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A systematic review to update the Australian physical activity guidelines for children and young people

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A systematic review to update the Australian physical activity guidelines for children and young people

Abstract

The objective of this review is to inform Australian Government policy on the relationship between physical activity (including the amount, frequency, intensity, duration, and type) and health outcome indicators, including the risk and prevention of chronic disease and unhealthy weight gain/obesity, and to provide information to guide evidence-based recommendations that can be used to encourage healthy, active living in apparently healthy children and young people aged 5-17 years, and as a basis for monitoring physical activity on a population level.

Keywords

people, young, children, systematic, review, guidelines, activity, physical, australian, update

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A SYSTEMATIC REVIEW TO UPDATE THE AUSTRALIAN PHYSICAL ACTIVITY GUIDELINES FOR CHILDREN AND YOUNG PEOPLE

**Prepared for the Australian Government Department of Health
by:**

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A Systematic Review to Inform the Australian Sedentary Behaviour Guidelines for Children and Young People

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Objective:

The objective of this review is to inform Australian Government policy on the relationship between physical activity (including the amount, frequency, intensity, duration, and type) and health outcome indicators, including the risk and prevention of chronic disease and unhealthy weight gain/obesity, and to provide information to guide evidence-based recommendations that can be used to encourage healthy, active living in apparently healthy children and young people aged 5-17 years, and as a basis for monitoring physical activity on a population level.

Overview of the Guideline Development Process:

The quality of practice guidelines depends upon the methodologies and strategies used in the guideline development process[1]. To limit the variability in guideline quality, the Appraisal of Guidelines for Research & Evaluation (AGREE) Instrument was developed. The AGREE instrument was designed to assess guideline quality and direct guideline development and reporting.[2] In 2010, the AGREE instrument was revised and refined resulting in the AGREE II instrument. This tool has been used in the development of the proposed guidelines. The AGREE II instrument is a 23-item tool with six quality domains. The development process for the proposed guidelines using each domain is briefly discussed in the following paragraphs [3-4].

The *Scope and Purpose* domain describes the target population, specific overall objectives and health questions addressed by the guideline. The guidelines apply to healthy children aged 5-17 years old. The objective of these guidelines was to inform Australian Government policy regarding the relationship between physical activity (including the amount, frequency, intensity and type of physical activity) and health outcome indicators (including: risk and prevention of chronic disease, unhealthy weight gain, and mental health and wellbeing); and to provide information to guide evidence-based recommendations that can be used to encourage healthy, active living in children and young people aged 5-17 years. The specific research questions are stated below.

The *Stakeholder Involvement* domain identifies stakeholders involved in the development process and indicates whether the views and preferences of targeted populations have been sought. The Guideline Development Committee included exercise physiologists, methodologists, behavioural scientists, and social marketing experts. Representatives from major Australian stakeholders, including the National Heart Foundation of Australia, the Australian Government Department of Health and Ageing, Sports Medicine Australia, and the Australian Council for Health, Physical Education and Recreation were involved. In addition, physical activity experts from the United States, Canada and Australia shared their ideas and previous experiences. The Guidelines provide recommendations for children and youth, parents, educators, public health and health care providers who are the proposed end users of the recommendations.

The *Rigour of Development* domain assesses how the evidence was gathered and synthesised. It outlines the current development and future development initiatives to update the recommendations. The methods used in the

development of the guidelines, including the search terms, time periods and inclusion/exclusion criteria are clearly described in the systematic review. Seven members of the Guideline Development Committee were assigned to review individual studies. The reviewers critically appraised individual studies and reflected on the body of evidence, considering the scientific validity of the studies. One reviewer appraised each study. The Guideline Development Committee met in Canberra, Australia, in May 2012 to develop a draft of the guidelines based on the evidence provided within this review, as well as that provided by previous systematic reviews. The Committee worked until they achieved consensus on the draft Preamble and Guidelines. The Committee circulated the guidelines to national and international physical activity experts for comment including experts involved in the development of previous guidelines. This also included physical activity experts from non-government organizations (NGOs; e.g. National Physical Activity Program Committee for the NHFA, ACHPER), as well as Australian State and Territory Government representatives. The Guideline Development Committee recommend that the Australian Physical Activity Guidelines for Children and Young People be updated every 5 years [5-6].

The *Clarity of Presentation* deals with the language, structure and format of the guidelines. The recommendations and their rationale are clearly described in the systematic review. The guidelines address the targeted population, key recommendations and specific goals.

The *Applicability* domain focuses on advice for implementing recommendations, resource implications, and monitoring strategies. The Guideline Development Committee recommended that these guidelines be integrated into all relevant Government policies and programs. However, the implementation of these guidelines is beyond the scope of the current development process. Specific goals were included in the recommendations for monitoring purposes (e.g., engage in 60 minutes of moderate-to-vigorous physical activity each day).

The *Editorial Independence* domain examines the potential biases in guideline recommendations with competing interests due to funding or guideline panel conflicts of interests. The development of these guidelines was funded by the Australian Department of Health and Ageing. The Department had no influence on the evidence accumulation or synthesis. However, Department of Health and Ageing staff provided feedback on the draft guidelines. Suggested changes were considered by full consensus among the Guideline Development Committee.

An overview of the guideline development process employed appears in Appendix B.

Systematic Review Methodology

Evidence included in the systematic review:

Any experimental or longitudinal study that used a valid and reliable measure of physical activity, either objective (e.g., wearable motion sensors, or direct

observation) or subjective (e.g., self-report questionnaire, or proxy-report questionnaire), was eligible for inclusion in the systematic review. Each study was required to provide sufficient information to ascertain the duration, intensity and/or frequency of physical activity, and include at least one measure of a specified health indicator.

Comparator required:

At least one baseline measure of physical activity was required for longitudinal studies. A control group was required for all experimental studies.

Outcomes of interest:

Cardiometabolic health, adiposity (including the prevention of unhealthy weight gain), musculoskeletal health, mental health, negative health outcomes, high-risk behaviours (such as illicit drug use, smoking), academic achievement and cognitive development, conduct behaviour/pro-social behaviour, motor development, cardiorespiratory fitness, and respiratory health.

These outcomes were chosen as they represent the broad spectrum of health outcomes known to be associated with physical activity in school-aged children and adolescents, are consistent with the latest systematic reviews of evidence in this area, are consistent with the previous review undertaken to inform the existing Australia’s Physical Activity Recommendations for Children and Adolescents, or were areas of emerging interest identified by the Guideline Development Committee. Specifically, cardiometabolic risk, adiposity, mental health, cardiorespiratory fitness, academic achievement, and prosocial behaviour were included in a recent systematic review of the evidence to inform the Canadian Physical Activity Guidelines for Children and Youth [7]. The expert panel that comprised the Guideline Development Committee also reached consensus on the following emerging areas of interest that were to be included in the review: musculoskeletal health; negative health outcomes; high risk behaviours; pro-social/conduct behaviour; motor development; and, respiratory health.

A definition of all outcomes of interest can be found in Appendix A.

***A priori* consensus rankings for each indicator by age group**

In order to assist with decision-making, all outcomes of interest were ranked according to their importance. This was undertaken prior to the literature search.

| Health Indicator | Children (5-12 yrs) | Adolescents (13-18 yrs) |
|------------------------------------|----------------------------|--------------------------------|
| Cardiometabolic health | Critical | Critical |
| Adiposity | Critical | Critical |
| Musculoskeletal health | Critical | Critical |
| Mental health | Critical | Critical |
| Negative health outcomes | Important | Important |
| High risk behaviours | Important | Important |
| Academic achievement and cognitive | Critical | Critical |

| | | |
|--|-----------|-----------|
| development | | |
| Conduct behaviour / pro-social behaviour | Critical | Critical |
| Motor development | Important | Important |
| Cardiorespiratory fitness | Important | Important |
| Respiratory health | Important | Important |

Note: Health indicators were ranked based on whether they were critical for decision-making, important but not critical, or of low importance for decision-making. The focus when searching and summarising the evidence was on indicators that were important or critical. Rankings were based on the GRADE framework [8], and were made by consensus by the Guideline Development Committee.

Research Questions:

- a) *What is the relationship between physical activity and the biopsychosocial indicators of health and healthy development (as above) in children and adolescents aged 5-18 years?*

The primary aim of this research question was to consider whether evidence existed on the relationship between physical activity and each health outcome at a sufficiently high level as to inform the development of Australian Physical Activity Guidelines. For those outcomes that were included in previous reviews, and therefore have a substantial base of evidence, this research question aimed to update the evidence on this relationship by providing a summary of the evidence published since the previous two reviews [7, 10]. For novel outcomes, such as motor development, the primary aim was to examine whether a relationship exists with physical activity at a level sufficient to inform Guideline development.

- b) *How much physical activity (frequency, intensity, duration) is needed for minimal and optimal health benefits (including weight management) in children and adolescents (i.e. does this increase in a dose-response manner)?*

The particular emphasis of this research question was to examine whether a dose-response relationship exists between the frequency and intensity of physical activity and health benefits for each outcome of interest. Specifically, was the most recent evidence consistent with a dose-response relationship with the frequency and/or intensity of physical activity, and was this consistent with the evidence of previous reviews (for example, the systematic review that was used to inform the Canadian Physical Activity Guidelines for Children and Youth [7], and the review that informed the previous Australian Physical Activity Guidelines [10])?

- c) *What types of physical activity are needed to produce health benefits?*

Physical Activity Guidelines that relate to children and adolescents worldwide are consistent in prescribing 60 minutes of moderate- to vigorous-intensity physical activity daily. However, there is less consensus on the evidence to inform the types of activity that are necessary to produce health benefits. This research question addressed, in particular, the evidence that existed to inform

guidelines pertaining to the types of activities that strengthen muscle and bone, as well as the types of activities identified as of a vigorous-intensity.

d) Do the effects of physical activity on health and healthy development in children and adolescents vary by sex and/or age?

Existing Australian Physical Activity Guidelines have been published separately for those 5-12 and 12-18 years of age. This research question addresses the issue of whether the most recent evidence justified separate Physical Activity Guidelines for these age groups. In addition the Guideline Development Committee resolved that potential differences in the evidence by sex should also be investigated.

Inclusion/Exclusion criteria for systematic review:

- a) Cross-sectional designs were excluded.
- b) Population-based studies (longitudinal studies, retrospective studies) were required to have a minimum sample size of 300 participants.
- c) Randomised controlled trials and other controlled trials were required to have a minimum of 30 participants.
- d) Longitudinal studies were included if there was at least one measure of physical activity between the ages of 5 and 18 years that was explicitly linked to a health outcome of interest.
- e) Studies conducted in special populations (for example: sporting groups; populations with clinical diagnoses, and; exclusively obese participants) were excluded.

These decisions were made by the Guideline Development Committee for the following four reasons: 1) To ensure that a high level of evidence was obtained by excluding cross-sectional evidence, as well as longitudinal and controlled trial studies with small sample sizes; 2) To ensure that the number of articles included in the review was manageable to ensure timely completion of the project; 3) To maintain consistency across studies in the information that was reported, that would allow a meaningful and viable summation of the evidence, and; 4) To maintain consistency with previous reviews [7] that followed the AGREE methodology [9].

Dates for systematic review searches:

| Outcome | End Date of last search | Current search start date |
|--------------------------|---|--|
| Cardiometabolic health | January 2008 (CPAG) | February 2008 |
| Adiposity | January 2008 (CPAG) | February 2008 |
| Musculoskeletal health | January 2008 (CPAG) ¹ February 2002 (APAG) | Skeletal: Feb 2008 Muscular: March 2002 |
| Mental health | January 2008 (CPAG) ² February 2002 (APAG) ³ | Depression: Feb 2008 Psychosocial: March 2002 Others ⁶ : Open |
| Negative health outcomes | January 2008 (CPAG) ⁴ February 2002 (APAG) | Injuries: Feb 2008 Others: March 2002 |
| High risk behaviours | Nil | Open |
| Academic achievement and | February 2002 (APAG) ⁵ | Academic achievement: |

| | | |
|--|----------------------|--|
| cognitive development | | March 2002 Others ⁷ : Open |
| Conduct behaviour / pro-social behaviour | Nil | Open |
| Motor development | Nil | Open |
| Cardiorespiratory fitness | February 2002 (APAG) | March 2002 |
| Respiratory health | Nil | Open |

* **Note.** CPAG = Canadian Physical Activity Guidelines; APAG = Existing Australian Physical Activity Guidelines.

¹Skeletal health only.

²Depression only.

³Social-psychological factors only.

⁴Injuries only.

⁵Academic achievement only.

⁶Self esteem, wellbeing, anxiety, mental illness, social isolation, social discrimination.

⁷Cognitive development, attention, concentration.

Databases searched:

MEDLINE, SportsDISCUS, EMBASE, PsycINFO, PUBMED, Scopus, ERIC.

Grey Literature Search:

The grey literature search occurred through contact with key informants, knowledge users, and content experts. This literature included unpublished work, but did not include masters or doctoral theses, or conference abstracts. This was to minimise potential duplication of evidence should these theses or abstracts be published in peer-reviewed journals. Background documents from alternate guidelines/suggested readings were also obtained.

Search Strategy (all databases followed an identical search strategy):

The terms used in literature search were negotiated between the Guideline Development Committee and a librarian with expertise in conducting systematic reviews. In particular, the terms encompassed the major outcome measures within each health outcome, in addition to the corresponding Medical Subject Headings. The Medical Subject Headings are the National Library of Medicine's controlled vocabulary for indexing and cataloguing research articles (found at: <http://www.nlm.nih.gov/mesh/>). The search terms were deliberately selected to capture a wide range of potential evidence in order to ensure that no relevant evidence was missed. A table outlining the complete search strategy can be found in Appendix C. An identical search strategy was conducted over six academic databases: MEDLINE; SportsDISCUS; PsycINFO; PUBMED; Scopus; and, ERIC. Each search was conducted by a single researcher. Where possible, results were limited to: English language; abstract available online; peer reviewed; journal articles, and; human subjects. The results of each search were saved, and entered into an Endnote X3 database (Thompson Reuters, California). Duplicates were removed by the Endnote program, however, manual searching of the final database revealed that many duplicates remained due to small differences in the formatting of citations between the databases. Where possible, these duplicates

were removed manually prior to initial screening; however, many were removed during the initial screening.

Results of the search:

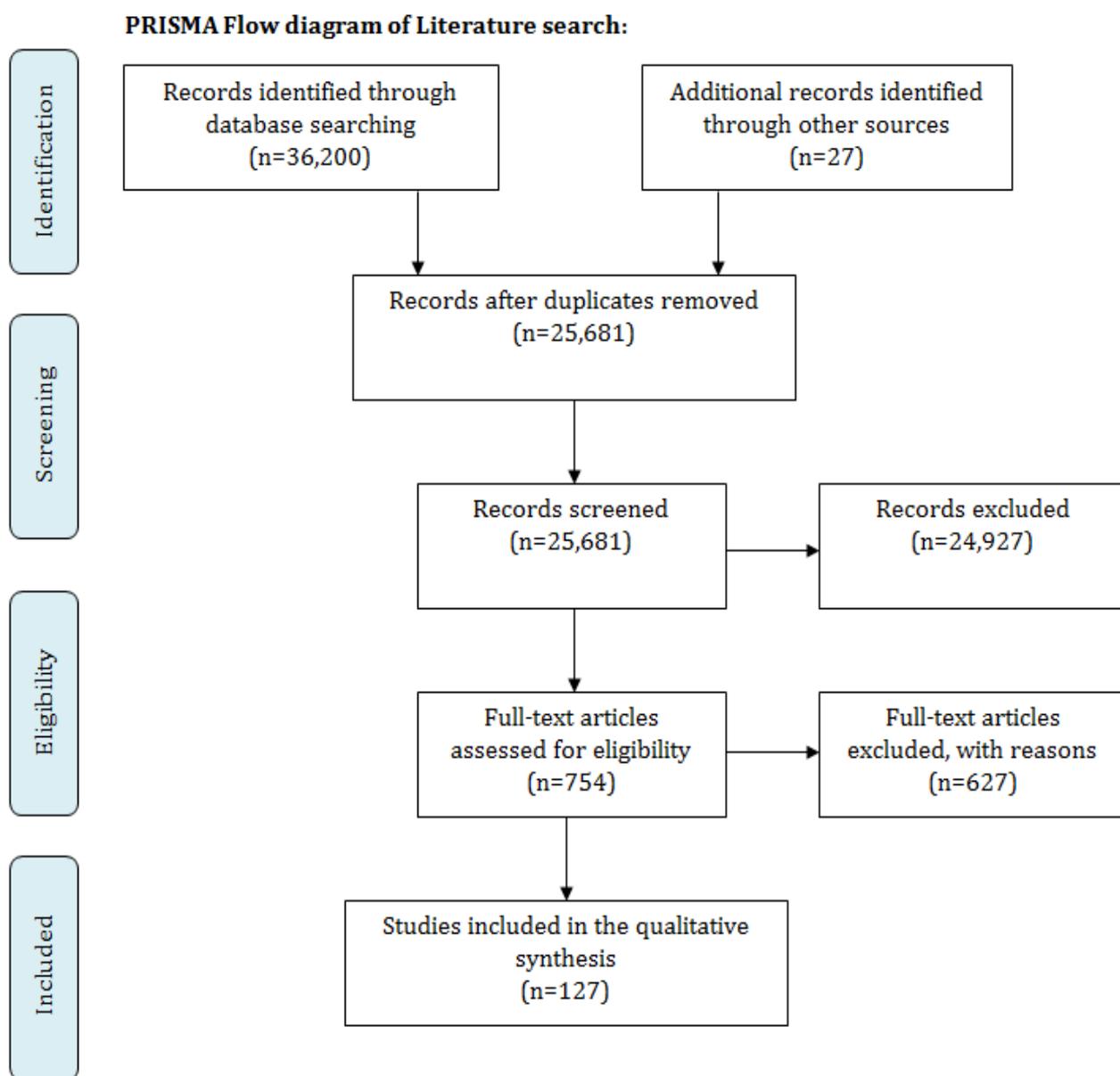
The results of the search are reported below. In total, 25,681 citations were entered into the Endnote database for initial screening. Initial screening was conducted by two independent researchers. The researchers screened each article by title and abstract for potential relevancy. It was only necessary for one reviewer to deem the article as potentially relevant for the article to be maintained for review. In total, there was a high degree of reliability between the researchers. Researcher 1 retained 723 articles, while researcher 2 retained 704 articles for review. In total, there were 754 articles retained for review, thus resulting in a high degree of consistency between researcher 1 (96%) and researcher 2 (93%).

| Database | Total Records Found | Duplicates Removed | Records Entered into Endnote | Cumulative Endnote Total |
|-------------|---------------------|--------------------|------------------------------|--------------------------|
| MEDLINE | 16718 | 190 | 16528 | 16528 |
| SportDISCUS | 6456 | 1369 | 5087 | 21615 |
| PsycINFO | 2551 | 819 | 1732 | 23347 |
| Scopus | 1106 | 91 | 1015 | 24362 |
| PubMed | 8303 | 7571 | 732 | 25094 |
| ERIC | 1066 | 479 | 587 | 25681 |

Following initial review by title and abstract, full text copies of the 754 included articles were obtained, and screened for relevancy. Where articles were excluded at this stage, a reason for exclusion was documented. All studies that included a dietary component for the intervention group alone were excluded because it was impossible to partition out the effect of exercise and diet in these studies. Secondary screening of full text articles was conducted by a single researcher, and resulted in a total of 127 articles for inclusion in the final systematic review. Where there was some ambiguity about the relevancy of any given article, this was discussed between two researchers and a consensus decision was reached between the two. A flow diagram of the systematic review process appears below. A full list of articles included in the review appears in Appendix D.

Data Analysis:

Data were extracted from each of the 127 included articles by one reviewer per articles. Data were extracted into a Microsoft Excel database (Microsoft Corporation, California). Information that was extracted from each paper included: author; date of publication; country of origin; study design; participants details; frequency, intensity, time, and type of physical activity; measure of physical activity used; relevant health outcomes; measures of health outcomes used; length of follow up; control group used (if any); statistical analyses used; statistical measures of the relationship between physical activity and health outcome; covariates (if any), and; comments on overall quality of the study.



Assigning the strength of the evidence:

When determining the strength of the evidence on which the Physical Activity Guidelines are based, previous systematic reviews must be considered. The reader is referred to the systematic review undertaken by Janssen and Leblanc [7] and Trost [10] for a detailed analysis of the strength of the evidence that underpins the proposed Guidelines. In addition, the strength of the evidence contained in this review was objectively rated. Consistent with the recent review undertaken by Janssen and Leblanc [7], levels of evidence were assigned using

rigorous and evidence-based methodology. The objective appraisal of the evidence is based upon a pre-specified scale that is determined by the study designs and quality. The table below outlines the pre-specified criteria for assigning levels of evidence to each health outcome, and has been adapted from Lau et al. [11]. Levels of evidence in this framework are dependent upon the quality of the studies included within each outcome, with a particular relevance to the studies included in this review. In particular, where there were limitations evident in randomised controlled trials, the level of evidence assigned to a health outcome could drop from Level 1 to Level 2. A level of evidence has been assigned to each health outcome separately for children and young people by one researcher.

| Level of evidence | Criteria |
|--------------------------|---|
| Level 1 | Randomised controlled trials without important limitations |
| Level 2 | Randomised controlled trials with important limitations |
| Level 3 | Observational studies with overwhelming evidence |
| Level 4 | Other observational studies Inadequate or no data in population of interest Anecdotal evidence or clinical experience |

Summary Table of Included Studies Organised by Health Outcome:

| Outcome | Studies | Study Types | Summary of Findings: Children | | | | | Summary of Findings: Adolescents | | | | |
|--------------------------------|---------|--|-------------------------------|--------------|------------|-------------------------------|----------------------------------|---|------------------|------------|------------------|---------------------------|
| | | | Freq/wk | Intensity | Time | Type | Other | Freq/wk | Intensity | Time | Type | Other |
| Cardiometabolic health | 23 | RCT (15) CT (6) Long (1) Quasi (1) | 3-5 | MVPA | 40-70 mins | Aerobic | | 3-6 | MVPA | 60 mins | Aerobic | |
| | | | Level 1 Evidence | | | | | | Level 1 Evidence | | | |
| Adiposity | 62 | RCT (36) CT (17) Long (8) Quasi (1) | 2-5 | MVPA | 60 mins | Aerobic | 50% of studies had a sig. effect | 2-4 | MVPA | 60 mins | All types | 1 study had a neg. effect |
| | | | Level 1 Evidence | | | | | Level 1 Evidence | | | | |
| Skeletal health | 13 | RCT (7) CT (6) | 3-5 | MVPA | 20-40 mins | Bone loading/ impact | | 3-5 | MVPA | 40-70 mins | Aerobic Strength | Dose response evident |
| | | | Level 1 Evidence | | | | | Level 1 Evidence | | | | |
| Muscular health | 26 | RCT (15) CT (8) Long (1) Quasi (2) | 2-5 | MVPA/ VPA | - | Varied with anaerobic content | | No new evidence available | | | | |
| | | | Level 1 Evidence | | | | | Level 4 Evidence | | | | |
| Mental health | 18 | RCT (12) Long (5) Quasi (1) | 3 | MVPA | 60 mins | Not specific | Dose response evident | - | - | 60 mins | - | Dose response evident |
| | | | Level 1 Evidence | | | | | Level 1 Evidence | | | | |
| Negative outcomes | 4 | RCT (1) Long (3) | No new evidence available | | | | | >8 hrs/wk of sport training is associated with greater risk | | | | |
| | | | Level 3 Evidence | | | | | Level 4 Evidence | | | | |
| High risk behaviours | 2 | CT (1) Long (1) | No new evidence available | | | | | There is evidence that PA is beneficial, and increased PA is not associated with greater risk | | | | |
| | | | Level 4 Evidence | | | | | Level 4 Evidence | | | | |
| Academic/cognitive development | 9 | RCT (8) CT (1) | 5-9 | MVPA/ VPA | 30-40 mins | Not specific | Dose response evident | No new evidence available | | | | |
| | | | Level 1 Evidence | | | | | Level 4 Evidence | | | | |
| Conduct behaviour | 4 | RCT (2) Long (2) | 7 | - | 10 mins | General movement | | >3 | - | 20 mins | Sport | |
| | | | Level 2 Evidence | | | | | Level 2 Evidence | | | | |
| Motor development | 6 | RCT (3) CT (3) | 1 | MVPA | 120 mins | Aerobic | Dose response evident | 2 | - | 90 | Strength | Girls only in one study |
| | | | Level 2 Evidence | | | | | Level 2 Evidence | | | | |
| Cardiorespiratory fitness | 41 | RCT (25) CT (10) Long (2) Quasi (4) | 3 | MVPA/ VPA | 120 mins | Aerobic | Dose response evident | No new evidence available | | | | |
| | | | Level 1 Evidence | | | | | Level 1 Evidence | | | | |
| Respiratory health | Nil | Nil | No new evidence available | | | | | No new evidence available | | | | |
| | | | Level 4 Evidence | | | | | Level 4 Evidence | | | | |

Note: Summary of findings are presented only for those studies that showed a positive association with health outcomes.

Some studies included more than one health outcome.

“No new evidence” indicates insufficient evidence within a given age category to suggest that previous physical activity recommendations should be changed.

RCT = Randomised Controlled Trial, CT = Controlled Trial, Long = Longitudinal Study, Quasi = Quasi-Experimental Study, MVPA = Moderate-to-Vigorous Physical Activity, VPA = Vigorous Physical Activity, PA = Physical Activity

Results of the Systematic Review

Qualitative Synthesis of the Evidence:

Overall Synthesis of the Evidence

This systematic review provided an update on the evidence examining the effect of physical activity on selected health outcomes in children (aged 5-12 years) and young people (aged 13-17 years). Overall, results confirmed that higher levels of physical activity are associated with multiple health benefits in these age groups. A high level of evidence was found for several health outcomes: cardiometabolic health; adiposity (including the prevention of unhealthy weight gain); musculoskeletal health; mental health; and cardiorespiratory fitness. The body of evidence for these outcomes was consistent with previous systematic and narrative reviews that underpin current guidelines worldwide. This evidence suggests that in order to achieve health benefits, children and young people should participate in a minimum of 60 minutes of at least moderate intensity physical activity, 3-5 times per week. Consistent with the review that underpins the Canadian Physical Activity Guidelines [7], there is some evidence that smaller amounts of physical activity (i.e. 20-40 mins) are also associated with health benefits. For several health outcomes, the evidence indicated that a dose-response relationship exists, in that a greater frequency and/or intensity of physical activity was associated with even greater health benefits. There was also some evidence to suggest that physical activity of a vigorous intensity is necessary for musculoskeletal and cardiorespiratory health benefits. However, there was insufficient evidence to make a recommendation on the frequency of vigorous physical activity that is required for such benefits. This is consistent with the body of evidence that underpins the Canadian, U.S., and WHO guidelines. The evidence indicated that a variety of aerobic physical activities provided health benefits for a majority of the selected health outcomes. In addition, weight-bearing, high impact, or high intensity exercises were found to be beneficial for musculoskeletal and cardiometabolic health. Evidence suggests that the latter should be undertaken on at least 3 occasions per week.

Cardiometabolic Health

A total of 23 studies examining the effect of cardiometabolic health met the inclusion criteria and had data extracted for this review. All but one of the 23 included studies were experimental in design (15 randomised controlled trials [12-26], 6 controlled trials [27-32], 1 quasi-experimental design [33], and 1 longitudinal study [34]). The sole longitudinal study showed that those who participated in greater than 570 minutes of physical activity per week (≈ 80 mins/day) at age 12 had significantly lower diastolic blood pressure at the age of 14. There was no relationship between physical activity and systolic blood pressure in the longitudinal analyses [34].

Of the experimental studies, only three showed no effect of physical activity on cardiometabolic risk. These three studies prescribed a relatively low dose of physical activity during the intervention period. George et al. [18] prescribed exercise of only moderate intensity, Henaghan et al. [19] prescribed only two sessions of 60 minutes per week over nine weeks, and Collins [20] prescribed only one session of structured exercise per week over 10 weeks. However, of those studies that showed significant effects of physical activity on cardiometabolic risk, there was evidence of intra-study variability. For example, Jones et al. [27] showed significant decreases in triglyceride levels following 60 minutes of physical activity at 65-80% of VO_2 max, three times per week for 32 weeks. However, there were no significant changes in either high- or low-density lipoprotein levels. Kriemler [17] showed an

improvement in triglyceride and glucose levels following the addition of daily physical activity to the school curriculum. However, there was no effect for blood pressure.

The accumulation of evidence from the 23 studies that report significant changes in cardiometabolic risk show that, in order for benefits to be inferred, physical activity should: be aerobic and of a moderate-to-vigorous intensity; occur on a minimum of three days per week; and, be a minimum of 40-70 minutes in duration on each occasion. Consistent with previous reviews [7] there is no evidence that has considered the impact of the dose of physical activity as it relates to frequency, duration, or intensity, or age and sex effects when considering cardiometabolic risk. This is an area that should be addressed.

Adiposity (and unhealthy weight gain)

A total of 61 studies included in this review examined the effect of physical activity on adiposity and unhealthy weight gain. There was high level evidence, with 36 randomised controlled trials [13-15, 17-19, 22-24, 26, 35-59], 16 non-randomised controlled trials [27, 29-31, 60-71], 8 longitudinal analyses [34, 72-78], and 1 quasi-experimental study [79]. A little over half of the studies (32) showed a significant impact of physical activity on adiposity and weight gain. The major outcome measures included in these studies were BMI, BMI z-score, waist circumference, and skin fold measures. A wide range of physical activities were shown to have a positive effect on measures of adiposity, including endurance activities [23], aerobic activities [69], sport-based games [26, 41, 48], sports training [46, 54], active play [57, 79], plyometric exercises [43], and resistance training [36, 52]. Of note is a randomised controlled trial that showed that a 24 week active video game intervention resulted in decreases in BMI, BMI z-score, and body fat [37].

Eight studies found significant sex differences [14, 22, 26, 52, 63, 69, 72, 75]. This is of particular interest because three of the most high quality studies were included, pointing to likely sex differences in the relationship between physical activity and adiposity. Martinez Vizcaino et al. [22] conducted a randomised controlled trial with 1,044 participants and found that a combination of aerobic and strength training undertaken three times per week for 90 minutes reduced body fat percentage in girls, but not in boys. Salcedo Aguilar et al. [26] conducted a randomised controlled trial with 1,119 participants and showed that non-competitive recreational activities such as dance, undertaken three times per week for 90 minutes was sufficient prevent an increase in body fat percentage for girls, but not for boys. In a prospective study of 4,150 participants, Riddoch et al. [75] showed that an extra 15 minutes of MVPA at age 12 provided a 14% reduction in fat mass in boys, but only a 7% reduction in girls at age 14. Further investigation of sex differences is required to understand the subtle differences in this relationship. In addition, research is needed that investigates dose-response relationships in regards to frequency, intensity and duration.

Skeletal Health

In total, 13 studies examining the impact of physical activity on skeletal health met inclusion criteria for this review. All these studies included a measure of bone mineral content or bone mineral density. There were 7 randomised controlled trials [48-49, 70, 80-83] and 6 non-randomised controlled experimental studies [65, 84-88]. Ten of these studies reported significant benefits to skeletal health as a result of physical activity, while three did not. Benefits were found for a wide range of physical activities, including sport participation [85], physical education [80], aerobic and resistance exercises [70]. However, the most consistent results were found for high-impact activities such as jumping [81-82, 86, 88]. Each of the

studies that used high-impact physical activity were conducted on a minimum of three days per week. Some evidence for a dose-response relationship was present, with moderate-impact physical activity (single leg drops), conducted on three days per week found not to improve skeletal health, while the higher-impact activities did.

There is emerging evidence for differences in the relationship between physical activity and skeletal health by sex. Both Lofgren et al. [80] and Macdonald et al. [82] reported a differential impact of physical activity on skeletal health. In addition, in two separate studies, Alwis and colleagues [65, 84] reported that 40 minutes of MVPA undertaken on 5 days per week increased bone mineral content in males, but not in females. More research is needed in order to substantiate sex differences in this area. Meyer et al. [81] report that 30 minutes of jumping per day had a differential impact by age, with a larger effect for younger children. More research is also needed to investigate potential age differences. Further research is also needed that explicitly examines a dose-response relationship between physical activity and skeletal health for the frequency, intensity and time of physical activity.

Muscular Health

A total of 26 studies met the inclusion criteria for this review that analysed outcomes of muscular health. There were 15 randomised controlled trials [13, 35-36, 40, 46, 51-52, 54, 58-59, 89-93], 8 non-randomised experimental studies [29, 60-62, 70, 94-96], 2 quasi-experimental designs [79, 97], and 1 longitudinal study [78]. Of these, only 3 studies showed no impact of physical activity on muscular health [40, 61, 70]. Significant changes were reported over three major outcomes. The majority of studies reported on muscular strength, power or endurance [13, 29, 35-36, 46, 51-52, 58, 60, 62, 79, 89-97]. Seven studies reported the impact of physical activity on flexibility [46, 54, 59, 69, 91-92, 95], and three studies reported on lean body mass (used as a proxy for muscle mass) [36, 52, 78].

Of those studies that reported increases in muscular health, the majority used a strength or resistance training program. These studies involved activities such as weights, plyometrics, or other resistance-based exercises of a moderate- or vigorous-intensity. Most studies included activities of both a moderate- (e.g., light resistance exercises, weight-bearing activities) and vigorous-intensity (free weights with low repetitions), and both intensities were sufficient to induce benefits to muscular health. One study addressed a dose-response relationship for intensity and found that both moderate- and vigorous-intensity activities improved muscular power [29]. However, this study suffered from a weak design and statistical approach. Similarly, Faigenbaum et al. [96] investigated a dose-response relationship, and found no extra benefit to muscular strength with strength training on two days per week over one day per week. Strength training on one or two days per week was better than no strength training. Therefore, conclusions regarding a dose-response relationship are inconclusive; however, the evidence points to a beneficial effect for both moderate- and vigorous-intensity resistance-based activities performed at least weekly. In order to achieve gains in muscular health, activities of a vigorous-intensity were typically undertaken on 2 to 3 days per week, while moderate-intensity activities such as organised sports were required on 3-5 days per week in order to produce benefits.

Flexibility was enhanced through weight-bearing and resistance training [59, 91-93], as well as taekwondo training [54], football (soccer) training [46], and dance training [95]. One study addressing both flexibility and strength used a particularly strong design. Katz et al. [91] conducted a randomised controlled trial with 1,216 participants and showed that a program

that included a variety of aerobic and strength exercises such as lunges, squats, star-jumps, jogging and dancing, undertaken for 30 minutes per school day led to gains in muscular strength and flexibility. Overall, there is sufficient evidence that a variety of activities produce gains in muscular health. More research is needed that explicitly addresses dose-response relationships for frequency, duration and intensity.

Mental Health

Eighteen studies that incorporated a broad range of mental health outcomes were included in this review. There were 12 randomised controlled trials [16-17, 36, 41-42, 46, 52, 98-102], five longitudinal studies [103-107], and one quasi-experimental study [97]. Outcome variables included measures of: quality of life [17, 99]; depression [97-98, 105, 107]; anxiety [97-98]; self-esteem [41, 46, 97-98, 103]; physical self perceptions [36, 41, 52, 100-103]; anger and emotional problems [42, 106], and; perceived stress [16]. Seven studies reported a significant relationship or impact of physical activity on mental health with a further six studies reporting some significant and some non-significant results. Four studies found no relationship between physical activity and mental health. The accumulation of evidence within this outcome suggests that, for mental health benefits, a minimum of moderate- to vigorous-intensity physical activity is needed on at least three days per week for 60 minutes each day.

There was evidence that physical activity has a different effect by sex. Lubans et al. [36, 52] report that weight/resistance training had no impact on the physical self-perceptions for males, but did have an impact for females in the form of increased perceived attractiveness. Lindwall and Lindgren [100] add to this by reporting that social physique anxiety can be decreased through sports participation in a sample of girls, when compared with non-significant changes reported over both sexes in other studies [101, 103].

There was also evidence of a dose-response relationship between the frequency, intensity and duration of physical activity and mental health. Petty, Tkacz and colleagues [41-42] examined the effect of 40 minutes of MVPA per day, 20 minutes of MVPA per day, and no MVPA. They found that a dose-response relationship existed, with 40 minutes of MVPA providing benefits beyond those reported for 20 minutes of MVPA for levels of depression, self-worth and perceived physical appearance. Additionally, 20 minutes of MVPA provided benefits that were not reported by non-physically active participants. Benefits for both the 20 and 40 minute groups were better than the non-active group for anger and anger expression. Further, Sund et al. [105] provided evidence for a dose-response relationship for the intensity of physical activity and mental health by reporting that low levels of VPA were associated with high levels of depressive symptoms. Lastly, in a longitudinal study of 13,426 adolescents, Rees et al. [107] reported that the effects of physical activity on depression and self-esteem were small, and were likely to be concentrated at higher frequencies of physical activity (more than 12 times per week).

Although evidence exists on potential sex differences within this outcome, current evidence is unclear. More research is needed to fully understand the differential effect of physical activity on mental health by sex. In particular, the impact on physical self-perceptions is unclear. More experimental evidence is needed on the impact of varying intensities of physical activity on mental health.

Negative Health Outcomes

Only 4 articles were found that examined the effect of physical activity on negative health outcomes. Three of these studies were observational in nature, and one study used a clustered randomised controlled design. Three studies used bone fracture incidence/risk as the outcome [80, 108-110]. One study assessed the incidence of injury as an outcome [110]. With a large sample of 6,831, Field et al. [108] showed that at 7-year follow up, children and adolescents who spent more time in physical activity were more likely to suffer stress fractures. Compared with those that participated in less than 4 hours of physical activity per week: children and adolescents who participated in 4 - 7.9 hours per week were 1.4 times more likely to suffer stress fractures; those who participated in 8 - 11.9 hours were 1.94 times more likely; those who participated in 12 - 15.9 hours were 2.78 times more likely, and; those who participated in 16 or more hours were 2.65 times more likely to suffer stress fractures. In addition, the activities of running, basketball and cheerleading/gymnastics were predictors of stress fracture incidence.

In a sample of 2,692 Clark et al. [109] found that children who participated in vigorous physical activity on a daily basis were 2.06 times more likely to suffer a fracture in the two years following than children who participated in vigorous physical activity four times per week or less. In contrast, using a clustered randomised controlled design with 271 participants, Lofgren [80] showed that increasing levels of physical activity by 200 minutes per week resulted in a significant decrease in the incidence of fractures among children. Finally, in a sample of 1,091 Verhagen [110] demonstrated that the incidence of injuries did not differ significantly between types of physical activity. However, girls were at greater risk of sports-related injuries, especially during leisure time physical activity. Overall, there is presently a low level of evidence to support the relationship between physical activity and negative health outcomes including injury and fractures. This is compounded by inconsistency in the evidence. More research is needed in this area to address the lack and inconsistency of evidence.

High Risk Behaviours

Only two studies investigating high-risk behaviours met inclusion criteria for this review. Both these studies were undertaken in samples of older children and young people (12-18 years). In a controlled study, Scott and Myers [102] showed that physical training five times per fortnight for 30 minutes did not result in any changes in substance use (including drug, alcohol and solvents) when compared with a control group. In a longitudinal study of 4240 adolescents, Korhonen et al. [111] showed that those who participated in physical activity less than 3 times per month at the age of 16 were more likely to be intoxicated weekly (OR = 1.9), experience problems with alcohol (OR = 2.0), and use drugs (OR = 3.7), than those who exercised 4 or more times per week. More research is needed in this area to establish associations and causal relationships between physical activity and high-risk behaviours.

Academic/Cognitive Development

A total of 9 studies using academic achievement or cognitive development as an outcome variable met the inclusion criteria [45, 50, 68, 91, 112-116]. All 9 studies were conducted with samples of children (up to 12.9 years of age). Eight studies used a randomised controlled design, and 1 study used a cross-over control design. Of the 9 studies, all but one showed a positive association between increases in physical activity and increases in academic achievement or cognitive development. The one study that showed no significant effect of physical activity was a large randomised controlled trial. This study showed that

participants subjected to physical activity breaks throughout the school day, up to a total of 30 minutes per day including light and moderate activity, showed no change in academic achievement scores compared with a control group [115].

Of note are two studies that assessed academic achievement as a separate outcome to cognitive development. In a large randomised controlled trial of 1,527 participants, Donnelly et al. [45] showed that physically active academic lessons, including 10 minutes of MVPA nine times per week, increased academic achievement scores. Alternatively, Coe et al. [113] demonstrated that participating in some weekly vigorous physical activity had a positive impact on children's school grades when compared with children who did not participate in any vigorous physical activity. This benefit was not evident for measures of overall physical activity or enrolment in physical education.

The six remaining studies each reported positive associations between physical activity and increases in cognitive development. Four studies incorporated between 15 and 70 minutes of MVPA on five days of the week, usually on every school day [50, 68, 112, 115]. One study introduced 30 minutes of MVPA on three days per week [116], and one study incorporated aerobic physical education lessons for one hour, twice per week [114]. There was a similarity in outcome measures, with physical activity shown to have a beneficial impact upon spatial and working memory [114-115], executive function [50, 112], fluid intelligence [116] and overall cognitive ability [68]. Overall, this body of literature is small, but shows consistent results. There is some evidence for a dose-response relationship with higher intensities and longer durations of physical activity associated with greater benefits [50, 91, 112-113]. However, more research is needed in adolescent populations (aged 13-17 years) to substantiate these preliminary results.

Behavioural Conduct

Four studies that examined the impact of physical activity on behavioural outcomes met inclusion criteria. This included two randomised controlled trials [91, 117] and two longitudinal studies [104, 106]. Both the randomised controlled trials investigated the impact of physical activity breaks during the school day on classroom behaviour. Katz et al. [91] found that there was no effect of up to 30 minutes of light and moderate- to vigorous-intensity physical activity breaks daily on work and social behaviour within the classroom. These results were derived from a large sample of participants (N = 1,216). In a much smaller randomised controlled trial (N = 62), one daily activity break of 10 minutes duration was found to have an impact on directly observed on-task behaviour in the classroom [117]. Similarly, the two longitudinal studies also reported contrasting findings. In a sample of 2,489 adolescents Sagatun et al. [104] found that MVPA at age 15-16 was negatively associated with peer problems at age 18-19. However, this held true for males only. There were no significant associations for females. Wiles [106], in a sample of 11-14 year olds, found that physical activity was not associated with any behavioural problems one year later, including peer problems, conduct problems, or prosocial behaviour. Thus, the little evidence that is available shows mixed results on the relationship between physical activity and conduct/prosocial behaviour. There is some suggestion that there may be sex differences with respect to this outcome, and this should be investigated in future research. Randomised controlled trials that incorporate a greater duration of physical activity than the "activity breaks" reported here is also warranted in order to further understand the relationship between physical activity and conduct/prosocial behaviour.

Motor Development

In total, five studies met inclusion criteria for this review that reported on the broad outcome of motor development. There were three randomised controlled trials [23, 46, 59] and two controlled experimental studies [62, 96]. Three studies reported a significant increase in motor development as a result of physical activity intervention [46, 59, 62], and two did not [23, 96]. There was a wide range of physical activities within these five studies. Faude et al. [46] showed that football (soccer) training, performed 3 times per week for 60 minutes at 80% of maximum heart rate had a beneficial effect on the generic motor skills of countermovement jump and one-leg standing score. Serbescu et al. [62] implemented a impact-loading, weight-bearing activity program two days per week for 50 minutes, and found that children in the intervention group had significant increases in upper body coordination when compared with a control group. In contrast, Walther et al. [23] reported no benefit to motor ability from 45 minutes of aerobic and endurance activity on each school day. Lastly, two studies examined the impact of strength training on motor development. Faigenbaum et al. [96] showed that there was no impact of strength training on motor ability when conducted once or twice per week for 50-60 minutes. However, when this dose was increased to three times per week in a study by Lillegard et al. [59], motor performance was increased. This provides some minimal evidence for a threshold level of muscle and bone strengthening activities, and suggests that in order to see benefits for motor skills and abilities, weight training activities should occur at least three days per week. Overall, this evidence base lacks the quantity of studies that is needed to make firm recommendations, and more research is needed in this area. Research that addresses the frequency, intensity, time and type of physical activity needed to enhance motor development is needed.

Cardiorespiratory Fitness

Forty studies that examined the impact of physical activity on cardiorespiratory fitness met inclusion criteria for this review. Twenty-five of these were randomised controlled trials [13, 15, 17-18, 23, 37, 42, 46-48, 50, 53-54, 56-58, 70, 90-91, 93, 98, 115, 118-120], nine were non-randomised controlled trials [29, 32, 60, 66, 71, 87, 102, 121-122], four utilised a quasi-experimental design [33, 79, 97, 123], and two were longitudinal in design [73, 77]. Of these, 29 showed a positive impact of physical activity on cardiorespiratory fitness, and 13 reported no effect. In general, a combination of moderate- and vigorous-intensity physical activity was necessary to bring about gains in cardiorespiratory fitness. Studies that only included physical activity of a moderate-intensity did not show any benefit [18, 120]. Further, studies that utilised a vigorous-intensity of physical activity showed a greater improvement in cardiorespiratory fitness than those that did not [32, 121-123]. Two studies addressed a dose-response relationship in regards to intensity. Buchan et al. [29] found that increases in cardiorespiratory fitness were present in both vigorous-intensity and moderate-intensity training groups, with no added benefits for vigorous-intensity training. Pfeiffer et al. [77] found that two or more blocks of MVPA per week were needed to produce increases in cardiorespiratory fitness, while only one block of VPA was sufficient.

A variety of physical activities were included in studies that showed benefits to cardiorespiratory fitness. Most studies utilised aerobic activities [32, 119, 122], however, sports training and active games [48, 56, 66, 97], as well as resistance and plyometric activities also showed benefits to cardiorespiratory fitness [13, 58, 93]. One study addressed potential sex differences, and found that the impact of vigorous-intensity interval running training on cardiorespiratory fitness did not differ by sex [122]. More research addressing

potential sex differences is needed, in addition to high quality studies that address potential dose-response relationships in regards to frequency, intensity and duration.

Respiratory Health

No studies met the inclusion criteria pertaining to respiratory health.

An analysis of the evidence pertaining to the health risks of physical inactivity

“Physically inactive” is a term used to describe those who do not meet the minimum level of physical activity that is specified by relevant physical activity guidelines. Undoubtedly, physical inactivity has associated health risks. However, an analysis of the evidence included in this review showed no studies that specifically examined the health risks of physical inactivity. The high level of evidence required for inclusion in this review, (only experimental or quasi-experimental studies with a control group, and longitudinal studies with over 300 participants) meant that it was unlikely such studies would be found, as it would be considered unethical to prescribe physical inactivity as an “intervention” in such studies. As such, studies that investigate the health risks of physical inactivity were most likely to be observational in nature, however, none of the longitudinal studies obtained within this review had included physical inactivity as a variable of interest. Thus, this review was unable to find evidence pertaining to the health risks of physical inactivity. Notwithstanding the above, it may generally be understood that the health risks associated with physical inactivity are the inverse of the health benefits of physical activity that have been reviewed thoroughly within this review.

Discussion

Consideration of special population groups:

This review covered two developmental stages or age groups: childhood (children) and adolescence (young people). Childhood was defined as between the ages of 5 and 12 years (corresponding with primary school). Adolescence was defined as between the ages of 13 and 17 (corresponding with secondary school). It is important to point out that there are clearly variations within these stages and that they serve primarily as a way of categorising the evidence and operationalising the guidelines. These groupings (children and young people) are also consistent with all of the current international guidelines and the existing Australian recommendations.

It is also important to note that whilst the existing guidelines refer separately to children and adolescents (or youth/young people) the specific amount of physical activity and the types of activities recommended (muscle and bone strengthening and vigorous activities) do not differ between the two developmental stages. Differences are only seen in the suggestions in the ways in which the guidelines can be met (such as the types of activities that could be undertaken) in some of the accompanying public resources (website material, brochures, information/fact sheets).

There is no scientific evidence from the existing systematic reviews and our own updated systematic review to support a different recommendation for the amount of activity for children or young people. There is also no evidence from our updated review or existing reviews that separate guidelines for physical activity should be developed for boys and girls

or for children and young people from different socioeconomic, cultural, and indigenous backgrounds. That is, these guidelines are applicable to the general population.

In undertaking the review, evidence concerning special populations (such as those with diabetes, obesity (not overweight), and various other special medical conditions – e.g., cystic fibrosis, cerebral palsy) has been excluded from analyses. Therefore, the evidence reviewed here (and the subsequent Guidelines) cannot be generalised to special populations. This has also been addressed within the Preamble to the Guidelines where it is recommended that those children and young people with a chronic or acute medical condition where participation in physical activity is either contraindicated or presents a risk to the child should consult their health care provider when using the Guidelines.

Existing Guidelines in Australia and Worldwide for Children and Young People:

When evaluating the development and content of existing Australian and international physical activity guidelines for children and adolescents, several criteria should be applied. First, guideline development should follow a process consistent with the recommended international best practices [124]. Second, the guidelines should be consistent with the typical patterns of physical activity in which children and young people aged 5-17 years participate. Third, there should be enough scientific evidence to support the association between the recommended amount of physical activity and the selected physical, mental and social health outcomes. Finally, physical activity guidelines should be behaviourally robust. That is, the frequency, duration, intensity, and type of activity recommended should be consistent with enabling factors that have been shown to be associated with physical activity behaviour in children and adolescents.

Several countries, including Australia, Canada, the United States and the United Kingdom, along with leading global health authorities such as the World Health Organisation, have issued physical activity recommendations and/or guidelines for children and young people. Some of these, such as the Canadian guidelines, have stringently followed recent best-practice recommendations, while others have relied more on existing systematic reviews to inform their final guidelines. Nonetheless, all have attempted to, based on available resources and timelines, apply the aforementioned criteria and apply what was widely acknowledged as best practice at the time the guidelines were developed. The existing international and Australian guidelines are summarised below:

Canadian Guidelines (www.csep.ca/guidelines):

In 2010, the Canadian Physical Activity Guidelines for Children (aged 5-11) and Youth (aged 12-17) were released by the Canadian Society for Exercise Physiology (CSEP). These guidelines followed all of the stages recommended as “best-practice” in the development of physical activity guidelines and are widely considered as the “gold-standard” for children and young people. The Canadian guidelines are as follows:

For health benefits, children/youth aged 5-11/12-17 should accumulate at least 60 minutes of moderate-to-vigorous physical activity daily.

This should include:

- Vigorous-intensity activities at least 3 days per week.
- Activities that strengthen muscle and bone at least 3 days per week

More daily physical activity provides greater health benefits.

United States (www.health.gov/paguidelines/):

In 2008, the *Physical Activity Guidelines for Americans* were released. A collaboration between the U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, American College of Sports Medicine, and American Heart Association, these guidelines included a systematic review, critical analysis of the evidence and summary statement [124]. These contained specific guidelines for children and adolescents (aged 6-17 years) as follows:

Children and adolescents should do 60 minutes (1 hour) or more of physical activity daily.

- **Aerobic:** Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity, and should include vigorous-intensity physical activity at least 3 days a week.
- **Muscle-strengthening:** As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.
- **Bone-strengthening:** As part of their 60 or more minutes of daily physical activity, children and adolescents should include bone-strengthening physical activity on at least 3 days of the week.

It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.

World Health Organisation**(www.who.int/dietphysicalactivity/factsheet_recommendations/en/):**

In 2010, the World Health Organisation released their *Global Recommendations on Physical Activity for Health*. These recommendations relied on evidence used in the process to develop the Canadian and U.S. guidelines, along with additional reviews (Tremblay & Haskell, 2012). An expert panel synthesized this scientific evidence and produced the following recommendations:

The recommendations to improve cardiorespiratory and muscular fitness, bone health, and cardiovascular and metabolic health biomarkers are:

1. Children and youth aged 5-17 should accumulate at least 60 minutes of moderate - to vigorous-intensity physical activity daily.
2. Amounts of physical activity greater than 60 minutes provide additional health benefits.
3. Most of the daily physical activity should be aerobic. Vigorous-intensity activities should be incorporated, including those that strengthen muscle and bone, at least 3 times per week.

United Kingdom**(www.dh.gov.uk/en/publicationsandstatistics/publications/PublicationsPolicyAndGuidance/DH_127931):**

In 2010, the UK Department of Health released the *UK Physical Activity Guidelines for Children and Young People* (aged 5-18 years) These guidelines drew on recent systematic reviews undertaken in Canada and the U.S. to draft their technical report (Tremblay & Haskell, 2012). The following guidelines were developed by an international expert panel:

1. All children and young people should engage in moderate to vigorous intensity physical activity for at least 60 minutes and up to several hours every day.
2. Vigorous intensity activities, including those that strengthen muscle and bone, should be incorporated at least three days a week.

Individual physical and mental capabilities should be considered when interpreting the guidelines.

Existing Australian Recommendations

(www.health.gov.au/internet/main/publish.nsf/content/health-publth-strateg-phys-act-guidelines):

In 2004, the Commonwealth Department of Health and Ageing released the existing Australian recommendations for 5-12 and 12-18 year olds. A systematic review was conducted of relevant material from 6 databases up to February 2002. Publications were evaluated using methods recommended by the National Health & Medical Research Council of Australia (NHMRC). Each study was categorised based on the strength of evidence provided. The overall level of evidence was then evaluated using NHMRC Guidelines. Draft recommendations were developed, presented and agreed upon at a National Consensus Workshop, and submitted for public consultation. The final recommendations are listed below:

For 5-12 year olds

- I. Children need at least 60 minutes (and up to several hours) of moderate to vigorous physical activity every day.

For 12-18 year olds

- II. At least 60 minutes of physical activity every day is recommended. This can be built up throughout the day with a variety of activities. Physical activity should be done at moderate to vigorous intensity.

Summary

All the existing international and national guidelines or recommendations for physical activity for children and adolescents have been based on systematic reviews, synthesis of findings, and some form of stakeholder consultation and consensus. All are consistent in the amount, intensity, and frequency of physical activity recommended (60 minutes of moderate-to vigorous-intensity activity every day). Given this consistency and the rigorous approach followed, it would not be prudent to modify this uniform recommendation unless there were compelling evidence to do so. In addition, all guidelines that have been developed in the past five years have included a recommendation to incorporate activities that strengthen muscle and bone at least three times/days per week and to incorporate some vigorous-intensity activity, either separate to or as part of the muscle and bone strengthening activities, at least three times per week. Again, unless there is evidence to indicate otherwise, there is no reason to vary these latter two recommendations. If variations have been made, the rationale for these has been provided in the section following the proposed guidelines.

The Proposed Physical Activity Guidelines for Children and Young People

Objective:

The objective of these guidelines is to: inform Australian Government policy as to the relationship between physical activity (including the frequency, intensity, duration and type

of physical activity) and health outcome indicators, including the risk and prevention of chronic disease and unhealthy weight gain/obesity, and to provide evidence-based recommendations that can be used to encourage healthy active living in children and adolescents aged 5-17 years.

Target Users:

The target users of the physical activity recommendations are parents, teachers, caregivers, coaches, policy makers, health care and cross-sector providers, and service and infrastructure providers. This is in addition to children and young people aged 5-17 years.

Draft Guidelines and External Review

The Guideline Development Committee met to consider the evidence presented above. During this meeting, the evidence was evaluated, and was considered in reference to previous systematic reviews including the reviews that underpin the current Canadian Physical Activity Guidelines and the existing Australian Physical Activity Recommendations. After consideration of the entire body of literature, in addition to a consideration of existing international and Australian guidelines, Physical Activity Guidelines and a Preamble (scientific statement intended for an informed stakeholder audience) were drafted.

The draft Physical Activity Guidelines and Preamble were sent for confidential comment to a wide range of key stakeholders via an online survey (N=80). This included national content experts from all states and territories in Australia, content experts involved in the formulation of existing international guidelines including the WHO, Canadian, US, and UK Physical Activity Guidelines, individuals who represented key Australian stakeholders including non-government organisations and health professional bodies, and state-based and national government representatives from across Australia. The online survey gave the individuals the chance to respond to the draft Preamble and Guidelines by rating their level of agreement on a five-point Likert Scale, in addition to providing an opportunity to provide open-ended comments. The material used in the online survey appears in Appendix E.

In total, 39 people responded and commented on the draft Preamble and Guidelines. This represented a response rate of 49%. Of those that responded, 41% indicated that they were currently employed in the Government sector, 33% were employed in the education/University sector, 15% in not-for-profit organisations, 8% in the healthcare sector, and 3% were employed in research/science.

The percentage of respondents who “agreed” or “strongly agreed” with the Preambles and Guidelines was high, and is outlined in the table below.

| | | N | % |
|--------------|------------|----|------|
| Children | Preamble | 36 | 92.3 |
| Children | Guidelines | 34 | 87.2 |
| Young People | Preamble | 35 | 89.8 |
| Young People | Guidelines | 34 | 87.2 |

All comments were given due consideration by the Guideline Development Committee during a teleconference. Common comments and the response of the Committee are outlined in Appendix F. The majority of comments were concerned with inadequate definitions of terms included in the Preamble. The Guideline Development Committee resolved to address this in

the messaging and dissemination of the Guidelines and Preamble, as opposed to addressing this within the Preamble itself. There were some comments that the Guideline Development Committee deemed to warrant small changes in the Preamble and Guidelines. These changes are also listed in Appendix F.

Following this process, the systematic review was sent out for international review by experts in physical activity. Subsequently, the Draft Physical Activity Preamble and Guidelines were finalised, and appear below:

The Draft Physical Activity Preamble and Guidelines for Children:

[Draft Preamble for the Australian Physical Activity Guidelines for Children](#)

These Physical Activity Guidelines apply to all children aged 5 to 12 years* irrespective of cultural background, gender, socioeconomic status, and ability.

Physical activity should occur in as many ways as possible, such as active transportation, leisure, active play, organised and non-organised sports, games, physical education and other activities at home, school and in the community. This is in addition to the routine activities accumulated during daily living (incidental physical activity).

Compliance with these Guidelines can improve cardiometabolic health, body composition, musculoskeletal health, aspects of mental health and wellbeing, and cardiorespiratory fitness. The potential benefits far exceed the potential risks associated with physical activity.

Greater amounts of physical activity – frequency, duration, and/or intensity are associated with additional health benefits for children. The level of evidence is not considered strong enough for a specific vigorous-intensity dose-based recommendation; however, it is acknowledged that additional health benefits may be achieved through participation in this type of activity. There is some evidence that benefits to cardiometabolic and musculoskeletal health are associated with resistance-based and weight-bearing activity on at least three days per week. All physical activity should be safe and appropriate for the age and developmental stage of the child.

For those who are not sufficiently active, it is appropriate to gradually increase activity levels to meet the Guidelines.

For guidance on reducing sedentary behaviour please refer to the Australian Sedentary Behaviour Guidelines for Children.

*except in cases where physical activity is contraindicated or presents a risk to the child because of the presence of a chronic or acute condition. Individuals who are unsure should consult their health care provider.

[Draft Australian Physical Activity Guidelines for Children](#)

- For health benefits, children aged 5-12 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day.
- Children's physical activity should include a variety of aerobic activities, including some vigorous-intensity activity.

- On at least three days per week, children should engage in activities that strengthen muscle and bone.
- To achieve additional health benefits children should engage in more activity – up to several hours per day.

The Draft Physical Activity Preamble and Guidelines for Young People:

Draft Preamble for the Australian Physical Activity Guidelines for Young People

These Physical Activity Guidelines apply to all young people aged 13 to 17 years* irrespective of cultural background, gender, socioeconomic status, and ability.

Physical activity should occur in as many ways as possible, such as active transportation, leisure, organised and non-organised sports, games, physical education and other activities at home, school, work and in the community. This is in addition to the routine activities accumulated during daily living (incidental physical activity).

Compliance with these Guidelines can improve cardiometabolic health, body composition, musculoskeletal health, aspects of mental health and wellbeing, and cardiorespiratory fitness. The potential benefits far exceed the potential risks associated with physical activity.

Greater amounts of physical activity – frequency, duration, and/or intensity are associated with additional health benefits for young people. The level of evidence is not considered strong enough for a specific vigorous-intensity dose-based recommendation; however, it is acknowledged that additional health benefits may be achieved through participation in this type of activity. There is some evidence that benefits to cardiometabolic and musculoskeletal health are associated with resistance-based and weight-bearing activity on at least three days per week. All physical activity should be safe and appropriate for the age and developmental stage of the young person.

For those who are not sufficiently active, it is appropriate to gradually increase activity levels to meet the Guidelines.

For guidance on reducing sedentary behaviour please refer to the Australian Sedentary Behaviour Guidelines for Young People.

*except in cases where physical activity is contraindicated or presents a risk to the young person because of the presence of a chronic or acute condition. Individuals who are unsure should consult their health care provider.

Draft Australian Physical Activity Guidelines for Young People

- For health benefits, young people aged 13-17 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day.
- Young people's physical activity should include a variety of aerobic activities, including some vigorous-intensity activity.
- On at least three days per week, young people should engage in activities that strengthen muscle and bone.
- To achieve additional health benefits young people should engage in more activity – up to several hours per day.

Rationale for each Guideline:

1) For health benefits, children/young people aged 5-12/13-17 years should accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day.

This guideline is consistent with the existing Australian Physical Activity recommendations [10], as well as the Canadian, US, UK and WHO guidelines. It is further supported and informed by the evidence from this systematic review which supports that 60 minutes of moderate-to-vigorous physical activity is needed daily. That is, the level of evidence for each health outcome was either sufficient to endorse the existing guidelines or insufficient to suggest that the existing guidelines should be changed. This was especially the case for outcomes where the highest level of evidence was found (cardiometabolic, adiposity, skeletal health, mental health, and cardiorespiratory fitness – all Level 1 evidence for both children and adolescents). Other points of consideration when formulating this recommendation were ease of surveillance and understanding.

2) This should include: a variety of aerobic activities.

This reinforces that a range of activities are preferred for the general population (rather than only 1-2 different types) and is in line with the literature on what motivates children and young people to be physically active. It also takes into consideration the many different contexts in which physical activity could and should occur and that different types of activities provide different, but important, health benefits. The evidence for this was based on the Canadian Systematic Review [7] which assigned a Level 2, Grade A for this sub-recommendation and our systematic review which assigned a Level 1 for the effect of physical activity on cardiorespiratory fitness.

3) Including some vigorous-intensity activity.

There is evidence from both existing systematic reviews and from our updated systematic review that vigorous-intensity activity provides health and other developmental benefits, and that these benefits may be additional to those found for lower intensity activity (such as light and moderate) (the “more is better than some” evidence).

In our opinion, the evidence is not sufficient to recommend a “dose” of vigorous-intensity physical activity (for example, three times per week). As such, the proposed guidelines will vary from those in other jurisdictions (which have recommended a dose of three days/times per week). We have based this decision on the following factors:

- I. The systematic review that informed the Canadian Physical Activity Guidelines (Janssen & LeBlanc, 2010) was not able to recommend a dose of vigorous intensity activity based on the evidence. They were only able to assign a Level 3, Grade B level of evidence for vigorous–intensity activity based on the “limited amount of evidence and the inconsistency in the evidence that is available” (pp. 12-13). This review recommended that “vigorous-intensity activities should be incorporated or added when possible” (p. 1) based on the premise that “more is better than some” which is consistent with our proposed guideline recommending including some vigorous intensity activity.
- II. The evidence cited in the U.S. guideline for vigorous-intensity activity was somewhat weak and reliant on cross-sectional studies.

- III. When the updated systematic review for the existing Australian recommendations was completed, there was not sufficient evidence to support a specific recommendation for vigorous intensity activity.
- IV. Our systematic review found that there was evidence that vigorous-intensity physical activity was associated with positive effects on a range of health and developmental outcomes. However, there was not sufficient evidence to recommend a specific dose for vigorous intensity activity.
- V. Based on the existing evidence from the above systematic reviews and the update for the proposed guidelines, it is our opinion that whilst there is evidence to support a stand-alone recommendation to include some vigorous intensity activity, the evidence is not sufficiently robust to recommend a dose for this intensity of activity.

4) On at least three days per week, children should engage in activities that strengthen muscle and bone.

The Guideline Development Committee endorsed the evidence that was used in including this sub-recommendation in the Canadian, US, and WHO Guidelines and believed it was robust enough, in addition with our updated review, to include a sub-guideline. The evidence for this was based on the Canadian systematic review [7] which assigned a Level 2, Grade A to this sub-recommendation and our updated review which assigned a Level 1 for the outcomes of skeletal health in children and adolescents and muscular health in children.

5) More activity – up to several hours per day – is associated with additional health benefits.

This reinforces the evidence that more physical activity above and beyond the 60 minutes per day will provide additional benefits (more is better than some). The up to several hours per day (defined as three) reinforces that there is an upper limit, beyond which the risks of participation increase (defined as intensive participation). This is consistent with the evidence of a dose-response relationship from observational studies [7] suggesting that more activity is better than some but that the relationship is curvilinear – that is, there is a point where additional activity may increase the risk of injury and not provide additional health benefits. Existing international guidelines and existing Australian guidelines include “up to several hours” as the upper daily limit which we endorse and suggest should be interpreted as three hours per day.

Brief Recommendations to Support Public Health Messaging & Promotion of the New Australian Physical Activity Guidelines for Children and Young People:

The following brief recommendations are based on the principles of social marketing communications [125], a recent systematic review of approaches to constructing physical activity public health messages [126] and the recent Canadian experience of translating the Canadian Physical Activity Guidelines into public health communications [127]. In line with these, an Australian health messaging strategy to accompany the development of the new Physical Activity Guidelines for Children and Young People should:

- Offer specific content about the type and amount of activity recommended for each age group;
- Be designed for specific population audiences and targeted at those specific groups (e.g. children, adolescents, parents, schools, government and non-government organisations). Further tailoring could also be considered on the basis of factors such as demographics (e.g. gender), motivation (e.g. readiness to change) and health

- literacy (including consideration of groups in Australia such as indigenous and culturally and linguistically diverse populations);
- Be based on an understanding of the preferences for, and barriers to, increasing physical activity (or reducing sedentary behaviours) that are meaningful to the target audiences;
 - Provide persuasive 'gain-framed' messages that encourage specific target audiences towards meeting the new guidelines; including the promotion of valued short term outcomes that are attractive to the audience (e.g. improved physical appearance for adolescents);
 - Maximise novelty and appeal to encourage messages being 'tuned into' and remembered;
 - Promote ways to assist the target audiences to overcome barriers to adoption such as including 'how-to' information, or use of vignettes or case studies modelling success, to foster self-efficacy;
 - Be tested with the target audience to ensure salience and acceptability
 - Utilise targeted and appropriate media and distribution channels relevant to 'reaching' the different target audiences (e.g. print, internet, mobile, TV, Radio);
 - Consider the use of appropriate 'messengers' to whom the audience can relate, and in situations where the target audiences can 'engage' with the messages;
 - Be evaluated in regards to whether the messages reach their target audiences, change knowledge and awareness of the new guidelines, impact on self-efficacy to adopt recommended behaviours, and impact on intentions to change physical activity or sedentary behaviours;
 - Be implemented on the basis of the understanding that the development and distribution of 'messages', will require incorporation into a comprehensive "social marketing approach" if adoption and adherence to the recommended behavioural guidelines is to be achieved.

These recommendations are consistent with contemporary understandings that whilst public health messages can create awareness of the benefits of adopting a behaviour (such as increased physical activity), they are insufficient to bring about behaviour change in the absence of other elements of the marketing mix (i.e., 'on-the-ground' activities and resources to facilitate behaviour change).

Future research needs, including next steps in policy development:

Following a review of the evidence, the Guideline Development Committee have been identified several areas as future research priorities. These include:

1. A need for greater use of objective measures of physical activity (e.g., accelerometry) in longitudinal studies.
2. More high quality evidence that examines the dose-response relationship between physical activity and health outcomes. For example, variations of frequency, intensity, time and type should be included in randomised controlled trials.
3. The health outcome of sleep should be incorporated into future research on the health impact of physical activity.
4. Greater evidence is needed on the impact of physical activity on mental health.

There are several important research areas that will impact upon Physical Activity Guideline policy and development. Research is especially needed into how the Guidelines will be communicated. For example, what is the effectiveness of positively versus negatively framed

guidelines, or paper versus television versus social media as a dissemination tool? This should incorporate research into social marketing in the area of physical activity.

It is recommended that these Guidelines be integrated into all relevant Government policies and programs. It is recommended that physical activity guidelines should be updated every 5 years [124]. This is based on the rate at which new evidence is emerging in this area. Thus, a review of the evidence and the Australian Physical Activity Guidelines for Children and Young People is recommended to occur in 2017

Monitoring/surveillance compliance

It is important that these proposed guidelines are regularly monitored on a national level. The current Australian Health Survey will be able to monitor compliance with the first of the proposed guidelines (accumulate at least 60 minutes of moderate- to vigorous-intensity physical activity every day) in both children and young people. We suggest that the “every day” component of this guideline be interpreted as 7 days in the past week for monitoring compliance with this guideline.

The second proposed guideline (Children and Young People’s physical activity should include a variety of aerobic activities, including some vigorous-intensity activity) and third proposed guideline (on at least three days per week, children and young people should engage in activities that strengthen muscle and bone) are not able to be monitored for compliance using the questions in the current Australian Health Survey. It is recommended that specific questions and objective monitoring of physical activity using accelerometry (which will be able to differentiate between different intensities of physical activity) be incorporated into future waves of this Survey.

APPENDIX A: Glossary of Key Terms

Relevant definitions (adapted from Tremblay et al. [128] and [http://www.csep.ca/CMFiles/Guidelines/PAGuidelinesGlossary E.pdf](http://www.csep.ca/CMFiles/Guidelines/PAGuidelinesGlossary_E.pdf)):

Academic achievement and cognitive development: This includes measures such as language development and attention, typically measured using cognitive assessments. These outcomes may also be measured through parent, caregiver or teacher proxy. Academic achievement is typically measured through school grades.

Adiposity (including the prevention of unhealthy weight gain): Outcomes of adiposity and unhealthy weight gain include multiple measures of overweight, obesity and fat mass. This includes measures of Body Mass Index, measures of waist circumference, and clinical measures of obesity including skin-folds, and dual energy x-ray absorptiometry.

Aerobic Activity: Activities that typically use the larger muscle groups over an extended period of time, and where energy is supplied by the oxygen utilising process. Example activities include jogging, swimming, and cycling.

Cardiometabolic health: Cardiometabolic health indicators are measured in a variety of different ways. Indicators may cluster or be presented individually. Indicators include: plasma lipids and lipoprotein concentrations (e.g. HDL-cholesterol, triglycerides), hypertension, fasting glucose, insulin resistance and inflammatory markers (e.g. C-reactive protein).

Cardiorespiratory fitness: Fitness includes a variety of measures that include measures of lung capacity (VO₂ max), cardiac function (e.g. resting heart rate), and measures of physical fitness (e.g. shuttle run test or one-mile run).

Conduct behaviour/pro-social behaviour: This includes a wide range of social behaviours that fall into either prosocial and antisocial behaviours. Measures are highly varied within this outcome.

Frequency: The number of times an exercise or activity is performed. Frequency is generally expressed in sessions, episodes, or bouts per day or week.

High-risk behaviours: High risk behaviours include measures of substance use and substance abuse, including alcohol and drug use, and smoking. This outcome may also include high risk sexual behaviours and other risk-taking behaviours.

Intensity: Refers to the rate of energy expended during an activity.

Mental health: Mental health encompasses the absence of mental illness and the presence of wellbeing. This may be measured as reductions in levels of mental illnesses (which may be clinical or subclinical) such as depression or anxiety. Measures will also include positive measures such as quality of life, wellbeing or happiness, and self-esteem.

Motor development: This outcomes includes the development of motor skill proficiency, coordination, and balance. There are a wide range of measures used to assess motor skill development.

Muscular health: Muscular health includes outcomes pertaining to muscle strength/power (e.g. one repetition max), muscle endurance (e.g. sit up or push up tests), and flexibility (e.g. sit and reach test).

Negative health outcomes: These are the negative outcomes directly associated with participation in physical activity and include injuries (including fractures and overuse injuries) and burnout.

Physical activity: Bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure. Moderate- to vigorous-intensity physical activity (MVPA) is activity equivalent to ≥ 3 METS (e.g., brisk walking pace).

Metabolic equivalents (METS): Unit of energy expenditure where 1 MET is equal to resting energy expenditure (3.5 ml O₂/kg/min).

Physically active: meeting established guidelines for physical activity (see Australian guidelines at <http://www.health.gov.au/internet/main/publishing.nsf/content/health-pubhlth-strateg-phys-act-guidelines>)

Physically inactive: not meeting established guidelines for physical activity.

Respiratory health: Includes physiological improvements to the respiratory system, as well as improvements in respiratory symptoms such as wheezing.

Skeletal health: Measures of bone and skeletal health include bone mineral density (BMD), and bone mineral content (BMC) which are measured using dual energy x-ray absorptiometry.

Time (duration): The length of time in which physical activity is performed. Duration is generally expressed in minutes.

Type (mode): The type of activity that the individual is engaging in.

APPENDIX B – An Overview of the AGREE Process

Adapted from Tremblay and Haskell [124].

| Stage | Task |
|--------------|---|
| 1 | Assemble a leadership team to oversee the development process. |
| 2 | Put in place assessment procedures to assess the development process. |
| 3 | Establish an expert advisory committee to drive the development process. |
| 4 | Domestic and international scan to ensure international and interjurisdictional harmonisation. |
| 5 | Review of the existing literature. |
| 6 | Interpretation of the findings of the literature review. |
| 7 | Identification of research gaps from the literature review. |
| 8 | Consultation of stakeholder organisations to establish consensus of the scientific recommendations. |
| 9 | Knowledge translation strategy, including language, presentation, communication and dissemination strategies. |
| 10 | Comprehensive evaluation of the guideline development process and the impact of guidelines. |
| 11 | Plan for updates and revision of the guidelines. |

Appendix C – The Search Strategy Used

| Database: | | Date of Search: | |
|-----------|---|----------------------|---------|
| # | Search Terms | Date Limit | Results |
| 1 | “Physical activity” OR fitness OR exercise OR “energy expenditure” OR “vigorous activity” OR mvpa OR “resistance training” OR “circuit training” OR “strength training” OR “locomotor activity” | None | |
| 2 | “Metabolic syndrome” OR “insulin resistance” OR “cardiovascular disease” OR cardiometabolic OR “heart disease” OR “vascular disease” OR cholesterol OR hypercholesterol* OR hyperlipid* OR “blood pressure” OR hypertension OR “deadly quartet” OR “plurimetabolic syndrome” OR lipoprotein OR triglyceride OR diabetes OR “c-reactive protein” | Feb 2008 - present | |
| 3 | Adiposity OR obes* OR overweight OR “body fat” OR “body composition” OR “waist circumference” OR “skin?fold “OR “body mass index” OR “body weight“ | Feb 2008 - present | |
| 4 | “Skeletal health” OR “bone density” OR “bone strength” OR “bone mass” OR “bone health” OR “bone mineral density” | Feb 2008 - present | |
| 5 | “Musc* health” OR “musc* fitness” OR “musc* strength” OR “explosive strength” OR “maximal strength” OR “musc* endurance” OR flexibility | March 2002 - present | |
| 6 | depression | Feb 2008 - present | |
| 7 | “Self concept” OR “self esteem” OR stress OR anxiety | March 2002 - present | |
| 8 | “Mental health” OR wellbeing OR “emotional health” OR “psychological health” OR “psychosocial health” OR “mental illness” OR “mental disorder” OR “psychiatric disorder” OR “satisfaction with life” OR “social isolation” OR “social discrimination” OR “quality of life” | None | |
| 9 | Injur* | Feb 2008 - present | |
| 10 | Overtraining OR overuse | March 2002 - present | |
| 11 | Alcohol OR drug OR drinking OR substance | None | |
| 12 | “Academic achievement” OR “educational achievement” OR “school admission criteria” OR “grade point average” OR “average grade” OR “school performance” OR “school dropout” | March 2002 - present | |

| | | | |
|----|---|----------------------|--|
| | OR "academic performance" | | |
| 13 | Cognition OR "cognitive function" OR "cognitive development" OR attention OR concentration OR "executive function" OR memory OR "learning disorders" | None | |
| 14 | "Child behavi* disorder" OR "conduct disorder" OR "behavi* conduct" OR "prosocial behavi*" OR "antisocial behavi*" OR aggression OR "social behavi*" | None | |
| 15 | "Fundamental movement skills" OR "fundamental motor skills" OR "motor development" OR "motor skills" OR coordination OR psychomotor OR "motor performance" | None | |
| 16 | "Physical fitness" OR "physical conditioning" OR "cardiovascular fitness" OR "cardiorespiratory fitness" OR "aerobic fitness" OR "heart rate" OR "lung capacity" OR "physical endurance" OR "lung volume" OR "respiratory health" OR "respiratory fitness" OR "vo2 max" | March 2002 - present | |
| 17 | Asthma OR wheezing OR bronchitis OR respiratory | None | |
| 18 | 2 OR 3 OR 4 OR 5 OR 6 OR 7 OR 8 OR 9 OR 10 OR 11 OR 12 OR 13 OR 14 OR 15 OR 16 OR 17 | | |
| 19 | 1 AND 18 | | |
| 20 | Child OR adolescen* OR "school aged" OR youth OR juvenile OR teenage OR "young person" OR teen OR preteen | None | |
| 21 | 19 AND 20 | | |

APPENDIX D – Articles included in the Systematic Review

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APPENDIX E – Survey Material used for Online Review.

[Presentation of the Draft Preamble to the Physical Activity Guidelines for Children]

Please indicate whether you agree or disagree with Draft Preamble.

- 1 – Completely Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Completely Agree

Are there any words in the Preamble that require a definition?

[Presentation of the Draft Physical Activity Guidelines for Children]

Please indicate whether you agree or disagree with Draft Physical Activity Guidelines.

- 1 – Completely Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Completely Agree

If you have any comments, you can write them here.

[Presentation of the Draft Preamble to the Physical Activity Guidelines for Young People]

Please indicate whether you agree or disagree with Draft Preamble.

- 1 – Completely Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Completely Agree

Are there any words in the Preamble that require a definition?

[Presentation of the Draft Physical Activity Guidelines for Young People]

Please indicate whether you agree or disagree with Draft Physical Activity Guidelines.

- 1 – Completely Disagree
- 2 – Disagree
- 3 – Neutral
- 4 – Agree
- 5 – Completely Agree

If you have any comments, you can write them here.

Physical Activity Guidelines are an important component of public health.

- 1 – Completely Disagree
- 2 – Disagree

- 3 – Neutral
- 4 – Agree
- 5 – Completely Agree

Should the Physical Activity and Sedentary Behaviour Guidelines be combined for dissemination? That is, appear in the same or separate documents?

Same document

Separate document

Do you have any other comments?

What is your gender?

Male

Female

What is your age range?

Under 18

18-24

25-34

35-54

55-64

65 +

In which sector are you currently employed?

Consulting

Education/University

Government

Healthcare/Medical

Non-profit

Research/Science

Other

In which country do you currently reside?

If you currently reside in Australia, in which state/territory is your primary residence?

APPENDIX F – Summary of Online Comments and Guideline Development Committee Responses.

| COMMENT | COMMITTEE RESPONSE |
|---|---|
| Provide examples of aerobic activities, moderate-intensity and vigorous-intensity activities, resistance-based activities, and weight-bearing activities. | The need for clarification was acknowledged. However, no changes were made because the Preamble is a scientific statement aimed at an informed stakeholder audience. Examples of these activities were recommended for public health messaging. |
| Are the “greater amounts of physical activity...” mentioned in sentence two (paragraph 4) about greater amounts of resistance-based and weight-bearing activity mentioned in sentence one (paragraph 4) or about greater amounts of any activity generally? | The sentence “There is some evidence that benefits to cardiometabolic and musculoskeletal health are associated with resistance-based and weight-bearing activity on at least three days per week” was moved from the 1 st sentence to the second-to-last sentence of the fourth paragraph of the Preamble. This was done in order to clarify that “greater amounts of physical activity...” is a general statement, and does not relate specifically to resistance-based and weight-bearing activities. |
| Non-organised sports should be included as an example of physical activity in the Preamble for Children, as in the Preamble for Young People. | “and non-organised sports” was added immediately after “organised sports” to reflect a more holistic understanding of the ways in which physical activity may occur, and to maintain consistency between the age groups. |
| It may be beneficial to make reference to overall wellbeing in addition to mental health (which can often be interpreted as mental illness only). | “wellbeing” was added to the health outcome of “mental health” so that it read “mental health and wellbeing”. |
| Place active play and leisure before physical education - this may help to place an importance on these activities. | “Physical education” was moved to the latter part of the same sentence, and the word “some” was removed from the sentence. |
| It makes more sense to have the vigorous physical activity statement before the resistance training statement. | This has been swapped. |
| The asterisk relating to conditions should also refer to disabilities – the lead-in sentence says regardless of ability – but this may not always be true. | The Committee acknowledged the comment, and decided not to change the Preamble. However, the Committee believed that physical activity is appropriate regardless of ability, pending medical advice as per the asterisk relating to conditions. |
| The adult guidelines recommend strength-based activities on 2 days per week. These guidelines (for children) recommend strength-based activities on 3 days per week. If this is a difference between adults and children this should be made clear. | The Committee believed that this was clear because these guidelines are specific to children and young people. |
| Replace the semi-colon in the second statement (of the guidelines) with a comma. | Within bullet point number 2, the semicolon “;” was changed to a comma “,”. |
| The fourth guideline reads as a statement (and not a guideline). | This has been changed to: To achieve additional health benefits children should engage in more activity – up to several hours per day. This will allow consistency between all four guidelines. |
| What does “up to several hours” mean? Is this 3 to 4, or 1 to 2 hours? Is this in addition to the 60 minutes guideline? | The Committee acknowledged the need for clarity. However, given that there is a lack of evidence upon which to specify an upper limit, the more general “up to several hours” was deemed sufficient. |

| COMMENT | COMMITTEE RESPONSE |
|--|--|
| The sentence around activities of daily living is unclear. | The sentence “This is in addition to the physical activities accumulated during routine activities of daily living (incidental activity)” was changed to the more understandable “This is in addition to the routine activities accumulated during daily living (incidental physical activity)”. |
| There is a difference within the outcome of “adiposity” in the physical activity guidelines, which is referred to as “body composition” in the sedentary behaviour guidelines. | The health outcome “adiposity” was changed to “body composition” to maintain consistency with the Sedentary Behaviour Guidelines. |

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