⊕⊕○
	Twenge JM et al. 2018	Cross-Sectional	40337 participants	⊕⊕○○
	Schimdt ME et al. 2012	Systematic Review	47 studies	⊕⊕○○
	Drummy C et al. 2016	Randomised Control Trial	120 participants	⊕⊕○○
	Ma JK et al. 2014	Single Cross-Over	50 participants	⊕○○○
	Fang et al. 2019	Systematic Review	16 studies	⊕⊕○○
	Koedijk et al. 2017	Systematic Review	17 studies	⊕⊕⊕○
	Stanczykiewicz et al. 2019	Systematic Review	31 studies	⊕⊕○○
Sleep	Chaput et al. 2016	Systematic Review	141 studies (592215 participants)	⊕⊕⊕○
	Fatima Y et al. 2015	Systematic Review	22 studies (24821 participants)	⊕⊕○○
	Dutil C et al. 2017	Narrative Review	23 studies	⊕○○○
	Sparano S et al. 2019	Cross-Sectional / Longitudinal	7974 participants / 5656 participants	⊕⊕○○
	Belmon et al. 2019	Systematic Review	45 studies	⊕⊕○○
Eating Activity	Scaglioni S et al. 2018	Narrative Review	88 studies	⊕⊕○○
	Wang DD et al. 2016	Cohort Study	83349 participants	⊕⊕○○
	Mattes et al. 2011	Systematic Review	12 studies	⊕⊕○○
	Morenga at al. 2013	Systematic Review	68 studies	⊕⊕○○
	Malik et al. 2013	Systematic Review	32 studies	⊕⊕○○
	Mohammadi et al. 2019	Systematic Review	17 studies	⊕⊕○○
Relationships of Activity	Janssen I et al. 2017	Cross-Sectional	17000 participants	⊕⊕○○
	Sampasa-Kanyinga H et l. 2017	Cross-Sectional	6106 participants	⊕⊕○○
	Saunders TJ et al. 2016	Systematic Review	14 studies (36560 participants)	⊕⊕○○
	Hjorth MF et al. 2014	Cross-Sectional / Longitudinal	723 participants	⊕⊕○○
	Carson V et al. 2017	Cross-Sectional	4157 participants	⊕⊕○○

	Dalene KE et al. 2017	Cross-Sectional	4937 participants	⊕⊕○○
	Huang YW et al. 2016	Cohort	672 participants	⊕○○○
Safety in Exercise	Rossler R et al. 2014	Systematic Review	21 studies (27561 participants)	⊕⊕⊕○

Values

Is there important uncertainty about, or variability in, how much people value the main outcomes?

Judgement

☐
Probably no important uncertainty or variability

Research evidence

There are existing national physical activity guidelines and active research in both physical activity and sedentary behaviour of children and adolescents in many countries in the Asia-Pacific region.

Balance of effects

Does the balance between desirable and undesirable effects favour the option or the comparison?

Judgement

☐ Probably favours the option

Research evidence

The option offers better outcomes via a holistic approach towards good metabolic and general health in children and adolescents.
The option also includes advice and information on possible undesirable effects such as exercise injuries.
The option also highlighted the complementary relationships of each activity and the significance of organizing these activities within 24 hours.

Resources required

How large are the resource requirements (costs)?

Judgement

☐ Moderate savings

Research evidence

The public will benefit from educational or infographic aids for easy understanding and reference.
Healthcare providers will benefit from scientific reports and educational lectures or workshops to improve skills in delivering the recommendations.
Improvement in metabolic and general health will contribute to considerable savings in healthcare expenditure over time.

Certainty of evidence of required resources

What is the certainty of the evidence of resource requirements (costs)?

Judgement

☐ Moderate

Research evidence

Improvement in metabolic and general health will contribute to considerable savings in healthcare expenditure over time.
This is assumed to be similar to current campaigns against NCDs in each country.

Cost-effectiveness

Does the cost-effectiveness of the option favour the option or the comparison?

Judgement

☐ Probably favours the option

Research evidence

The investment in the public education of these recommendations will contribute to considerable savings in healthcare expenditure over time.
This is assumed to be similar to current campaigns against NCDs in each country.

Equity

What would be the impact on health equity?

Judgement

☐ Probably increased

Research evidence

These recommendations are available to all children and adolescents in the Asia-Pacific region.
These recommendations can be delivered from primary care, tertiary care and related organisations.

Acceptability

Is the option acceptable to key stakeholders?

Judgement

☐ Probably Yes

Research evidence

The option is likely acceptable to key stakeholders as it is similar to their current campaigns against NCDs.

Feasibility

Is the option feasible to implement?

Judgement

☐ Probably Yes

Research evidence

The option is likely feasible to implement as this approach is similar to their current campaigns against NCDs.

CONCLUSIONS

Summary of judgements

Problem	– Don't know	– Varies		– No	– Probably No	– Probably Yes	**Yes**
Desirable effects	– Don't know	– Varies		– Trivial	– Small	**Moderate**	– Large
Undesirable effects	– Don't know	– Varies		– Large	– Moderate	**Small**	– Trivial
Certainty of the evidence	– No included studies			– Very low	– Low	**Moderate**	– High
Values				– Important uncertainty or variability	– Possibly important uncertainty or variability	**Probably no important uncertainty or variability**	– No important uncertainty or variability
Balance of effects	– Don't know	– Varies	– Favours the comparison	– Probably favours the comparison	– Does not favour either the option or the comparison	**Probably favours the option**	– Favours the option

Resources required	– Don't know	– Varies	– Large costs	– Moderate costs	– Negligible costs or savings	**Moderate savings**	– Large savings
Certainty of evidence of required resources	– No included studies			– Very low	– Low	**Moderate**	– High
Cost-effectiveness	– Don't know	– Varies	– Favours the comparison	– Probably favours the comparison	– Does not favour either the option or the comparison	**Probably favours the option**	– Favours the option
Equity	– Don't know	– Varies	– Reduced	– Probably reduced	– Probably no impact	**Probably increased**	– Increased
Acceptability	– Don't know	– Varies		– No	– Probably No	**Probably Yes**	– Yes
Feasibility	– Don't know	– Varies		– No	– Probably No	**Probably Yes**	– Yes

Type of recommendation

Recommendation

1. Children and adolescents should integrate the recommended physical activity, sedentary behaviour, sleep and eating habits within each 24-hour period for good physical, mental and social health
2. Accumulate a daily average of 60 minutes or more of moderate- to vigorous-intensity physical activity
3. Engage in muscle and bone strengthening activities at least three times a week
4. Engage in a variety of light-intensity physical activities as often as possible throughout the day
5. Take the necessary precautions when engaging in physical activity and seek medical help if you feel any discomfort
6. Sedentary recreational screen time should be limited to 2 hours or less per day
7. Take regular movement breaks when there is prolonged sitting or inactivity
8. Have daily sleep of 9 to 11 hours (for 5 - 13 years old) and 8 to 10 hours (for 14 - 18 years old)
9. Take the recommended amounts of foods and drinks that are balanced and nutritious to support growth and daily activities
10. Work towards meeting all the recommendations for physical activity, sedentary behaviour, sleep and eating habits for optimal health and development

Justification

Detailed justification

☒ Problem ☒ Desirable effects ☒ Undesirable effects ☒ Certainty of the evidence ☐ Values ☐ Balance of effects ☐ Resources required ☐ Certainty of evidence of required resources ☒ Cost-effectiveness ☐ Equity ☐ Acceptability ☐ Feasibility	**Problem** Metabolic morbidities and NCDs in children and adolescents are increasing in Asia Pacific region and straining both healthcare resources and expenditure. Lifestyle interventions are vital to improving the metabolic and general health of children and adolescents to combat NCDs and to cultivate good lifelong habits. **Desirable effects** The evidence is at least moderately certain to recommend the integration of regular physical activity, minimal sedentary behaviour, adequate sleep and good eating habits towards good metabolic and general health in children and adolescents. **Undesirable effects** Children and adolescents need to take the necessary precautions when exercising and they should consult doctors if they become unwell during exercise. **Certainty of the evidence** The review of the evidence consisted of many systematic reviews with large number of studies or participants and the overall evidence is at least moderately certain to support the recommendations. **Cost-effectiveness** Early lifestyle interventions will likely reduce the overall healthcare expenditure over time.