Department of Health & Social Care

Llywodraeth Cymru
Welsh Government

Department of Health
An Roinn Sláinte
Männystrie O Poustie
www.health-ni.gov.uk

Scottish Government
Riaghaltas na h-Alba
gov.scot

UK Chief Medical Officers' Physical Activity Guidelines

Published 7 September 2019

Contents

Foreword by the Chief Medical Officers 3
Acknowledgements 5
Executive Summary 7
Introduction 12
Under 5s Physical Activity Guidelines 21
Children and Young People Physical Activity Guidelines 24
Adults Physical Activity Guidelines 29
Older Adults Physical Activity Guidelines 39
Conclusion 45
Annex A: Glossary 46
Annex B: Expert Working Groups and Methods 48
Annex C: References 54

Foreword by the Chief Medical Officers

Professor Dame Sally C Davies
Chief Medical Officer, England

Dr Frank Atherton
Chief Medical Officer/Medical Director NHS Wales

Dr Michael McBride
Chief Medical Officer, Northern Ireland

Dr Catherine Calderwood
Chief Medical Officer, Scotland

In 2010, we were among the first Nations in the world to set out the evidence for how much and what kinds of physical activity we need to do to keep ourselves healthy.

Since then, the evidence has become more compelling and the message is clear:

> "If physical activity were a drug, we would refer to it as a miracle cure, due to the great many illnesses it can prevent and help treat."

Physical activity is not just a health issue. It brings people together to enjoy shared activities and contributes to building strong communities whilst supporting the economy to grow.

These physical activity guidelines update the 2011 guidelines across all age groups. We have also drawn on new evidence to develop additional guidance on being active during pregnancy and after giving birth, and for disabled adults.

We want as many people as possible to make use of these guidelines to work towards and achieve the recommended activity levels. With that in mind, we have developed updated infographics to help bring these guidelines to life and make them easy for everyone to use.

Being active every day provides a foundation for a healthier and happier life. The recommendations we made in 2011 on muscle strength have not achieved the recognition we believe they merit. We therefore want to underline the importance of regular strength and balance activities: being strong makes all movement easier and increases our ability to perform normal daily tasks.

We want this report to be a catalyst for change in our attitudes to physical activity. Our environment can make it difficult to be healthy and our health is being damaged by inactivity. But the good news is that even small changes can make a big difference over time, such as using the stairs for a couple of floors rather than taking the lift or getting off the bus a stop early and walking the rest of the way.

You always feel better for being active. We want as many people as possible to protect their future health and start their journey to a healthier life now.

September 2019

Acknowledgements

We would like to give special thanks for the support we have received from the Centre for Exercise, Nutrition and Health Sciences, School for Policy Studies at the University of Bristol and the leadership provided by Dr Charlie Foster.

We would like to thank the contributing authors and members of our UK Chief Medical Officer (CMO) Guidelines Writing Group and the members of the expert working groups (listed in Annex B). Their ongoing advice and support have been invaluable.

UK CMO Guidelines Writing Group

- Chair: Dr Charlie Foster, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies, University of Bristol, England
- Under 5s: Professor John Reilly, School for Psychological Sciences and Health, University of Strathclyde Glasgow, Scotland
- Children & Young People: Professor Russell Jago, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies, University of Bristol, England
- Adults: Professor Marie Murphy, Doctoral College and Sport & Exercise Sciences Research Institute, Ulster University, Northern Ireland
- Older Adults: Professor Dawn Skelton, Centre for Living, School of Health & Life Sciences, Glasgow Caledonian University, Scotland
- Sedentary Behaviour: Professor Ashley Cooper, Centre for Exercise, Nutrition & Health Sciences, School for Policy Studies, University of Bristol, England
- Sedentary Behaviour: Dr Richard Pulsford, Sport and Health Sciences, University of Exeter
- Disability: Professor Brett Smith, School of Sport and Exercise Sciences, Durham University, England
- Communications & Surveillance: Professor Nanette Mutrie, Physical Activity for Health Research Centre (PAHRC), Institute for Sport, Physical Education and Health Sciences (ISPEHS), The University of Edinburgh, Scotland

Thanks also to Kate Willis (Centre for Exercise, Nutrition and Health Sciences, School for Policy Studies, University of Bristol); Catherine Falconer (England Chief Medical Officer's office); and Scottish Physical Activity Research Connections (SPARC), who all contributed to the report and/or to the Scientific Consensus meetings; as well as to the UK policy leads

for physical activity of the four home countries for their contributions. Our thanks to our UK External Reviewers: Professors Melvyn Hillsdon, Gareth Stratton, Alan Batterham, and Dr Simon Williams.

Finally, a special thanks to the UK Government Department of Health of Social Care and Active Scotland Division of the Scottish Government, in particular Beelin Baxter and Caspian Richards who project managed this work on behalf of the four home countries, supported by Fiona Cunnah and Ian McClure. We would like to also acknowledge support provided by Sport England and Dr Mike Brannan at Public Health England.

Executive Summary

This report presents an update to the 2011 physical activity guidelines issued by the four Chief Medical Officers (CMOs) of England, Scotland, Wales and Northern Ireland. The UK CMOs draw upon global evidence to present guidelines for different age groups, covering the volume, duration, frequency and type of physical activity required across the life course to achieve health benefits.

Since 2011, the evidence to support the health benefits of regular physical activity for all groups has become more compelling. In children and young people, regular physical activity is associated with improved learning and attainment, better mental health and cardiovascular fitness, also contributing to healthy weight status. In adults, there is strong evidence to demonstrate the protective effect on physical activity on a range of many chronic conditions including coronary heart disease, obesity and type 2 diabetes, mental health problems and social isolation. Regular physical activity can deliver cost savings for the health and care system and has wider social benefits for individuals and communities. These include increased productivity in the workplace, and active travel can reduce congestion and reduce air pollution.

Our understanding of the relationship between physical activity and health has grown. In general, the more time spent being physically active, the greater the health benefits. However, we now know that even relatively small increases in physical activity can contribute to improved health and quality of life. As such, although we recommend that all individuals work towards achieving these guidelines, they are not absolute thresholds and we recognise the benefits that can be achieved at levels both above and below the thresholds.

This report emphasises the importance of regular activity for people of all ages, and for the first time presents additional guidance on being active during pregnancy, and after giving birth, and for disabled adults. These new guidelines are broadly consistent with previous ones, while also introducing some new elements and allowing for more flexibility in achieving the recommended levels of physical activity for each age group.

This report underlines the importance of all age groups participating in a range of different activities. Considering the importance of strength for physical function, particularly later in life, we did not feel the 2011 recommendations on strengthening activities were given the merit they deserve. In childhood, strengthening activities help to develop muscle strength and build healthy bones, while in adults and older adults they help to maintain strength and delay the natural decline in muscle mass and bone density which occurs from around 50 years of age. The new guidelines reinforce the importance of these types of activities for all age groups and highlight the additional benefit of balance and flexibility exercises for older adults.

The report also highlights the risks of inactivity and sedentary behaviour for health. There have been notable developments in the evidence base for the health effects of sedentary time in adults, with research suggesting sitting time is associated with all-cause and cardiovascular mortality, and cancer risk and survivorship. Similar effects are seen in children where sedentary behaviour is associated with cardiovascular fitness and obesity. In all groups, the relationships of sedentary behaviour and health occur independently of moderate-to-vigorous physical activity (MVPA) for some health outcomes. Prolonged sitting is harmful, even in people who achieve the recommended levels of MVPA. Despite this, the evidence does not currently support including a specific time limit or minimum threshold of sedentary time within these guidelines.

This report recognises an emerging evidence base for the health benefits of performing very vigorous intensity activity performed in short bouts interspersed with periods of rest or recovery (high intensity interval exercise, HIIT). The available evidence demonstrates that high intensity interval exercise has clinically meaningful effects on fitness, body weight and insulin resistance, and can be as or more effective than MVPA. This option has therefore been incorporated into the recommendation for adults.

These new guidelines allow greater flexibility for how and when children and young people can achieve the recommended levels of physical activity across the week. Contrary to 2011, the current evidence does not support a specific minimum daily threshold of 60 minutes of MVPA for health benefits, and instead recommends an average number of 60 daily minutes to be achieved across the week.

Evidence now demonstrates that there is no minimum amount of physical activity required to achieve some health benefits. The previous requirement for a 10-minute bout of activity is no longer valid and is no longer included. However, specific targets - such as aiming to do at least 10 minutes at a time - can be effective as a behavioural goal for people starting from low levels of activity

We present the new guidelines following a life course approach with a separate chapter for the age groups covered in the report: Under-5s, Children and Young people (5-18 years), Adults (19-64 years), and Older Adults (65+). Each chapter includes an introduction, sets out the guidelines for that age group, summarises the evidence to support the new guidelines, and outlines any changes made since 2011.

We hope these guidelines will be read by health professionals, policy makers and others working to promote physical activity, sport, exercise and active travel. The guidelines are designed to aid health professionals and others to provide individuals and communities with information on the type and amount of physical activity that they should undertake to improve their health.

Summary of Guidelines by age group

Under-5s

Infants (less than 1 year):

- Infants should be physically active several times every day in a variety of ways, including interactive floor-based activity, e.g. crawling.

- For infants not yet mobile, this includes at least 30 minutes of tummy time spread throughout the day while awake (and other movements such as reaching and grasping, pushing and pulling themselves independently, or rolling over); more is better.

NB: Tummy time may be unfamiliar to babies at first, but can be increased gradually, starting from a minute or two at a time, as the baby becomes used to it. Babies should not sleep on their tummies.

Toddlers (1-2 years):

- Toddlers should spend at least 180 minutes (3 hours) per day in a variety of physical activities at any intensity, including active and outdoor play, spread throughout the day; more is better.

Pre-schoolers (3-4 years):

- Pre-schoolers should spend at least 180 minutes (3 hours) per day in a variety of physical activities spread throughout the day, including active and outdoor play. More is better; the 180 minutes should include at least 60 minutes of moderate-to-vigorous intensity physical activity.

Children and Young People (5 to 18 years)

- Children and young people should engage in moderate-to-vigorous intensity physical activity for an average of at least 60 minutes per day across the week. This can include all forms of activity such as physical education, active travel, after-school activities, play and sports.

- Children and young people should engage in a variety of types and intensities of physical activity across the week to develop movement skills, muscular fitness, and bone strength.

- Children and young people should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of not moving with at least light physical activity.

Adults (19 to 64 years)

- For good physical and mental health, adults should aim to be physically active every day. Any activity is better than none, and more is better still.

- Adults should do activities to develop or maintain strength in the major muscle groups. These could include heavy gardening, carrying heavy shopping, or resistance exercise. Muscle strengthening activities should be done on at least two days a week, but any strengthening activity is better than none.

- Each week, adults should accumulate at least 150 minutes (2 1/2 hours) of moderate intensity activity (such as brisk walking or cycling); or 75 minutes of vigorous intensity activity (such as running); or even shorter durations of very vigorous intensity activity (such as sprinting or stair climbing); or a combination of moderate, vigorous and very vigorous intensity activity.

- Adults should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of inactivity with at least light physical activity.

Older Adults (65 years and over)

- Older adults should participate in daily physical activity to gain health benefits, including maintenance of good physical and mental health, wellbeing, and social functioning. Some physical activity is better than none: even light activity brings some health benefits compared to being sedentary, while more daily physical activity provides greater health and social benefits.

- Older adults should maintain or improve their physical function by undertaking activities aimed at improving or maintaining muscle strength, balance and flexibility on at least two days a week. These could be combined with sessions involving moderate aerobic activity or could be additional sessions aimed specifically at these components of fitness.

- Each week older adults should aim to accumulate 150 minutes (two and a half hours) of moderate intensity aerobic activity, building up gradually from current levels. Those who are already regularly active can achieve these benefits through 75 minutes of vigorous intensity activity, or a combination of moderate and vigorous activity, to achieve greater benefits. Weight-bearing activities which create an impact through the body help to maintain bone health.

- Older adults should break up prolonged periods of being sedentary with light activity when physically possible, or at least with standing, as this has distinct health benefits for older people.

Despite the widely reported benefits of physical activity, most adults and many children across the UK are insufficiently active to meet the full set of recommendations. We want this report to act as a catalyst for a change in our attitudes to physical activity.

These guidelines present a UK-wide consensus on the amount and type of physical activity that is needed to benefit health across the life course. The guidelines have been updated using the best available evidence and reflect what we know now about the relationship between physical activity and health. The guidelines apply across the population, irrespective of gender, age or socio-economic status. We know there are clear health inequalities in relation to physical inactivity and therefore interventions to promote physical activity must consider this.

We want as many people as possible to make use of these guidelines to work towards and achieve the recommended activity levels. With that in mind, we have developed the updated infographics included in this report to help bring the guidelines to life and make them easy for everyone to use. We hope these guidelines help all individuals to become more active. The good news is that even small changes can make a big difference over time. As we say in these guidelines: some is good, more is better.

Introduction

What is the aim of this report?

This report is a UK-wide document presenting the UK Chief Medical Officers' (CMO) new Physical Activity Guidelines for different age groups, covering the volume, duration, frequency and type of physical activity required across the life course to achieve general health benefits. The guidelines present thresholds for the achievement of optimal health benefits at the recommended levels of physical activity in terms of strength, moderate and vigorous physical activity, and balance activities.

Who is this report for?

The main intended audience for this report is professionals, practitioners and policymakers from a wide range of organisations concerned with formulating and implementing policies and programmes that promote physical activity, sport, exercise and active travel to achieve health gains. These groups will want to adapt the messages and recommendations in this report to suit the specific needs and interests of those they are working with and the context they are working in.

A UK Communications Working Group is being established to provide advice on approaches to communicating these messages and recommendations to the wider public, and on disseminating the guidelines to a wide range of stakeholders.

Principles

Physical activity for good health and wellbeing

Regular physical activity provides a range of physical and mental health benefits. These include reducing the risk of disease, managing existing conditions, and developing and maintaining physical and mental function.

The UK CMOs' guidelines provide recommendations on the frequency, intensity, duration and types of physical activity at different life stages, from early to later years. Benefits are accrued over time, but it is never too late to gain health benefits from taking up physical activity.

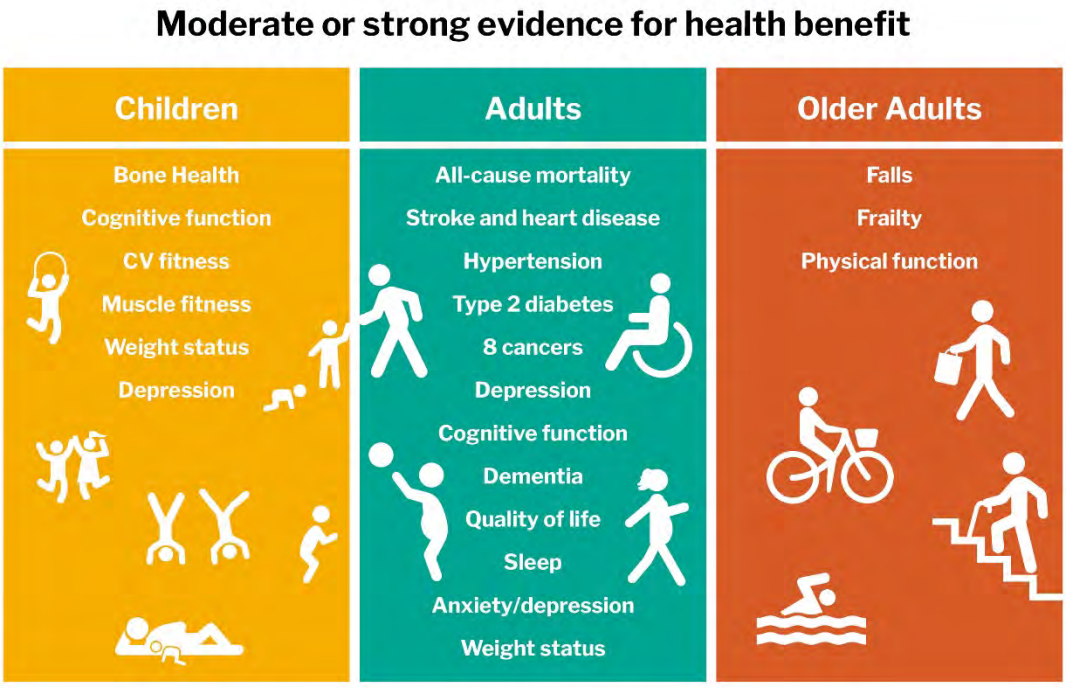


Figure 1: Cumulative health benefits of physical activity across ages. Adapted from (1)

Some is good, more is better

Although we recommend that all individuals work towards achieving these guidelines, there are no absolute thresholds: benefits are achieved at levels both below and above the guidelines.

In general, the more time spent being physically active, the greater the health benefits. However, the gains are especially significant for those currently doing the lowest levels of activity (fewer than 30 minutes per week), as the improvements in health per additional minute of physical activity will be proportionately greater.

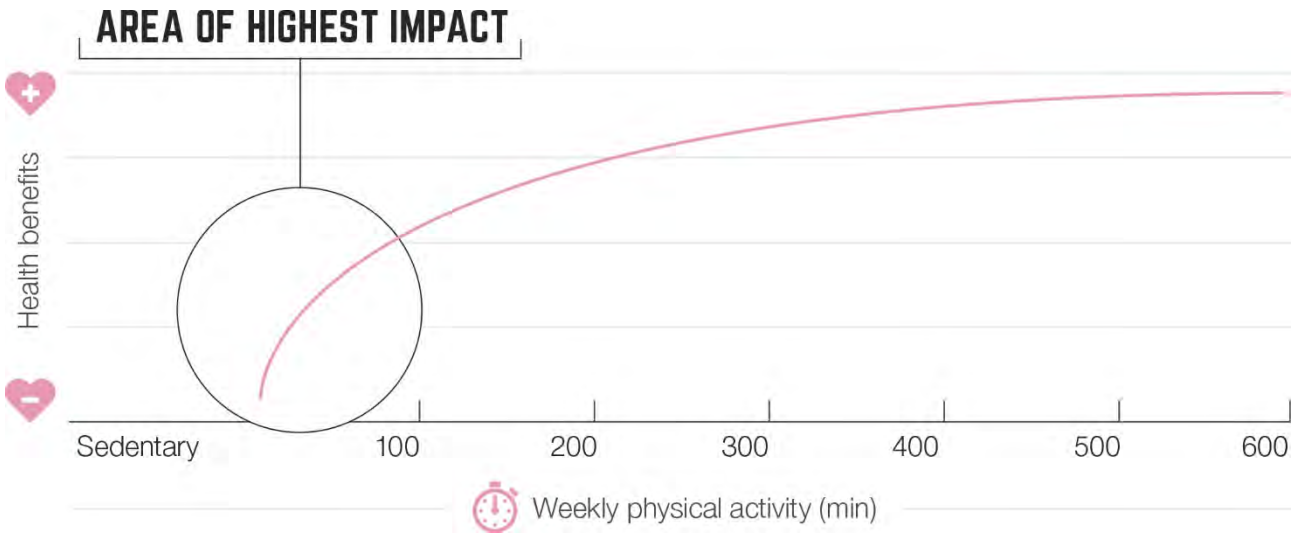


Figure 2: Dose-response curve of physical activity and health benefits. Adapted from (2)

There is no minimum amount of physical activity required to achieve some health benefits. Specific targets below the recommended levels – such as aiming to do at least 10 minutes at a time – can be effective as a behavioural goal for people starting from low levels of activity (3) (including disabled adults and those with long-term conditions), and as a step on the journey towards meeting the recommended levels set out in the UK CMOs' guidelines. Small bouts (i.e. of fewer than 10 minutes) accumulated over the day and week will also provide benefits (4).

It is recommended that people are active every day. Spreading activity across the day or week can help make the guidelines achievable within daily living; for example, walking, wheeling or cycling for daily travel is often the easiest way to get physically active.

Health benefits of different types of physical activity

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure. It takes many forms, occurs in many settings, and has many purposes (e.g. daily activity, active recreation, and sport).

Health-enhancing physical activity includes multiple types of activity: cardiovascular; muscle and bone strengthening; and balance training.

Cardiovascular activity

Cardiovascular activity, sometimes called aerobic activity, increases breathing rate and makes the heart and muscles work harder. It can be of low, moderate or vigorous intensity and is relative to an individual’s fitness. Therefore, what could be light intensity for a young

person (who is very fit and active) could be moderate or vigorous intensity for an older adult or a younger individual who is inactive and unfit.

Although activity of any intensity provides health benefits, greater intensity provides more benefit for the same amount of time. Activities need to be of at least moderate-to-vigorous intensity to achieve the full breadth of health benefits.

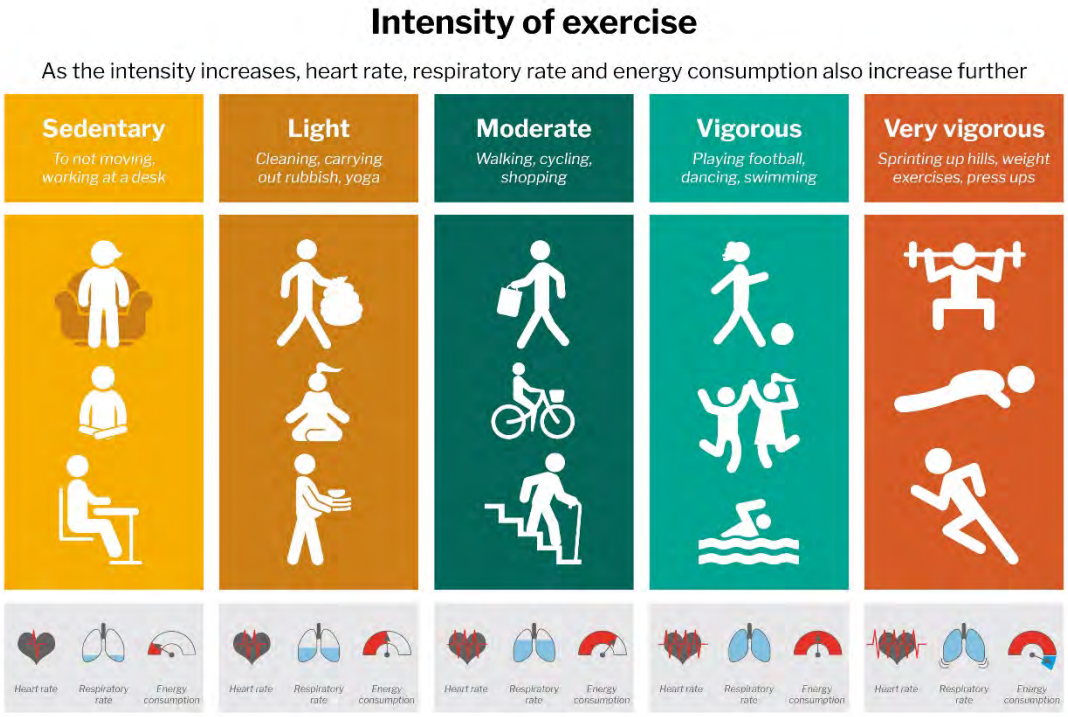


Figure 3: Types of physical activity and their intensities with examples of everyday activities and exercises - adapted from Netherlands Physical Activity Guidelines 2017 & Ainsworth et al 2017 (5)

Moderate and vigorous activity can be differentiated by the 'talk test': being able to talk but not sing indicates moderate intensity activity, while having difficulty talking without pausing is a sign of vigorous activity.

Very vigorous physical activities performed in short bursts interspersed with rest or lower intensity activity breaks, sometimes referred to as High Intensity Interval Training (HITT), have been shown to bring health benefits (6). Data on HIIT is still emerging, but evidence so far suggests benefits for a range of physiological health outcomes. Further work is needed to identify an optimal amount and form of HIIT to recommend, but overall there are clear benefits from these types of activity.

Muscle and bone strengthening and balance training activities

Muscle strength, bone health and the ability to balance underpin physical function, particularly later in life. Each attribute contributes independently to overall health and functional ability, and in combination they provide lifelong benefits.

Muscle and bone strength play a critical role in ensuring good muscular and skeletal health, and in maintaining physical function. When undertaking muscle strengthening activities, it is important to work all the major muscle groups. Bone strengthening involves moderate and high impact activities to stimulate bone growth and repair.

Strengthening activities are important throughout life for different reasons: to develop strength and build healthy bones during childhood and young adulthood; to maintain strength in adulthood; and to delay the natural decline in muscle mass and bone density which occurs from around 50 years of age, maintaining function in later life.

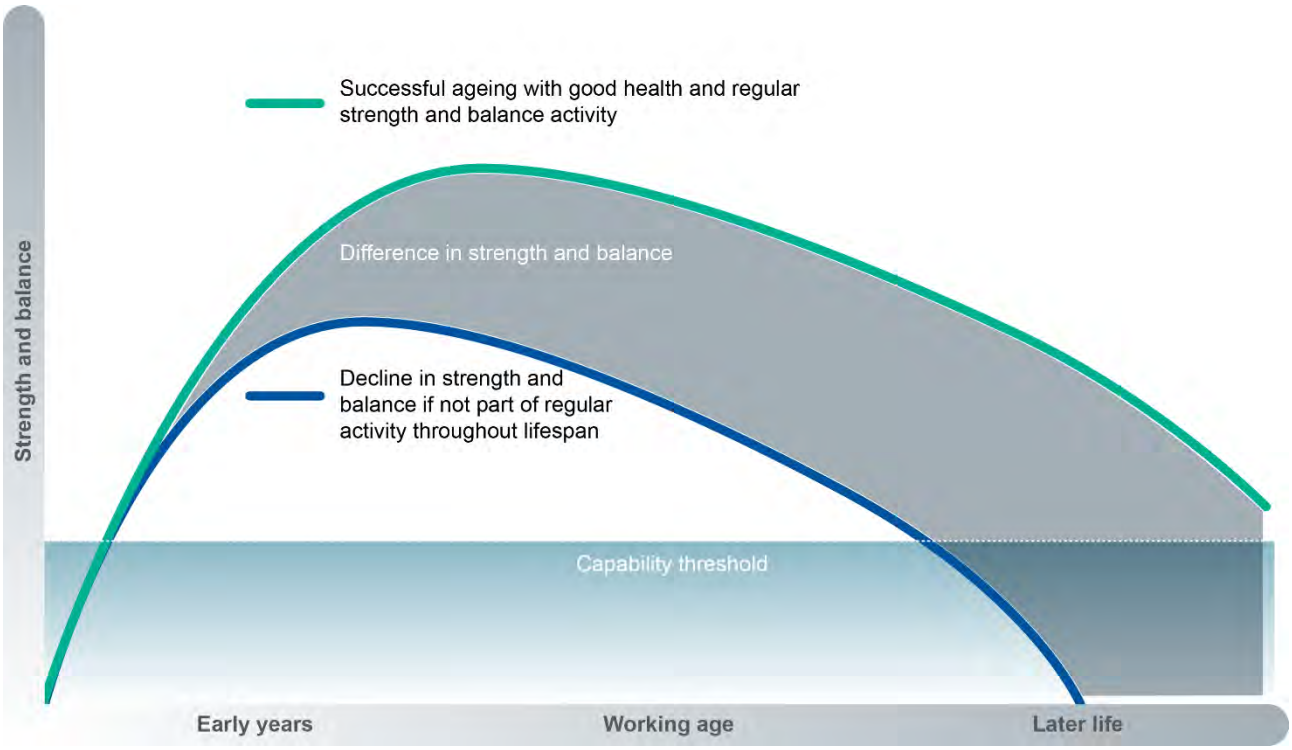


Figure 4: Physical activity for muscle and bone strength across the life course (7, 8)

Balance training involves a combination of movements that challenge balance and reduce the likelihood of falling (114).

Different activities have differential effects on muscle and bone strength and balance.

Table 2: Types of activities that can help maintain or improve aerobic capacity, strength, balance and bone health and contribute to meeting the physical activity guidelines (8)

Inactivity and sedentary behaviour

Inactive and sedentary behaviours are those which involve being in a sitting, reclining or lying posture during waking hours, undertaking little movement or activity and using little energy above what is used at rest (9). Examples of sedentary behaviours include sitting in a chair while using a screen or reading, or a child sitting in a car seat or buggy. They do not include being active while in a sitting or reclining posture, e.g. wheeling, chair exercises, or seated gym work.

Periods of inactivity or sedentary behaviour are an independent risk factor for poor health outcomes and should be minimised when possible. Extended periods should be broken up by at least light physical activity. The term ‘when possible’ is emphasized as certain groups of people who depend daily on a wheelchair, unavoidably sit for long periods of time and sitting may therefore be the norm.

The relationship between sedentary behaviour and some health outcomes varies by the amount of MVPA also undertaken. Currently there is insufficient evidence to make specific recommendations on threshold levels of activity that would mitigate the negative impacts of sedentary time.

Physical activity and weight

As the most effective way of increasing our daily energy expenditure, physical activity plays a role in maintaining a healthy weight – including the prevention of weight gain and reduction in body fat – by balancing energy intake from our dietary intake. It also plays a role in the prevention of weight regain after substantial weight loss. However, irrespective of any change in weight, people who are overweight or obese will reduce their risk of cardiovascular disease and improve their health by being physically active.

In combination with dietary change, physical activity can support weight loss.

Risks of physical activity

The risk of adverse events from physical activity is relatively low, and the health benefits accrued from such activity outweigh the risks (1). This evidence also extends now to disabled adults, with the available evidence suggesting there are no major risks of engaging in physical activity when it is performed for an appropriate duration and at an appropriate level of intensity for the individual.

Musculoskeletal injury is more common during activities which involve impact and is inversely associated with total volume of physical activity, but the relative contribution of frequency, intensity and duration are unknown. Adverse cardiac events are rare and are inversely associated with volume of regularly performed vigorous activity. Some impairment groups who use a wheelchair and who participate in upper extremity activity or overhead-sports are at risk of rotator cuff tears. Therefore, although greater exercise intensity also brings greater levels of cardiorespiratory fitness, it also carries a greater risk of injury, especially in individuals who are unaccustomed to exercise.

Fear of injury or exacerbating a health issue can be a barrier to undertaking activity, especially for those who are not regularly active, are disabled, have a health condition, are pregnant, or are older or frail. However, there is little evidence to suggest that physical activity is unsafe for anyone when performed at an intensity and in a manner appropriate to an individual’s current activity level, health status and physical function (4, 10). Starting

at low durations and intensities and building up over time as the body adjusts is the safest way to progress from inactivity to meeting the guidelines.

As the frequency and intensity of physical activity increases, there are small increases in health risk (e.g. accidents and injuries). However, the health benefits of activity far outweigh the risks of being active.

Gender and ethnicity

Although most of the evidence underlying the association between physical activity and health has been derived from studies of men, more recent evidence has confirmed similar relationships in women. At this stage there is no reason to vary the guidelines according to sex. Data for non-white populations remain more limited, but do not suggest that the relationship between physical activity and health varies by ethnicity. Therefore, there is no reason to vary the guidelines according to ethnicity.

Disability

There is growing evidence on the volume, duration, frequency and type of physical activity required to achieve general health benefits for disabled adults. The evidence is, however, largely based on studies involving people with physical impairments (mostly spinal cord injury) or intellectual impairments. In comparison, the evidence base for people with sensory impairments is limited. Nevertheless, there is no reason to vary the guidelines according to impairment type.

Wider benefits of being active

Physical activity not only promotes good health and functioning and helps prevent and manage disease; it also contributes to a range of wider social benefits for individuals and communities.

The relevance and importance of the wider benefits of physical activity for individuals vary according to life stage and various other factors but include: improved learning and attainment; managing stress; self-efficacy; improved sleep; the development of social skills; and better social interaction.

In addition to the health benefits, increasing physical activity across a population also has social, environmental and economic benefits for communities and wider society. These come primarily from physical activities undertaken in a community setting, such as walking, cycling, active recreation, sport and play.

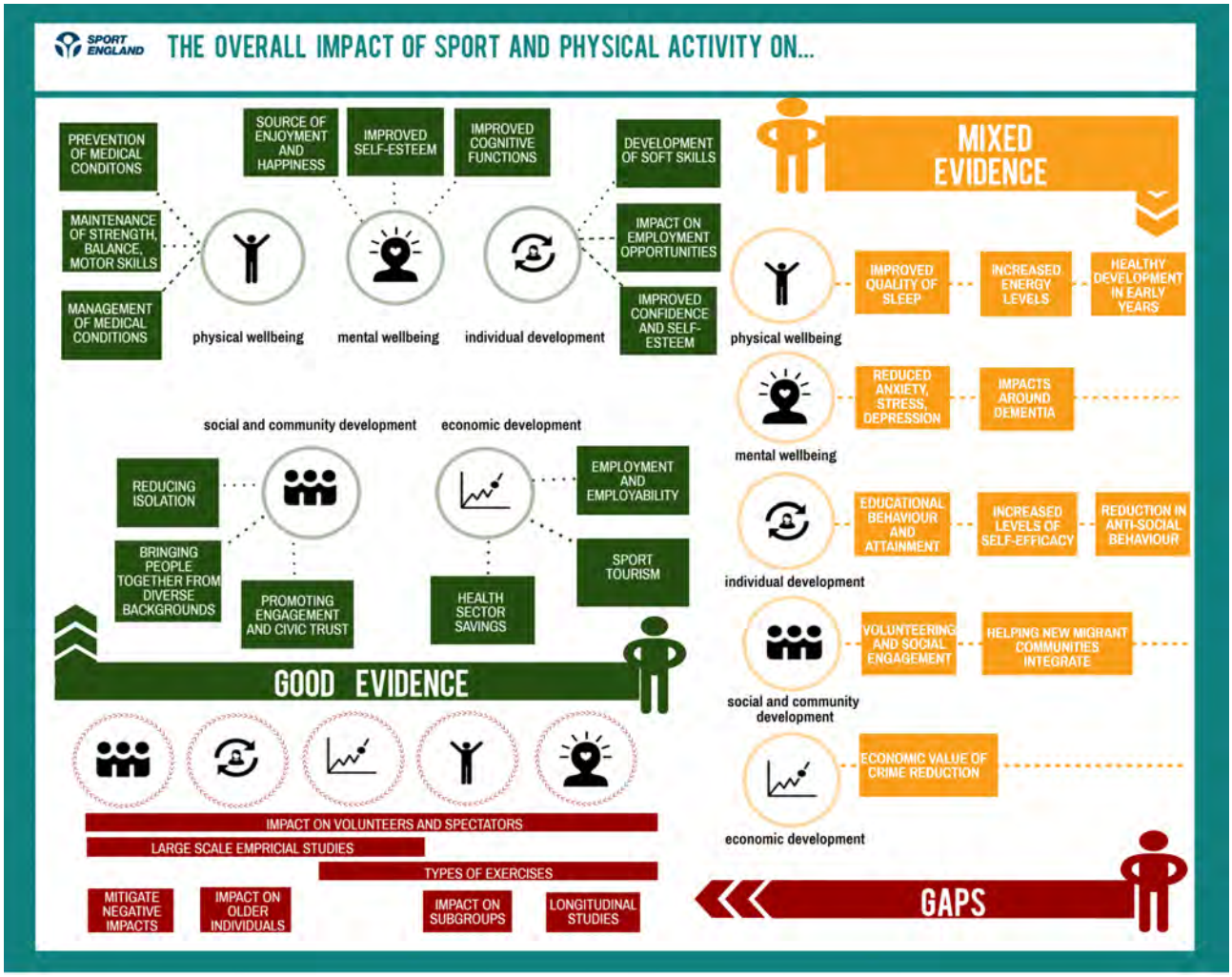


Figure 5: Individual and societal health and wellbeing benefits of physical activity (11)

Under 5s Physical Activity Guidelines

Introduction

The Under-5s age group encompasses a very wide range of developmental stages and physical capabilities. These new guidelines for the Under 5s follow the approach taken in the 2011 guidelines of considering three distinct developmental stages and age groups: infants (less than 1 year); toddlers (1-2 years); and pre-schoolers (3-4 years).

The evidence-base on physical activity in the Under-5s has expanded substantially since the development of the previous set of guidelines (12). There is now a large body of evidence that the amount of physical activity in the Under-5 period influences a wide range of both short-term and long-term health and developmental outcomes (13,14). For example, low levels of physical activity have been recognised as a contributor to increasing rates of child obesity in this age group (15, 16). It has become very clear that higher levels of physical activity are better for health, and lower levels worse, and that there are benefits to increasing levels of physical activity across the distribution of starting physical activity level (13, 14).

The evidence-base used to develop guidelines for the Under-5s has largely been restricted to studies of apparently healthy, typically developing, individuals. However, individuals with a medical condition or disability are also likely to benefit from higher levels of physical activity. The same may be said of disabled children, but the current evidence is limited to support any specific guidelines for this group.

Despite concern over levels of physical activity in the Under-5s, in both boys and girls the average level of physical activity reaches a lifetime peak around the age of school-entry (5 years old) and declines thereafter (17-19 years old). Achieving higher levels of physical activity in the early years should therefore help maintain higher levels later in childhood and adolescence (13, 14, 20, 21).

Physical activity guidelines for Under-5s

Infants (less than 1 year):

- Infants should be physically active several times every day in a variety of ways, including interactive floor-based activity, e.g. crawling.

- For infants not yet mobile, this includes at least 30 minutes of tummy time spread throughout the day while awake (and other movements such as reaching and grasping, pushing and pulling themselves independently, or rolling over); more is better.

NB: Tummy time may be unfamiliar to babies at first, but can be increased gradually, starting from a minute or two at a time, as the baby becomes used to it. Babies should not sleep on their tummies.

Toddlers (1-2 years):

- Toddlers should spend at least 180 minutes (3 hours) per day in a variety of physical activities at any intensity, including active and outdoor play, spread throughout the day; more is better.

Pre-schoolers (3-4 years):

- Pre-schoolers should spend at least 180 minutes (3 hours) per day in a variety of physical activities spread throughout the day, including active and outdoor play. More is better; the 180 minutes should include at least 60 minutes of MVPA.

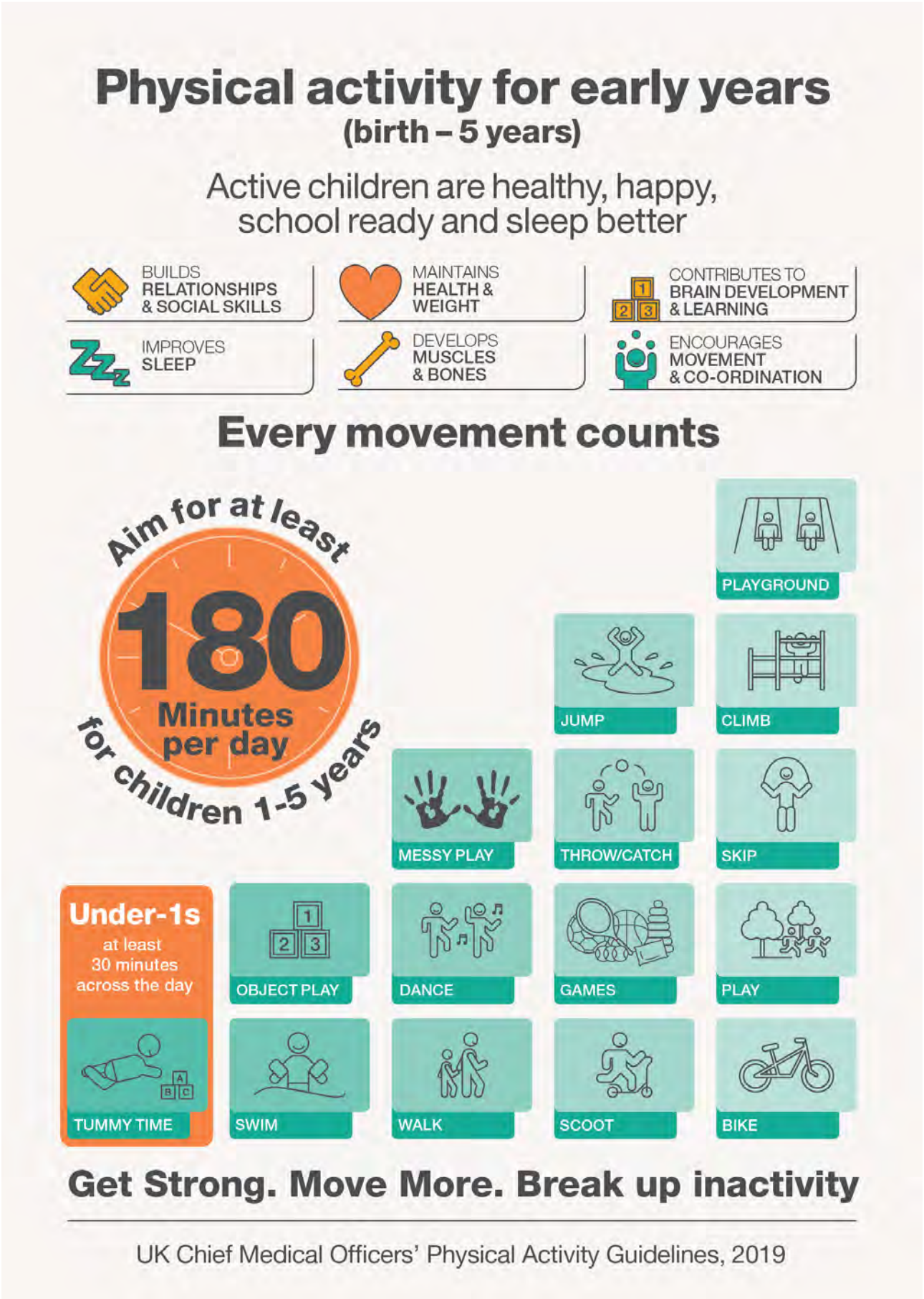
Summary of scientific support for the new guidelines

The last decade has seen an expansion in the evidence base on the health and developmental impact of variation in time spent in physical activity in the Under-5s. Whilst still lacking evidence regarding disabled children, new evidence shows the importance of time spent in physical activity of any intensity (for infants, toddlers, and pre-schoolers); time spent in MVPA (for pre-schoolers); and time spent in various specific types of physical activity (for infants, toddlers, pre-schoolers). As a result, these new guidelines for the Under-5s reflect these different exposures.

New recommendations for 2019 include time spent in physical activity ('tummy time') in infants, in MVPA in pre-schoolers, and new specific guidance on time spent in physical activity and outdoor play in pre-schoolers. These conclusions were based on evidence on the following health and developmental outcomes: adiposity; motor development; psychosocial health (e.g. wellbeing, quality of life); cognitive development; cardiovascular and musculoskeletal fitness; skeletal health; cardiometabolic health; and harms.

The evidence-base on the health and developmental impact of time spent in physical activity in the Under-5s was reviewed systematically and appraised critically using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) methodological approach in 2016-2018 (22). Full details for methods are available in Annex B.

As summarised in the following infographic, the evidence demonstrated that higher levels of time spent in physical activity were associated consistently with improved: adiposity (infants); motor development (infants, toddlers, pre-schoolers); cognitive development (infants, pre-schoolers); fitness (pre-schoolers); bone/skeletal health (pre-schoolers); and cardiometabolic health (pre-schoolers).


Physical activity for early years
(birth – 5 years)
Active children are healthy, happy, school ready and sleep better
BUILDS RELATIONSHIPS & SOCIAL SKILLS
MAINTAINS HEALTH & WEIGHT
CONTRIBUTES TO BRAIN DEVELOPMENT & LEARNING
IMPROVES SLEEP
DEVELOPS MUSCLES & BONES
ENCOURAGES MOVEMENT & CO-ORDINATION
Every movement counts
Aim for at least
180
Minutes per day
for children 1-5 years
PLAYGROUND
JUMP
CLIMB
MESSY PLAY
THROW/CATCH
SKIP
Under-1s
at least 30 minutes across the day
OBJECT PLAY
DANCE
GAMES
PLAY
TUMMY TIME
SWIM
WALK
SCOOT
BIKE
Get Strong. Move More. Break up inactivity
UK Chief Medical Officers' Physical Activity Guidelines, 2019

Children and Young People Physical Activity Guidelines

Introduction

The physical activity guidelines for children and young people are relevant to those aged from 5 to 18 years. Physical activity is associated with better physiological, psychological and psychosocial health among children and young people (23, 24). Global and UK-specific evidence has shown that boys are more active than girls at all ages and that physical activity levels decline through childhood into adolescence (17, 25, 26). There is also some evidence to suggest that physical activity levels track from childhood into adulthood (27). As such, ensuring that all children are as active as possible throughout childhood is important for current and future population health.

In recent years, there has been increasing awareness of the impact that inactivity and sedentary behaviour may have on health. As set out in the Introduction, sedentary behaviour is not simply the absence of moderate or vigorous physical activity. It includes behaviours such as watching television, reading, working with a computer, sitting while playing video games, or travelling in a motor vehicle. The most common measures of sedentary time used in the literature are self-reported time spent sitting, screen time, and the volume of device-based measures of sedentary time (accelerometer/inclinometer). For young people, evidence suggests that higher levels of sedentary behaviour are weakly associated with greater levels of obesity and lower physical fitness.

It is important to note that this chapter does not include specific recommendations for disabled children and disabled young people. Specific guidelines need to be developed for this group, but this speciality was beyond the remit and expertise of the group undertaking the review of the children and young people guidelines.

Physical activity guidelines for Children and Young People

- Children and young people should engage in MVPA for an average of at least 60 minutes per day across the week. This can include all forms of activity such as physical education, active travel, after-school activities, play and sports.

- Children and young people should engage in a variety of types and intensities of physical activity across the week to develop movement skills, muscular fitness, and bone strength.

- Children and young people should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of not moving with at least light physical activity.

Summary of scientific support for the new guidelines

The recommendations are based on the best available current evidence and are intended to provide guidance for children and young people, parents, and health professionals, but it is important to recognise that the benefits of physical activity operate on a continuum. Thus, for children and young people who are inactive, any increase in physical activity or any reduction in sedentary time is likely to provide health benefits and should be encouraged.

To develop these guidelines, the expert panel reviewed scientific evidence published from 2010 to 2018. The purpose of this review was to identify any new evidence justifying a change to the previous guidelines from 2011. Where insufficient additional evidence was available, the 2011 guideline was retained. The searches primarily focused on review-level evidence for longitudinal cohort studies examining the relationship between physical activity and health outcomes. Systematic reviews and meta-analyses were also examined, along with randomised controlled trials, to identify what types and volume of physical activity were used in effectiveness studies. Full details of methods are available in Annex B.

The three revised recommendations presented below are a refinement of the previous CMOs' guidelines from 2011 (12). The evidence leading to the updated recommendations is outlined below.

Children and young people should engage in MVPA for an average of at least 60 minutes per day across the week

The review of evidence indicated that it would be helpful to change this guideline to an average of at least 60 minutes of MVPA per day. This was because the current evidence base does not support a specific minimum daily threshold of 60 minutes of MVPA for health benefits. Current studies have broadly used an average of 60 minutes per day to assess the benefits of physical activity on health outcomes. The expert panel was unable to assess whether a 60-minute minimum daily threshold is required for health benefits. Recommending an average number of daily minutes more closely reflects the evidence and as such this is the new recommendation.

Children and young people should engage in a variety of types and intensities of physical activity across the week to develop movement skills, muscular fitness, and bone strength

The review of the evidence found broad support for health benefits of vigorous intensity physical activity and activities that would strengthen bone being undertaken by children and young people but found no strong evidence for specific numbers or durations of bouts of moderate-to-vigorous or vigorous intensity physical activity per day.

A recent analysis of nearly 30,000 children suggests that time spent in physical activity with increasing intensity was favourably associated with risk markers of future adult disease in youth, irrespective of bout duration (28). Furthermore, a recent paper has shown that children rarely accumulate physical activity in long bouts, and that the total time in MVPA, rather than time spent in specific bouts, was important for health outcomes (28, 29).

The evidence reviews identified moderate quality evidence that physical activity in children and young people is positively associated with increased proficiency in motor/movement skills (sometimes referred to as a component of physical literacy), and that this relationship is reciprocal (30). Moreover, exposure to different types of activities is implicated in higher perceptions of competence, which are also associated with higher physical activity levels (31). Physical education is likely to play a key role in the development of movement skills and supporting the promotion of high-quality physical education provision is therefore important for the development of children's skills and confidence to be physically active. Nevertheless, there is insufficient evidence to specify the intensity or amount of activity required to accrue such benefits, nor for specifying movements that contribute to fitness improvements.

The current evidence, does, however, suggest that developing a broader, more diverse range of movement skills, providing variety in the types of physical activity that children and young people engage in, is likely to be beneficial, although more high-quality evidence in this area is required (30, 32). The evidence therefore supports a guideline advocating a range of different types and intensities of physical activity across the week, in order to develop movement skills, muscular fitness, and bone strength.

Children and young people should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of not moving with at least light physical activity

In relation to sedentary time, the review of the evidence base highlighted that there is little evidence to suggest modification of the previous guidelines, other than adding a statement recommending that young people reduce periods of inactivity, and replace these with a variety of activities, including light as well as MVPA. This clarification has therefore been made to the wording of the previous guidelines.

Types of physical activity for children and young people

As described above, a key finding from the evidence review is the benefits for children and young people of engaging in different forms of physical activity across the week. Children and young people should engage in a range of activities to improve their skills such as jumping, running and catching, as well as building the confidence to be active. There is therefore no single way in which children and young people should be active; the focus

should be on identifying activities that they find enjoyable, and on creating opportunities to be active. Equally, children and young people should aim to limit sedentary time and replace this with light intensity physical activity wherever possible. The following infographic suggests activities that could be key components of helping children and young people to be physically active.

Physical activity
for children and young people
(5–18 Years)
BUILDS CONFIDENCE & SOCIAL SKILLS
MAINTAINS HEALTHY WEIGHT
DEVELOPS CO-ORDINATION
STRENGTHENS MUSCLES & BONES
IMPROVES SLEEP
IMPROVES CONCENTRATION & LEARNING
IMPROVES HEALTH & FITNESS
MAKES YOU FEEL GOOD
Be physically active
Spread activity throughout the day
Aim for an average of at least 60 minutes per day across week
All activities should make you breathe faster & feel warmer
PLAY
RUN/WALK
BIKE
ACTIVE TRAVEL
SWIM
SKATE
SPORT
PE
Activities to develop movement skills, and muscle and bone strength ACROSS WEEK
SKIP
CLIMB
WORKOUT
DANCE
Get strong
REDUCE
INACTIVITY
Move more
Find ways to help all children and young people accumulate an average of at least 60 minutes physical activity per day across the week
UK Chief Medical Officers' Physical Activity Guidelines, 2019

Adults Physical Activity Guidelines

Introduction

This chapter presents revised physical activity guidelines for adults from 19 to 64 years of age. It also covers new guidelines and infographics developed for disabled adults (4, 33) and for pregnant (10) and post-partum women within this age group.

Regular physical activity is associated with decreased mortality and lower morbidity from several non-communicable diseases (34). Adults who are physically active report more positive mental and physical health (1). Since publication of the previous physical activity guidelines in 2011, the scientific evidence on the relationships between physical activity and health has continued to accumulate, including new evidence on the volume, duration, and frequency of physical activity for substantial health benefits for disabled adults.

The previous guidelines recommended that adults should undertake 150 minutes per week of moderate intensity physical activity (MPA) or 75 minutes of vigorous intensity physical activity (VPA) or a combination of the two, and resistance training two or more times per week, to gain a range of physical and mental health benefits, and to reduce the risk of many non-communicable diseases. They recommended that physical activity should be spread throughout the week by being active on most days and accumulated in bouts of 10 minutes or more.

However, more recent evidence suggests that these 150 minutes can in fact be accumulated in bouts of any length (35), and/or achieved in one or two sessions per week while still leading to health benefits. In addition, it suggests that health benefits may also be derived from lower volumes, intensities and frequencies of activity, particularly for individuals with low levels of physical fitness and for disabled adults. Further new evidence suggests that short duration, very vigorous exercise (at or close to all-out or maximal effort) at lower volumes than 75 minutes per week may bring equivalent health benefits to those derived from adherence to the previous guidelines, in a more time-efficient manner. Improving fitness also further reduces the risk of cardiovascular disease beyond the reduction associated with regular physical activity.

The evidence continues to suggest that at least twice a week, all adults should undertake activities which increase or maintain muscle strength (resistance training). The activities chosen should use major muscle groups in the upper and lower body. This can include activities such as using bodyweight, free weights, resistance machines or elastic bands, as well as activities of daily living such as stair climbing, wheeling your wheelchair, carrying shopping bags, lifting and carrying children, and gardening.

The evidence reviewed suggests that greater than 150 minutes of physical activity along with dietary restriction may be required for weight loss. Given the interdependency of

energy intake and expenditure, it is not possible to specify how much of an increase in physical activity is likely to result in weight loss. The evidence continues to support the role of physical activity in maintaining weight following weight loss, as well as the health benefits of physical activity in overweight and obese individuals even in the absence of weight loss.

Physical activity guidelines for Adults

- For good physical and mental health, adults should aim to be physically active every day. Any activity is better than none, and more is better still.

- Adults should do activities to develop or maintain strength in the major muscle groups. These could include heavy gardening, carrying heavy shopping, or resistance exercise. Muscle strengthening activities should be done at least two days a week, but any strengthening activity is better than none.

- Each week, adults should accumulate at least 150 minutes (2 1/2 hours) of moderate intensity activity (such as brisk walking or cycling); or 75 minutes of vigorous intensity activity (such as running); or even shorter durations of very vigorous intensity activity (such as sprinting or stair climbing); or a combination of moderate, vigorous and very vigorous intensity activity.

- Adults should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of inactivity with at least light physical activity.

Summary of scientific support for the new guidelines

To develop these guidelines, the expert panel reviewed scientific evidence published from 2010 to 2018. The purpose of this review was to identify any new evidence justifying a change to the previous guidelines from 2011. Where insufficient additional evidence was available, the 2011 guideline was retained. Evidence from recently published evidence reviews used to update international physical activity guidelines came from pooled analyses, meta-analyses and systematic reviews from prospective and randomised controlled trails (RCTs), and, in the case of disabled adults, also qualitative research. Full details of methods are available Annex B.

For good physical and mental health, adults should aim to be physically active every day. Any activity is better than none, and more is better still.

The scientific evidence continues to support 150 minutes of MVPA per week spread across the week, with a recent evidence review on disability adding weight to this. However, there is now evidence that lower volumes (less than 150 minutes per week),

lower intensities (i.e. light physical activity) and lower frequencies (one or two sessions per week) of physical activity may nevertheless confer health benefits.

This lower range for health benefits was also reported in the physical activity evidence review on disability. Setting a minimum dose of physical activity is a challenge given the broad spectrum of health outcomes. Different volumes and intensities of physical activity are likely to induce different physiological changes and health benefits among people with different conditions.

The curvilinear dose-response relationship between physical activity and health outcomes suggests that the proportionately greatest benefits come from progressing from being inactive to achieving moderate levels of activity which are still below the threshold of the guidelines. The evidence reviewed suggests that even light intensity physical activity is associated with a range of health benefits, including lower risk of obesity and all-cause mortality, and improved markers of lipid and glucose metabolism (36). Moreover, threshold recommendations (i.e. 150 minutes of MPA or 75 minutes of VPA) may appear as a barrier to many, particularly those starting from low levels of physical activity, and discourage them from seeking to become more active. This barrier was also identified in the recent evidence review of physical activity for disabled adults. As a result, the statement that 'some is good, more is better' included in the previous physical activity guidelines for Older Adults has now been incorporated into these revised guidelines for all adults by recognising that any activity is better than none, and more is better still.

Although recent evidence suggests that the way in which the recommended amount of physical activity is distributed across the week does not alter its health benefit, there is both previous (37-39) and new evidence (40-42) of short-term (acute) responses in the 24 to 48 hour period after physical activity, supporting the recommendation for being physically active every day.

Adults should also do activities to develop or maintain strength in the major muscle groups. Muscle strengthening activities should be done at least two days a week, but any strengthening activity is better than none.

The available evidence continues to support the recommendation that all adults should undertake activities which increase or maintain muscle strength at least twice a week. The activities chosen should ideally use major muscle groups in both the upper and lower body and be repeated to failure (i.e. until the muscles feel temporarily 'tired out' and unable to repeat the exercise until rested for a short period). Activities to meet this guideline could include using bodyweight, free weights, resistance machines or elastic bands. However, activities of daily living such as stair climbing, wheeling a wheelchair, carrying shopping bags, lifting and carrying children, and gardening will all contribute to developing and maintaining strength. Emerging evidence suggests that such activities performed just once a week at a higher volume of work can also provide similar health effects, but at this stage the evidence is insufficient to justify changing the frequency recommended.

Although not the intention, the recommendation in the previous guidelines regarding resistance training appears to have been interpreted as secondary to the primary message of achieving 150 minutes of MVPA, and there is some evidence that the strength guideline is both less well known and less often achieved. Given the importance of maintaining or increasing muscle strength, particularly for adults at the upper end of the 19-64 age range, this guideline should be given equal emphasis. The order in which the guidelines are presented has therefore been changed accordingly.

Each week, adults should accumulate at least 150 minutes (2 1/2 hours) of moderate intensity activity; or 75 minutes of vigorous intensity activity; or even shorter durations of very vigorous intensity activity; or a combination of moderate, vigorous and very vigorous intensity activity.

Although there is no consistent new evidence to suggest that the 150 minutes of moderate intensity activity per week threshold should be changed, it is nevertheless recognised that the specific figure of 150 minutes is somewhat arbitrary. This threshold has been widely adopted internationally, and therefore has good research evidence supporting the benefits of accruing that amount of activity. Furthermore, 150 minutes of moderate intensity activity per week is likely to be achievable for many people, when environments are accessible and inclusive. However, there is new evidence that these 150 minutes can be accumulated in bouts of any length, and/or achieved in one or two sessions per week, while still retaining the beneficial effects. Wording in the previous guidelines specifying that this physical activity should be in bouts of 10 minutes or more and distributed across most days of the week has therefore been removed in these new guidelines.

Dose-response relationship varies by disease risk. Often increases in the volume of physical activity bring additional reductions in risk. For example, for hypertension, the evidence suggests that 150 minutes (10 MET-h) of ‘leisure time PA’ reduces the risk of hypertension by 6%, with further reductions of a similar magnitude for every additional 150 minutes (43). For type 2 diabetes, dose-response analysis indicates that risk reduction can be achieved below 150 minutes of MVPA per week, but that substantially greater benefits can be achieved by being more active (44). For cardiovascular disease (CVD), recent evidence suggests that achieving the current guidelines is associated with reduced risk, but that moving from inactive to moderately active (6 MET-h per week, or less than half of the guideline amount) brings proportionately the greatest benefit.

Several meta-analyses and systematic reviews published since 2010 have demonstrated that very vigorous intensity activity performed in short bouts interspersed with rest or recovery (high intensity interval exercise) has clinically meaningful effects on fitness, adiposity, body weight and insulin resistance (6). There is limited evidence of the benefits of high intensity interval exercise for disabled people. The available evidence suggests that short duration, very vigorous intensity activity can be as or more effective than MVPA, and this option has therefore been incorporated into the recommendation.

Adults should aim to minimise the amount of time spent being sedentary, and when physically possible should break up long periods of inactivity with at least light physical activity.

There have been notable developments in the epidemiological evidence base for adults, particularly regarding associations between sedentary behaviour and cancer risk and survivorship (45-49). Recent meta-analytical data from 34 studies, including over one million unique individuals (50), concluded that for adults, above 6 to 8 hours per day of total sitting time and 3 to 4 hours per day of TV viewing time are associated with greater risk of all-cause and CVD mortality, independently of levels of MVPA. Despite these new studies, there currently remains insufficient evidence to determine a dose–response relationship or a threshold for clinically relevant risk. At present the evidence therefore does not support including a specific time limit or minimum threshold of sedentary time within this recommendation. New evidence on the health benefits of shifting from sitting to standing was insufficient to support including a recommendation to interrupt sedentary time by standing.

Weight loss and weight maintenance

Physical activity expends energy, and therefore makes a valuable contribution to weight management by reducing adiposity. The evidence reviewed suggests that greater than 150 minutes of physical activity, together with dietary restriction, may be required for weight loss. Given the interdependency of energy intake and expenditure for weight loss, it is not possible to specify how much more physical activity alone would be likely to result in weight loss. However, given the scale of the problem of overweight and obesity, the importance of physical activity and the need to simultaneously restrict energy intake should be emphasised. Moreover, the role of physical activity in maintaining weight following weight loss should be highlighted. It is also worth emphasising that the health benefits associated with physical activity are experienced by adults irrespective of weight status, and in the absence of weight loss.

Physical activity for disabled adults

A rapid evidence review was carried out of the evidence base on physical activity for general health benefits for disabled adults (4). It found that, with respect to safety, no evidence exists that suggests appropriate physical activity is a risk for disabled adults and analogous health benefits for disabled adults of engaging in physical activity as for the rest of the adult population. It concluded that any myths about physical activity being inherently harmful for disabled people should be dispelled.

Physical activity during pregnancy & during postpartum

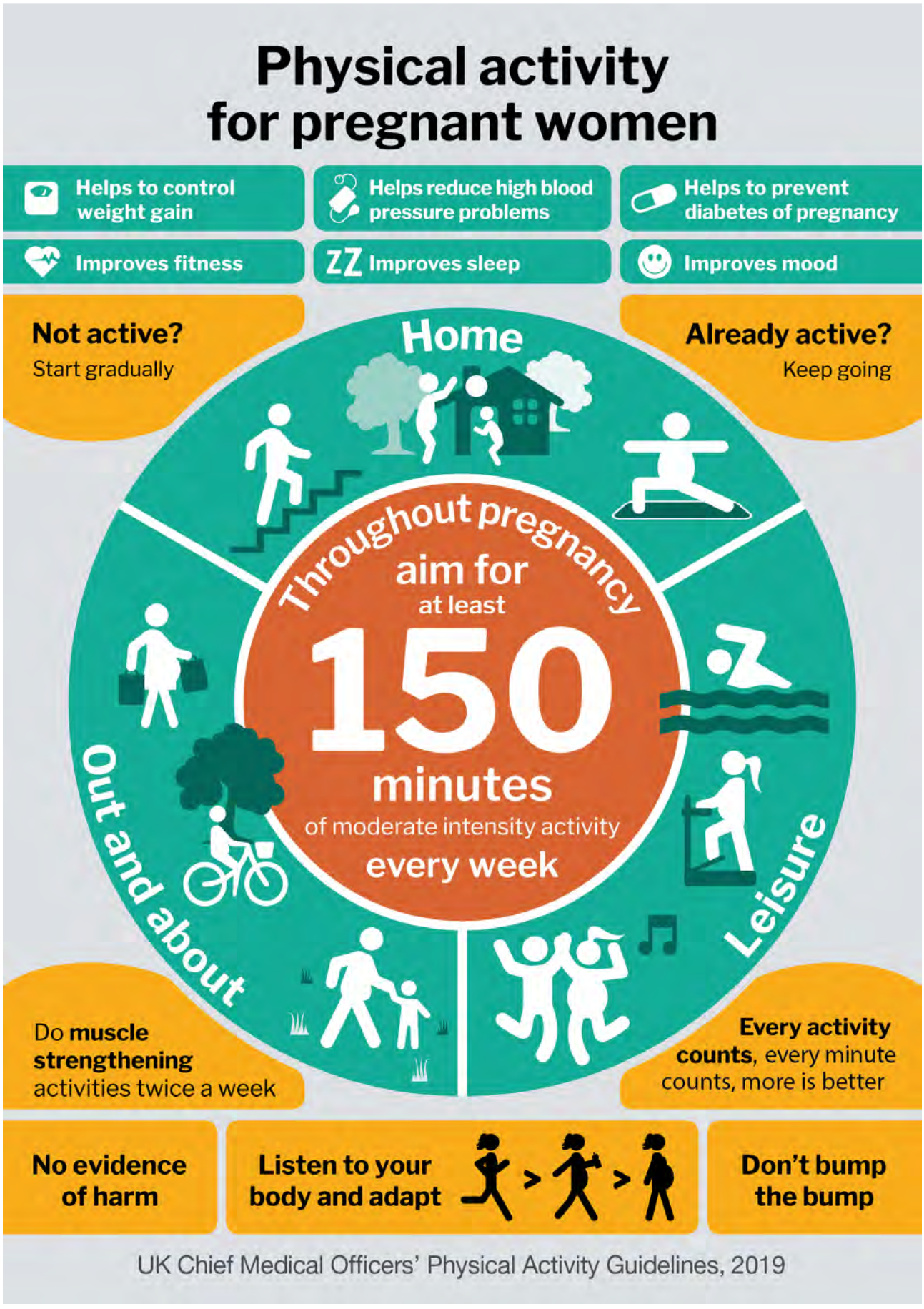
Evidence-based recommendations for physical activity and pregnancy and physical activity and postpartum have also been produced, following standard methods examining pooled analyses, meta-analyses and systematic reviews from prospective and randomised controlled trails (RCTs), and qualitative research on experiences of physical activity of health professionals and women (10). Based on these, the infographics included in this section have been co-produced and tested with health professionals and women.

The benefits of physical activity during pregnancy identified by the review were reduction in hypertensive disorders; improved cardiorespiratory fitness; lower gestational weight gain; and reduction in risk of gestational diabetes. The benefits of physical activity in the postpartum period (up to one year) were identified as a reduction in depression; improved emotional wellbeing; improved physical conditioning; and reduction in postpartum weight gain and a faster return to pre-pregnancy weight.

Physical activity can safely be recommended to women during and after pregnancy and had no negative impact on breastfeeding postpartum. Physical activity choices should reflect activity levels pre-pregnancy and should include strength training. Vigorous activity is not recommended for previously inactive women. After the 6 to 8 week postnatal check, and depending on how the woman feels, more intense activities can gradually resume, i.e. building up intensity from moderate to vigorous over a minimum period of at least 3 months.

Physical activity for adults and older adults
Benefits health
Improves sleep
Maintains healthy weight
Manages stress
Improves quality of life
Reduces your chance of
Type II Diabetes -40%
Cardiovascular disease -35%
Falls, depression etc. -30%
Joint and back pain -25%
Cancers (colon and breast) -20%
Some is good, more is better
Make a start today: it's never too late
Every minute counts
Be active
at least 150 minutes moderate intensity per week
increased breathing able to talk
OR
or a combination of both
at least 75 minutes vigorous intensity per week
breathing fast difficulty talking
Swim
Brisk walk
Cycle
to keep muscles, bones and joints strong
Build strength
on at least 2 days a week
Gym
Yoga
Carry heavy bags
Run
Stairs
Sport
Minimise sedentary time
Break up periods of inactivity
Bowls
Tai Chi
Dance
For older adults, to reduce the chance of frailty and falls
Improve balance
2 days a week
UK Chief Medical Officers' Physical Activity Guidelines 2019

Physical Activity
for
Disabled Adults
Make it a daily habit
Improves mental health and quality of life
Makes maintaining a healthy weight easier
Creates opportunities to meet new people and feel part of the community
Makes daily tasks easier and increases independence
Disabled adults
Physical activity makes you feel good
Give things a go and enjoy what you do
Being inactive is harmful to health
Don't be still for too long
Even a little movement is better than nothing
Helps to prevent chronic disease
Strengthens muscles and bones
Improves mobility and balance
Improves fitness
Do strength and balance activities on at least two days per week
For substantial health gains aim for at least 150 minutes each week of moderate intensity activity
Remember the talk test:
Can talk, but not sing = moderate intensity activity
Difficulty talking without pausing = vigorous intensity activity
UK Chief Medical Officers' Physical Activity Guidelines, 2019


Physical activity for pregnant women
Helps to control weight gain
Helps reduce high blood pressure problems
Helps to prevent diabetes of pregnancy
Improves fitness
Improves sleep
Improves mood
Not active?
Start gradually
Already active?
Keep going
Home
Throughout pregnancy
aim for
at least
150
minutes
of moderate intensity activity
every week
Out and about
Leisure
Do muscle strengthening activities twice a week
Every activity counts, every minute counts, more is better
No evidence of harm
Listen to your body and adapt
Don't bump the bump
UK Chief Medical Officers' Physical Activity Guidelines, 2019

Physical activity for women after childbirth (birth to 12 months)
Time for yourself - reduces worries and depression
Helps to control weight and return to pre-pregnancy weight
Improves tummy muscle tone and strength
Improves fitness
Improves mood
ZZ Improves sleep
Not active?
Start gradually
Active before?
Restart gradually
Out and about
Leisure
aim for
at least
150
minutes
of moderate intensity activity
every week
Start pelvic floor exercises as soon as you can and continue daily
Build back up to muscle strengthening activities twice a week
Home
It's safe to be active. No evidence of harm for post partum women
Depending on your delivery listen to your body and start gently
You can be active while breastfeeding
UK Chief Medical Officers' Physical Activity Guidelines, 2019

Older Adults Physical Activity Guidelines

Introduction

Regular physical activity contributes to the key determinants of healthy ageing: good physical and mental function; opportunities for social interaction; a sense of control over, and responsibility for one's own health and well-being; and managing or coping with disease symptoms and functional limitations (51, 52). There is now also emerging evidence that increasing physical activity contributes to improving social functioning and reducing loneliness and social isolation.

Although age alone does not determine physical condition or capacity, older age (65 years and over) is associated with a greater risk and prevalence of many health conditions including coronary heart disease, stroke, type 2 diabetes, cancer and obesity, as well as depression and dementia. Older adults are also at greater risk of falling, often resulting in the avoidance of activity, and consequent fractures and impairments.

There is strong evidence that physical activity contributes to increased physical function, reduced impairment, independent living, and improved quality of life in both healthy and frail older adults. Physical activity in later life can help treat and offset the symptoms of a range of chronic conditions (e.g. depression, CVD, Parkinson's disease). Since the first UK physical activity guidelines specifically for older people were published in 2011, new evidence has strengthened and reinforced the main elements of those.

However, some changes have been made to the previous guidelines to take account of new evidence. Given the lower levels of physical activity amongst the population of older adults (53, 54), small increases in the volume of daily physical activity can produce important health and functional benefits. Growing evidence supports the importance of light intensity activity to health (55, 56), a message that is particularly important to communicate to those who are currently inactive and/or frailer. These revised guidelines for older adults therefore give greater emphasis to regular light activity. This can be a means of breaking up prolonged periods of sedentary time, and of building up gradually to the recommended weekly amount of MVPA. The previous recommendation that moderate intensity activity should be in bouts of 10 minutes or more is no longer considered necessary and has therefore been removed.

The value to older adults of activities which improve strength, balance and flexibility cannot be overstated, and therefore receive greater prominence in these revised guidelines. These components of fitness help maintain physical function, reduce the risk of falls, and help people feel more confident and able to meet the MVPA guidelines. It is now emphasised that activities to improve strength, balance and flexibility can be incorporated into sessions that also involve MVPA, rather than necessarily being in addition.

Physical activity guidelines for Older Adults (65 years and over)

- Older adults should participate in daily physical activity to gain health benefits, including maintenance of good physical and mental health, wellbeing, and social functioning. Some physical activity is better than none: even light activity brings some health benefits compared to being sedentary, while more daily physical activity provides greater health and social benefits.

- Older adults should maintain or improve their physical function by undertaking activities aimed at improving or maintaining muscle strength, balance and flexibility on at least two days a week. These could be combined with sessions involving moderate aerobic activity or could be additional sessions aimed specifically at these components of fitness.

- Each week older adults should aim to accumulate at least 150 minutes of moderate intensity aerobic activity, building up gradually from current levels. Those who are already regularly active can achieve these benefits through 75 minutes of vigorous intensity activity, or a combination of moderate and vigorous activity, to achieve greater benefits. Weight-bearing activities which create an impact through the body help to maintain bone health.

- Older adults should break up prolonged periods of being sedentary with light activity when physically possible, or at least with standing, as this has distinct health benefits for older people.

Summary of scientific support for the new guidelines

To develop these guidelines, the expert panel reviewed scientific evidence published from 2010 to 2018. The purpose of this review was to identify any new evidence justifying a change to the previous guidelines from 2011. Where insufficient additional evidence was available, the 2011 guideline was retained. Full details of methods are available in Annex B.

Physical activity plays a changing role in the lives of older adults, as for some it becomes more about the maintenance of independence and the management of symptoms of disease, rather than primary disease prevention. There is enough knowledge of the benefits associated with physical activity in older adults to categorically state that they outweigh the risks. In older adults with frailty, moderate-to-severe dementia, or a history of vertebral fractures or regular falls, it might be more appropriate for any new exercises to be initially supervised by a trained professional, to ensure efficacy and safe techniques to avoid injury.

Older adults should participate in daily physical activity to gain health benefits. Some physical activity is better than none: even light activity brings some health benefits compared to being sedentary.

The use of wearable devices to objectively measure the physical activity of older individuals during the activities of daily life, in addition to structured activity programmes, has provided a growing evidence base that supports the health benefits of light-intensity physical activity, independently of those provided by MVPA (57-60). Light activity is associated with a range of health benefits, including lower risk of obesity, CVD, cancer, and all-cause mortality (61); improved markers of lipid and glucose metabolism (56); and reductions in unplanned hospital admissions and future prescriptions for health conditions (62). Although still extremely limited in number, studies show a link between inactivity and loneliness and social isolation, and that increasing physical activity can reduce loneliness and social isolation, as well as improving social functioning (63, 64).

Older adults should break up prolonged periods of being sedentary with light activity when physically possible, or at least with standing, as this has distinct health benefits for older people.

Prolonged sedentary behaviour is associated with many poor health and functional outcomes in older adults (65). There is emerging evidence that for inactive older adults, replacing sedentary behaviour with light-intensity activity is likely to produce some health benefits. Specifically, for individuals who perform no or little MVPA, replacing sedentary or inactive behaviours with light-intensity activity (such as walking at 2 miles per hour, dusting or polishing furniture, or easy gardening) reduces the risk of all-cause mortality, cardiovascular disease incidence and mortality, and type 2 diabetes (57). In those transitioning to frailty and who find light activity difficult, there is emerging evidence that short periods of standing repeated hourly provides some benefits to physical function (66).

These revised guidelines therefore highlight the potential of light-intensity activity to benefit the health of older adults, and that increasing the volume of light-intensity movement in daily routines can bring important health benefits at a population level. This is particularly valuable for those older adults unable to perform moderate-intensity activity. Other evidence supports the benefits of being active throughout the day, such as better maintenance of bone health with higher volumes of light intensity activity spread throughout the day (67).

Older adults should maintain or improve their physical function by undertaking activities aimed at improving or maintaining muscle strength, balance and flexibility on at least two days a week.

A loss of muscle strength in advancing age is the primary limiting factor for functional independence (68). Physical function has a linear relationship with mortality, and those with poor physical function have a higher risk of all-cause mortality, even from mid-life (69). Multi-component strength and balance activities, including flexibility, are key to improving physical function (70). Poor balance also predicts a higher rate of cognitive decline, as well as higher all-cause mortality (71). Good balance and mobility are essential to the successful performance of most activities of daily living, as well as the ability or confidence to take part in recreational activity.

Evidence-based strength and balance exercise programmes reduce falls rate and risk (72), are cost-effective (73), increase confidence, and can increase habitual moderate physical activity towards meeting the guidelines (74). They can be group or home-based, and strength and balance activities can be embedded within everyday activities.

Each week older adults should aim to accumulate at least 150 minutes (2½ hours) of moderate intensity aerobic activity, building up gradually from current levels.

The evidence that at least 150 minutes of moderate intensity activity per week contributes significantly to the prevention of chronic disease has strengthened (1). In addition, the risk of progression of disabilities affecting the basic activities of daily living is almost halved in those who undertake regular moderate intensity physical activity, compared to those who do not (75). Bone mineral density is greater in those who meet the MVPA guidelines (67). There is strong support for the role of physical activity in reducing the risk of cognitive impairment and dementia (76), and bouts of 30 minutes of moderate activity per day almost halve the odds of experiencing depression (77).

Alternative ways of recording exercise, such as using pedometers or step counters, may be helpful to some older adults in tracking progress towards the MVPA guidelines. Evidence suggests that 30 minutes of daily MVPA accumulated in addition to habitual daily activities in healthy older adults is equivalent to taking approximately 7,000 to 10,000 steps per day (78-80). This evidence suggests 4500 to 5500 steps a day for improved health related quality of life, above 7000 steps a day for better immune function, and 8000 to 10000 steps a day for an effect on metabolic syndrome and maintenance of weight (81).

For those who are already regularly active, a combination of moderate and vigorous aerobic activity brings greater benefit (1). 75 minutes of vigorous aerobic activity spread across the week can produce comparable benefits to 150 minutes of moderate intensity activity (1). High intensity interval training is one approach to accumulating vigorous

intensity physical activity, but there is currently very limited evidence on its benefits and harms among older populations.

Emerging evidence from cross-sectional and prospective studies indicates that bouts of any length of MVPA contribute to the health benefits associated with accumulated volume of physical activity (1, 55, 59). The previous recommendation of a minimum bout length of 10 minutes is therefore no longer necessary for the optimal health message. This seems particularly relevant to older adults, given the sporadic nature of accumulated activity in this population.

Types of physical activities for this group

Older adults are more likely to have already been diagnosed with disease, and also experience different life events to middle-age adults, such as retirement, helping with grandchildren, and the increased likelihood of becoming a carer. These circumstances bring a new set of challenges in terms of physical activity participation and may temporarily halt people's ability to be active. Nevertheless, a few strategies can help to re-engage in physical activity and build activity levels up gradually. For those who are limited by disease or impairment, there is value in even small increases in activity, which can also help to slow or prevent further decline. This section provides examples of how a combination of different activities addressing the different components of the guidelines can be tailored to the range of circumstances encountered in older age, from those who are already active, to those who are losing function but otherwise healthy, to those who are frail (78-80).

Active Older Adults

Active older adults are those who are already active through daily walking, an active job, and/or who engage in regular recreational or sporting activity. For many, this may just involve aerobic activity such as brisk walking, whereas significant additional benefits can be achieved from incorporating activities to improve strength, balance and flexibility. Undertaking a programme of activity at least twice per week that includes resistance activities (lifting weights, using resistance bands or other equipment to provide resistance, etc.), some impact activities (running, jumping, skipping etc.), and balance activities (standing on one leg, backwards walking, activities that involve 3-dimensional movement etc.) would provide these benefits (8). A mix of sporting activities, Tai Chi, dance and aqua-aerobics, for example, would contribute to both the aerobic and the strength and balance guidelines.

In transition

Older people in transition describes people whose function is declining due to low levels of activity and too much sedentary time, who may have lost muscle strength and/or be overweight but otherwise remain reasonably healthy. 'Walk and rest for a minute' may be a useful strategy for adults in this age group to manage fatigue, particularly while building up

gradually towards the guideline level for moderate-intensity activity. The inclusion of strength and balance activities may be particularly useful to increase confidence and stability. Sit-to-stands, stair climbing, and home-based strength and balance exercises can all contribute to stability. They can also build the confidence to move safely on to activities that improve aerobic activity, such as brisk walking and exercise classes to improve strength and balance.

Frailer older adults

Frailer older adults are those who are identified as being frail or have very low physical or cognitive function, perhaps because of chronic disease such as arthritis, dementia or advanced old age itself. Any increase in the volume and frequency of light activities, and any reduction in sedentary behaviour, is a place to start and contributes towards health. For this group, more strenuous activities are less likely to be feasible. A programme of activities could focus instead on reducing sedentary behaviour and engaging in regular sit-to-stand exercise and short walks, stair climbing (82), embedding strength and balance activities into everyday life tasks (72), and increasing the duration of walking, rather than concentrating on intensity.

Conclusion

These revised UK Chief Medical Officers' Physical Activity Guidelines reflect the most up-to-date scientific evidence for the benefits of physical activity. They offer a recommended frequency, intensity, duration and volume of aerobic, muscle strengthening, and balance activities to achieve health benefits, based on reviews of evidence across the life course and through key life stages.

Maintaining a consistent set of physical activity guidelines across all the UK remains one of the key strengths of a joint report from the four Chief Medical Officers of England, Northern Ireland, Scotland and Wales. It provides the opportunity to communicate consistent messages, based on the same underpinning evidence, through the professional networks and public communications of each Chief Medical Officer in their respective countries.

Effective tools to support health professionals and the range of practitioners who carry out the vital work of supporting people to be physical active are essential if these guidelines are to make a difference in practice. The set of infographics included in this report have been developed with that purpose in mind. They are available on the Chief Medical Officers' Physical Activity Guidelines web pages as separate files in a range of formats and are intended for widespread dissemination and use.

Following on from publication of this report, two new Working Groups will be established to continue co-ordination on effective and consistent messages to support and encourage physical activity. Firstly, a Communications Working Group will consider approaches to develop and extend the materials and approaches used to communicate the physical activity guidelines more widely and provide advice on overall communications strategy for the guidelines. Secondly, a Monitoring and Surveillance Working Group will be convened to consider how physical activity levels are measured at population level, and to identify opportunities to improve the quality and consistency of data across the different countries within the UK.

Future work will also include ongoing reviews of these guidelines in the light of new evidence. It is anticipated that the next update will be considered via a scoping review of new evidence in 2024, with the next full revision completed before 2029.

Annex A: Glossary

Balance

Balance activities are those activities that involve the maintenance of the body balance while stationary or moving.

Bone Health

Bone health includes bone quality that refers to the capacity of bones to withstand a wide range of loading without breaking. Bone health also includes bone mineral content, structure, geometry and strength.

Disability

Disability refers to people who have long-term physical (e.g. spinal cord injury), sensory (e.g. visual impairment), cognitive (e.g. learning difficulties), and/or mental impairments (e.g. depression) which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others. Rather than focusing on just one impairment, the UK CMO Guidelines considered a range of impairments. See United Nations Convention on the Rights of Persons with Disabilities.

Epidemiological studies

The study and analysis of the distribution, patterns and determinants of health and disease conditions in defined populations.

Impact Activities

High Impact Activities are those activities or sports that put stress on weight bearing joints such as the knee, hip, or ankle.

HIIT

High Intensity Interval Training (HIIT) is very vigorous physical activities performed in short bursts interspersed with breaks.

Meta-analyses

A statistical analysis that combines the results of multiple epidemiological studies.

METs

Metabolic Equivalent of Task (MET) is the objective measure of the ratio of the rate at which a person expends energy, relative to the mass of that person, while performing some specific physical activity compared to the energy expended whilst sedentary.

MPA

Moderate physical activity is an activity that requires a moderate amount of effort and noticeably accelerates heart and breathing rate

MVPA

Moderate-to-vigorous physical activity (MVPA) are activities that can be done at different intensities like cycling. They can be differentiated by the ‘talk test’: being able to talk but not sing indicates moderate intensity activity, while having difficulty talking without pausing is a sign of vigorous activity.

Non-communicable diseases

A disease that is not transmissible directly from one person to another.

Postpartum

Postpartum refers to a period of time after the end of pregnancy. The postpartum period is commonly defined as up to six weeks following the end of pregnancy, with the late postpartum period from six weeks up to one year after the end of pregnancy. For the CMO Guidelines postpartum includes up to one year post delivery.

Sedentary behaviour

Inactive and sedentary behaviours are those involving being in a sitting, reclining or lying posture during waking hours, undertaking little movement/activity and using little energy above what is used at rest.

Systematic review

A technique that uses systematic methods to collect secondary data, critically appraise studies and synthesise findings.

VPA

Vigorous physical activity is an activity that requires a large amount of effort and causes rapid breathing and substantial increase in heart rate.

Annex B: Expert Working Groups and Methods

A number of Expert Working Groups (EWG) were established to review the evidence for updating the 2011 CMO physical activity guidelines. Each EWG drew upon three types of evidence: 1: recent published evidence reviews used to construct or update international physical activity guidelines; 2: the most recent pooled analyses, meta-analyses and systematic reviews from prospective and RCT research published since the most recent reviews used to update international guidelines; and 3: any additional relevant papers identified by each EWG. In addition, comments and suggestions regarding the 2011 CMO physical activity recommendations were identified for each EWG from the first National Consultation.

The sections below describe these review methods in further detail. The full technical reports produced by each EWG available on the UK CMO Physical Activity Guidelines Update website.

Methods for the Under-5s physical activity guidelines

Extensive guideline development work for 24-hour movement behaviours for the Under-5s has occurred internationally over the past 24 months (83-85). In order to develop draft recommendations for the UK, the Under 5s EWG used the GRADE-ADOLOPMENT (adoption and/or adaptation of an existing guideline, plus de novo development) approach (84, 86). This approach has been used to adopt/adapt the 2017 Canadian Society for Exercise Physiology 24-Hour Movement Guidelines for the Early Years (0-4 years) to produce guidelines for Australia in 2017 (84) and has been used to produce international (WHO) guidelines, and guidelines for South Africa (85).

The Under-5s EWG used the Canadian Society for Exercise Physiology 24-Hour Movement Guideline for the Early Years (0-4 years) (83) as the basis of the UK draft recommendations. The Canadian guidelines were chosen because (in contrast to other candidate guidelines): they met a number of essential/desirable criteria (84, 86): recently published; followed GRADE methodology; addressed clear questions; had an assessment of benefit/harms; had been assessed using the International Approach to Guidelines, Research, and Evaluation (AGREE) (87); could be updated; had risk of bias assessment; took a 24 –hour movement behaviour approach and provided access to evidence tables/summaries for consideration by the UK Under-5s EWG. The results of the literature searches (Summary of Findings and GRADE tables) were made available by the Canadian Society for Exercise Physiology and the Australian Guideline Development Group in 2017. It was desirable to update and extend these searches for the UK process which took place in 2018: the ‘WHO Guidelines Development Group for integrated 24-hour movement in young children: physical activity, sedentary behaviour and sleep time in

children under 5 years of age' kindly shared the results of their updated literature searches with the UK EWG in 2018. The EWG draft recommendations are based on the updated and extended evidence synthesis where possible.

The Under-5s EWG considered evidence for 3 distinct populations: infants (up to age 1 year); toddlers (age 1-2 years); pre-schoolers (age 3-4 years). A large number of exposures were considered, under the general headings of physical activity, sedentary behaviour, and sleep duration. We included the following outcomes: adiposity, motor development, emotional-behavioural regulation; psychosocial health (e.g. wellbeing, quality of life), cognitive development, cardiovascular and musculoskeletal fitness, harms (i.e. injuries), skeletal health, cardiometabolic health; growth, physical activity/TV viewing (outcomes with sleep as the exposure variable).

Methods for the Children and Young People, Adults, and Older Adults physical activity and sedentary behaviour guidelines

Each EWG adopted the same principle, namely, to identify whether there was any new evidence to suggest a change to the 2011 guidelines based on the GRADE-ADOLOPMENT process (88). Using the GRADE-ADOLOPMENT process, the most recent international physical activity guidelines for children and young people were identified: these were from the Netherlands. Together with the 2011 UK guidelines, this formed the starting point of the review.

The current UK physical activity guidelines were constructed as advice to the general population about the recommended frequency, intensity, time and types of physical activity required to prevent major chronic disease and to maintain health. In the UK, the diseases refer specifically to mortality, years of life lost, and disease burden (coronary heart disease, stroke, heart failure, diabetes mellitus type 2, chronic obstructive pulmonary disease (COPD), breast cancer, colorectal cancer, lung cancer, osteoarthritis, dementia and cognitive decline, and depression and depressive symptoms). The guidelines also focus on preventing premature (or all-cause) mortality and fractures, disabilities in the elderly, injuries and, in children, attention deficit hyperactivity disorder (ADHD) symptoms. Four risk factors were also included (systolic blood pressure, LDL cholesterol, body weight (BMI Z-score in children), and insulin sensitivity), which have a causal relationship with these chronic diseases. For the children and young people expert review, muscle strength, cardiorespiratory fitness, bone health, cognitive functioning and academic performance were included as key health indicators for this age group.

The specific steps that were followed to address items 1-3 highlighted above are described in detail below.

1. Identifying recent national evidence reviews used to construct or update physical activity guidelines

Google was used, and public health bodies (i.e. National Centre for Health and Clinical Excellence, Centre for Disease Control) were targeted to search for evidence reviews of physical activity that had been used to construct national physical activity guidelines and recommendations (published since 2010). International experts who had authored recent national guidelines to identify further examples of relevant reviews from Australia, Canada and the Netherlands (23, 89, 90) were also contacted. National evidence reviews for the construction of children's physical activity guidelines were found for 15 European countries and four other worldwide countries. Twelve of these evidence reviews were eligible for inclusion based on publication date (23, 89-99).

2. Identifying the most recent pooled analyses, meta-analyses and systematic reviews from prospective and RCT research to answer the specific questions posed

Purposive searches were undertaken to identify relevant literature on the relationship between physical activity and health outcomes. These primarily focused on review-level evidence for longitudinal cohort studies examining the relationship between physical activity and health outcomes. Systematic reviews and meta-analyses were also examined for randomised controlled trials to identify what types and volume of physical activity were used in effectiveness studies. PubMed was searched using a tailored set of broad MeSH terms (Medical Subject Headings) to capture the most current studies published, relevant to the needs of each EWG. For example, "resistance training", "muscle", "bone', "balance" AND "physical activity" AND "adults".

The terms of the searches and their dates reflected the most recent international evidence reviews searches. For example, the Netherlands searches were truncated at 1 October 2016, so searches include all publications from January 1st, 2016 (in case of delayed archiving) to 1st January 2018. EWGs synthesised the effectiveness of the evidence across their health outcomes using this process.

A total of 42 publications were identified via the PubMed search. Studies were excluded if they were outside of the date range, included 'at risk' populations or focussed solely on sedentary behaviour. The central review team research associate removed duplicates and assessed the eligibility of the studies against the key questions outlined below, and via this process a total of 14 publications were eligible for inclusion (30, 100-112).

3. Identification by each EWG of any additional relevant papers

Each EWG was also asked to identify any relevant outcomes and primary papers from their own sources and networks. EWGs identified the most relevant and up to date high

quality reviews from these sources and summarised the effectiveness of the evidence across their health outcomes.

Communication and Surveillance

The Communication and Surveillance EWG considered how the communication of the CMOs' guidelines could be made most effective and targeted to different audiences, and how monitoring of the uptake of the guidelines could be improved and made more consistent across the UK. A paper on the monitoring issues has been published (113), and further work on both communication and monitoring will be taken forward through two new working groups following publication of these guidelines.

Membership of Expert Working Groups

Expert Working Group	Members
Under 5s	Prof John Reilly - Chair Dr Kathryn Hesketh Dr Catherine Hill Dr Adrienne Hughes Dr Xanne Janssen Dr Ruth Kipping Prof Sonia Livingstone Dr Anne Martin
Children and Young People	Prof Russell Jago - Chair Prof Stuart Fairclough Dr Kelly Mackintosh Dr Paul McCrorie Dr Simon Sebire Dr Lauren Sherar Dr Esther van Sluijs Prof Craig Williams
Adults	Prof Marie Murphy - Chair Dr David Broom Prof Jason Gill Dr Cindy Gray Prof Andy Jones Dr James Steele Prof Dylan Thompson Dr Jet Veldhuijzen van Zanten
Adults with disabilities	Prof Brett Smith - Chair Nathalie Kirby Dr Rebekah Lucas Bethany Skinner Leanne Wightman

Expert Working Group	Members
Older Adults	Prof Dawn Skelton - Chair Dr Daniel Cleather Prof Rob Copeland Dr Carolyn Greig Dr Alexandra Mavroeidi Dr Afroditi Stathi Dr Garry Tew Prof Mark Tully
Sedentary Behaviour	Prof Ashley Cooper - Chair Prof Stuart Biddle Dr Sebastien Chastin Dr Stacy Clemes Dr Sally Fenton Dr Claire Fitzsimons Dr Richard Pulsford Dr Thomas Yates
Communication and Surveillance	Prof Nanette Mutrie - Chair Anna Chalkley Nick Colledge Dr Philippa Dall Dr Paul Kelly Bob Laventure Dr Karen Milton Dr Andy Pringle Sarah Ruane Laura Smith Prof Martyn Standage Dr Tessa Strain
Pregnancy	Professor Marion Knight - Chair Dr Lucy Mackillop Dr Anne Matthews Dr Manisha Nair Dr Hamish Reid Dr Ralph Smith
Postpartum	Dr Hayley Mills - Chair Katie Dalrymple Dr Marlize De Vivo Prof Marian Knight Dr Lucy Mackillop Dr Islay McEwan Prof Lucilla Poston Dr Shuby Puthussery Dr Ralph Smith
UK External Reviewers	Prof Alan Batterham Prof Melvyn Hillsdon

Expert Working Group	Members
	Prof Gareth Stratton Dr Simon Williams

International Advisory Group

Prof Ulf Ekelund Department of Sports Medicine, Norwegian School of Sports Sciences, Norway

Prof Abby King Health Research and Policy, Stanford University, USA

Prof Tony Okely Early Start Research Institute, University of Wollongong, Australia

Prof Russ Pate Arnold School of Public Health, University of South Carolina, USA

Prof Jo Salmon School of Exercise and Nutrition Science, Deakin University, Australia

Dr Wanda Wendel-Vos Centre for Prevention and Health Services Research of the National Institute for Public Health and the Environment, Netherlands

Annex C: References

1. 2018 Physical Activity Guidelines Advisory Committee. 2018. Physical Activity Guidelines Advisory Committee Scientific Report. Washington, DC: U.S. Department of Health and Human Services; 2018.

2. Department of Health, Physical Activity, Health Improvement and Prevention. At least five a week: Evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer; 2004.

3. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. Public Health Rep. 1985;100(2):126-31.

4. Public Health England. Physical activity for general health benefits in disabled adults: Summary of a rapid evidence review for the UK Chief Medical Officers' update of the physical activity guidelines. London; 2018.

5. Ainsworth BE, Haskell WL, Herrmann SD, Meckes N, Bassett DR, Jr., Tudor-Locke C, et al. 2011 Compendium of Physical Activities: a second update of codes and MET values. Med Sci Sports Exerc. 2011;43(8):1575-81. Scoping Review. Arch Phys Med Rehabil. 2017;98(10):2066-78 e4

6. Batacan RB, Jr., Duncan MJ, Dalbo VJ, Tucker PS, Fenning AS. Effects of high-intensity interval training on cardiometabolic health: a systematic review and meta-analysis of intervention studies. Br J Sports Med. 2017;51(6):494-503. Epub 2016/11/01.

7. Skelton DA and Mavroedi, A. How do muscle and bone strengthening and balance activities (MBSBA) vary across the life course, and are there particular ages where MBSBA are most important?. Journal of Frailty, Sarcopenia and Falls. 2018;3(2):74-84.

8. Public Health England. Muscle and bone strengthening and balance activities for general health benefits in adults and older adults: Summary of a rapid evidence review for the UK Chief Medical Officers' update of physical activity guidelines. London; 2018.

9. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act. 2017;14(1):75.

10. Smith R, Reid H, Matthews A, Calderwood C, Knight M, Foster C, et al. Infographic: physical activity for pregnant women. Br J Sports Med. 2018;52(8):532-3.

11. Sport England. Review of evidence of the outcomes for sport and physical activity: A rapid evidence review. London; 2017.

12. Department of Health, Physical Activity, Health Improvement and Protection. Start Active, Stay Active: A report on physical activity from the four home countries' Chief Medical Officers. London: Department of Health; 2011.

13. Carson V, Lee EY, Hewitt L, Jennings C, Hunter S, Kuzik N, et al. Systematic review of the relationships between physical activity and health indicators in the early years (0-4 years). Bmc Public Health. 2017;17.

14. WHO. Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age. Geneva: World Health Organisation; 2019.

15. WHO. Commission on Ending Childhood Obesity (ECHO). Geneva: World Health Organisation; 2016.

16. WHO. Report of the Commission on Ending Childhood Obesity. Implementation Plan: Executive Summary. Geneva: World Health Organisation; 2017 (WHO/NMH/PND/ECHO/17.1).

17. Cooper AR, Goodman A, Page AS, Sherar LB, Esliger DW, van Sluijs EM, et al. Objectively measured physical activity and sedentary time in youth: the International children's accelerometry database (ICAD). Int J Behav Nutr Phys Act. 2015;12:113.

18. Farooq MA, Parkinson KN, Adamson AJ, Pearce MS, Reilly JK, Hughes AR, et al. Timing of the decline in physical activity in childhood and adolescence: Gateshead Millennium Cohort Study. Br J Sports Med. 2018;52(15):1002-6.

19. Kwon S, Janz KF, Letuchy EM, Burns TL, Levy SM. Developmental Trajectories of Physical Activity, Sports, and Television Viewing During Childhood to Young Adulthood: Iowa Bone Development Study. JAMA Pediatr. 2015;169(7):666-72.

20. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U, et al. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012;380(9838):247-57.

21. Aubert S, Barnes JD, Abdeta C, Abi Nader P, Adeniyi AF, Aguilar-Farias N, et al. Global Matrix 3.0 Physical Activity Report Card Grades for Children and Youth: Results and Analysis From 49 Countries. J Phys Act Health. 2018;15(S2):S251-S73.

22. BMJ Best Practice. What is GRADE? 2011 [Available from: https://bestpractice.bmj.com/info/toolkit/learn-ebm/what-is-grade/.

23. Poitras VJ, Carson, V., Chaput, J.P., Saunders, T.J., Connor Gorber, S., Kho, M.E. and Tremblay, M.S. Canadian 24-Hour Movement Guidelines for Children and Youth: An Integration of Physical Activity, Sedentary Behaviour, and Sleep. Guideline Development Report. Ottawa; 2016.

24. Strong WB, Malina RM, Blimkie CJ, Daniels SR, Dishman RK, Gutin B, et al. Evidence based physical activity for school-age youth. J Pediatr. 2005;146(6):732-7.

25. Jago R, Solomon-Moore E, Macdonald-Wallis C, Sebire SJ, Thompson JL, Lawlor DA. Change in children's physical activity and sedentary time between Year 1 and Year 4 of primary school in the B-PROACT1V cohort. Int J Behav Nutr Phys Act. 2017;14(1):33.

26. Farooq MA, Parkinson KN, Adamson AJ, Pearce MS, Reilly JK, Hughes AR, et al. Timing of the decline in physical activity in childhood and adolescence: Gateshead Millennium Cohort Study. Br J Sports Med. 2017.

27. Telama R, Yang X, Leskinen E, Kankaanpaa A, Hirvensalo M, Tammelin T, et al. Tracking of physical activity from early childhood through youth into adulthood. Med Sci Sports Exerc. 2014;46(5):955-62.

28. Tarp J, Child A, White T, Westgate K, Bugge A, Grontved A, et al. Physical activity intensity, bout-duration, and cardiometabolic risk markers in children and adolescents. Int J Obes (Lond). 2018.

29. Chinapaw M, Klakk H, Moller NC, Andersen LB, Altenburg T, Wedderkopp N. Total volume versus bouts: prospective relationship of physical activity and sedentary time with cardiometabolic risk in children. International Journal of Obesity. 2018.

30. Barnett LM, Lai SK, Veldman SLC, Hardy LL, Cliff DP, Morgan PJ, et al. Correlates of Gross Motor Competence in Children and Adolescents: A Systematic Review and Meta-Analysis. Sports Med. 2016;46(11):1663-88.

31. Sebire SJ, Jago R, Fox KR, Edwards MJ, Thompson JL. Testing a self-determination theory model of children's physical activity motivation: a cross-sectional study. Int J Behav Nutr Phys Act. 2013;10:111.

32. Lima RA, Pfeiffer K, Larsen LR, Bugge A, Moller NC, Anderson LB, et al. Physical Activity and Motor Competence Present a Positive Reciprocal Longitudinal Relationship Across Childhood and Early Adolescence. J Phys Act Health. 2017;14(6):440-7.

33. Smith B, Kirby N, Skinner B, Wightman L, Lucas R, Foster C. Infographic. Physical activity for disabled adults. Br J Sports Med. 2019;53(6):335-6.

34. Warburton DE, Charlesworth S, Ivey A, Nettlefold L, Bredin SS. A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. Int J Behav Nutr Phys Act. 2010;7:39.

35. Murphy MH, Lahart I, Carlin A, Murtagh E. The Effects of Continuous Compared to Accumulated Exercise on Health: A Meta-Analytic Review. Sports Med. 2019.

36. Fuzeki E, Engeroff T, Banzer W. Health Benefits of Light-Intensity Physical Activity: A Systematic Review of Accelerometer Data of the National Health and Nutrition Examination Survey (NHANES). Sports Med. 2017;47(9):1769-93.

37. Thompson PD, Crouse SF, Goodpaster B, Kelley D, Moyna N, Pescatello L. The acute versus the chronic response to exercise. Med Sci Sports Exerc. 2001;33(6 Suppl):S438-45; discussion S52-3.

38. Whyte JJ, Laughlin MH. The effects of acute and chronic exercise on the vasculature. Acta Physiol (Oxf). 2010;199(4):441-50.

39. Katsanos CS. Prescribing aerobic exercise for the regulation of postprandial lipid metabolism : current research and recommendations. Sports Med. 2006;36(7):547-60.

40. Casonatto J, Goessler KF, Cornelissen VA, Cardoso JR, Polito MD. The blood pressure-lowering effect of a single bout of resistance exercise: A systematic review and meta-analysis of randomised controlled trials. Eur J Prev Cardiol. 2016;23(16):1700-14.

41. Ensari I, Greenlee TA, Motl RW, Petruzzello SJ. Meta-Analysis of Acute Exercise Effects on State Anxiety: An Update of Randomized Controlled Trials over the Past 25 Years. Depress Anxiety. 2015;32(8):624-34.

42. Ludyga S, Gerber M, Brand S, Holsboer-Trachsler E, Puhse U. Acute effects of moderate aerobic exercise on specific aspects of executive function in different age and fitness groups: A meta-analysis. Psychophysiology. 2016;53(11):1611-26.

43. Liu X, Zhang D, Liu Y, Sun X, Han C, Wang B, et al. Dose-Response Association Between Physical Activity and Incident Hypertension: A Systematic Review and Meta-Analysis of Cohort Studies. Hypertension. 2017;69(5):813-20.

44. Smith AD, Crippa A, Woodcock J, Brage S. Physical activity and incident type 2 diabetes mellitus: a systematic review and dose-response meta-analysis of prospective cohort studies. Diabetologia. 2016;59(12):2527-45.

45. Brenner DR, Shaw E, Yannitsos DH, Warkentin MT, Brockton NT, McGregor SE, et al. The association between recreational physical activity, sedentary time, and colorectal

polyps in a population screened for colorectal cancer. Cancer Epidemiol. 2018;53:12-20.

46. Ma P, Yao Y, Sun W, Dai S, Zhou C. Daily sedentary time and its association with risk for colorectal cancer in adults: A dose-response meta-analysis of prospective cohort studies. Medicine (Baltimore). 2017;96(22):e7049.

47. Eaglehouse YL, Koh WP, Wang RW, Jin AZ, Yuan JM, Butler LM. Physical activity, sedentary time, and risk of colorectal cancer: the Singapore Chinese Health Study. Eur J Cancer Prev. 2017;26(6):469-75.

48. Fassier P, Zelek L, Partula V, Srour B, Bachmann P, Touillaud M, et al. Variations of physical activity and sedentary behavior between before and after cancer diagnosis: Results from the prospective population-based NutriNet-Sante cohort. Medicine. 2016;95(40).

49. van Roekel EH, Winkler EA, Bours MJ, Lynch BM, Willems PJ, Meijer K, et al. Associations of sedentary time and patterns of sedentary time accumulation with health-related quality of life in colorectal cancer survivors. Prev Med Rep. 2016;4:262-9.

50. Patterson R, McNamara E, Tainio M, de Sa TH, Smith AD, Sharp SJ, et al. Sedentary behaviour and risk of all-cause, cardiovascular and cancer mortality, and incident type 2 diabetes: a systematic review and dose response meta-analysis. Eur J Epidemiol. 2018;33(9):811-29.

51. WHO. The Role of Physical Activity in Healthy Ageing. Geneva: World Health Organisation; 1998.

52. WHO. World report on ageing and health. Geneva: World Health Organisation; 2015.

53. Strain T, Fitzsimons C, Foster C, Mutrie N, Townsend N, Kelly P. Age-related comparisons by sex in the domains of aerobic physical activity for adults in Scotland. Prev Med Rep. 2016;3:90-7.

54. Strain T, Fitzsimons C, Kelly P, Mutrie N. The forgotten guidelines: cross-sectional analysis of participation in muscle strengthening and balance & co-ordination activities by adults and older adults in Scotland. Bmc Public Health. 2016;16(1):1108.

55. LaMonte MJ, Lewis CE, Buchner DM, Evenson KR, Rillamas-Sun E, Di CZ, et al. Both Light Intensity and Moderate-to-Vigorous Physical Activity Measured by Accelerometry Are Favorably Associated With Cardiometabolic Risk Factors in Older Women: The Objective Physical Activity and Cardiovascular Health (OPACH) Study. Journal of the American Heart Association. 2017;6(10).

56. Fuzeki E, Engeroff T, Banzer W. Health Benefits of Light-Intensity Physical Activity: A Systematic Review of Accelerometer Data of the National Health and Nutrition Examination Survey (NHANES). Sports Med. 2017;47(9):1769-93.

57. Hupin D, Roche F, Gremeaux V, Chatard JC, Oriol M, Gaspoz JM, et al. Even a low-dose of moderate-to-vigorous physical activity reduces mortality by 22% in adults aged >= 60 years: a systematic review and meta-analysis. Brit J Sport Med. 2015;49(19).

58. Fox KR, Ku PW, Hillsdon M, Davis MG, Simmonds BAJ, Thompson JL, et al. Objectively assessed physical activity and lower limb function and prospective associations with mortality and newly diagnosed disease in UK older adults: an OPAL four-year follow-up study. Age Ageing. 2015;44(2):261-8.

59. Jefferis BJ, Parsons TJ, Sartini C, Ash S, Lennon LT, Papacosta O, et al. Objectively measured physical activity, sedentary behaviour and all-cause mortality in older men: does volume of activity matter more than pattern of accumulation? Br J Sports Med. 2018.

60. Chastin SFM, De Craemer M, De Cocker K, Powell L, Van Cauwenberg J, Dall P, et al. How does light-intensity physical activity associate with adult cardiometabolic health and mortality? Systematic review with meta-analysis of experimental and observational studies. Brit J Sport Med. 2019;53(6):370-+.

61. LaMonte MJ, Buchner DM, Rillamas-Sun E, Di C, Evenson KR, Bellettiere J, et al. Accelerometer-Measured Physical Activity and Mortality in Women Aged 63 to 99. J Am Geriatr Soc. 2018;66(5):886-94.

62. Simmonds B, Fox K, Davis M, Ku PW, Gray S, Hillsdon M, et al. Objectively Assessed Physical Activity and Subsequent Health Service Use of UK Adults Aged 70 and Over: A Four to Five Year Follow Up Study. Plos One. 2014;9(5).

63. Robins LM, Jansons, P. and Haines, T. The Impact of Physical Activity Interventions on Social Isolation Among Community - Dwelling Older Adults: A Systematic Review. Research & Reviews: Journal of Nursing & Health Sciences. 2016;2(1):62-71.

64. Shvedko A, Whittaker AC, Thompson JL, Greig CA. Physical activity interventions for treatment of social isolation, loneliness or low social support in older adults: A systematic review and meta-analysis of randomised controlled trials. Psychol Sport Exerc. 2018;34:128-37.

65. Copeland JL, Ashe MC, Biddle SJ, Brown WJ, Buman MP, Chastin S, et al. Sedentary time in older adults: a critical review of measurement, associations with health, and interventions. Br J Sports Med. 2017;51(21):1539.

66. Harvey JA, Chastin SFM and Skelton DA. Breaking sedentary behaviour has the potential to increase/maintain function in frail older adults. Journal of Frailty, Sarcopenia and Falls. 2018;3(1):26-34.

67. Onambele-Pearson G, Wullems J, Doody C, Ryan D, Morse C, Degens H. Influence of Habitual Physical Behavior - Sleeping, Sedentarism, Physical Activity - On Bone Health in Community-Dwelling Older People. Front Physiol. 2019;10.

68. Dinan-Young S and Skelton DA, Physical Activity Instruction of Older Adults. 2nd edition ed. Rose DJ. Champaign, IL, USA: Human Kinetics; 2018.

69. Keevil VL, Luben R, Hayat S, Sayer AA, Wareham NJ, Khaw KT. Physical capability predicts mortality in late mid-life as well as in old age: Findings from a large British cohort study. Arch Gerontol Geriat. 2018;74:77-82.

70. Jadczak AD, Makwana N, Luscombe-Marsh N, Visvanathan R, Schultz TJ. Effectiveness of exercise interventions on physical function in community-dwelling frail older people: an umbrella review of systematic reviews. JBI Database System Rev Implement Rep. 2018;16(3):752-75.

71. Cooper R, Kuh D, Hardy R, Mortality Review G, Falcon, Teams HAS. Objectively measured physical capability levels and mortality: systematic review and meta-analysis. BMJ. 2010;341:c4467.

72. Sherrington C, Michaleff ZA, Fairhall N, Paul SS, Tiedemann A, Whitney J, et al. Exercise to prevent falls in older adults: an updated systematic review and meta-analysis. Brit J Sport Med. 2017;51(24).

73. Public Health England and the National Falls Prevention Coordination Group. Falls and fractures consensus statement: Supporting commissioning for prevention. London; 2017.

74. Iliffe S, Kendrick, D., Morris, R., Masud, T., Gage, H., Skelton, D., Dinan, S., Bowling, A., Griffin, M., Haworth, D., Swanwick, G., Carpenter, H., Kumar, A., Stevens, Z., Gawler, S., Barlow, C., Cook, J. and Belcher, C. Multicentre cluster randomised trial comparing a community group exercise programme and home-based exercise with usual care for people aged 65 years and over in primary care. Health Technology Assessment. 2014;18(49):1-105.

75. Tak E, Kuiper R, Chorus A, Hopman-Rock M. Prevention of onset and progression of basic ADL disability by physical activity in community dwelling older adults: A meta-analysis. Ageing Research Reviews. 2013;12(1):329-38.

76. Loprinzi PD, Edwards MK, Crush E, Ikuta T, Del Arco A, Id, et al. Dose-response association between physical activity and cognitive function in a national sample of older adults. American Journal of Health Promotion. 2018;.32(3).

77. Catalan-Matamoros D, Gomez-Conesa A, Stubbs B, Vancampfort D. Exercise improves depressive symptoms in older adults: An umbrella review of systematic reviews and meta-analyses. Psychiatry Res. 2016;244:202-9.

78. British Heart Foundation National Centre for Physical Activity and Health. Interpreting the UK physical activity guidelines for older adults (65+): Guidance for those who work with older adults described as actives. 2012.

79. British Heart Foundation National Centre for Physical Activity and Health. Older adults in transition: Interpreting the UK physical activity guidelines for older adults (65+). 2012.

80. British Heart Foundation National Centre for Physical Activity and Health. Interpreting the UK physical activity guidelines for older adults (65+): Guidance for those who work with frailer, older people. 2012.

81. Tudor-Locke C, Craig CL, Aoyagi Y, Bell RC, Croteau KA, De Bourdeaudhuij I, et al. How many steps/day are enough? For older adults and special populations. The International Journal of Behavioral Nutrition and Physical Activity. 2011;8(80):19.

82. Donath L, Faude O, Roth R, Zahner L. Effects of stair-climbing on balance, gait, strength, resting heart rate, and submaximal endurance in healthy seniors. Scand J Med Sci Sports. 2014;24(2):e93-101.

83. Tremblay MS, Chaput JP, Adamo KB, Aubert S, Barnes JD, Choquette L, et al. Canadian 24-Hour Movement Guidelines for the Early Years (0-4 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep. BMC Public Health. 2017;17(Suppl 5):874.

84. Okely AD, Ghersi D, Hesketh KD, Santos R, Loughran SP, Cliff DP, et al. A collaborative approach to adopting/adapting guidelines - The Australian 24-Hour Movement Guidelines for the early years (Birth to 5 years): an integration of physical activity, sedentary behavior, and sleep. BMC Public Health. 2017;17(Suppl 5):869.

85. Okely AD, Tremblay MS, Reilly JJ, Draper CE, Bull F. Physical activity, sedentary behaviour, and sleep: movement behaviours in early life. Lancet Child Adolesc. 2018;2(4):233-5.

86. Schunemann HJ, Wiercioch W, Brozek J, Etxeandia-Lkobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and

de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. J Clin Epidemiol. 2017;81:101-10.

87. Brouwers MC, Kerkvliet K, Spithoff K, Consortium ANS. The AGREE Reporting Checklist: a tool to improve reporting of clinical practice guidelines. BMJ. 2016;352:i1152.

88. Schunemann HJ, Wiercioch W, Brozek J, Etxeandia-Ikobaltzeta I, Mustafa RA, Manja V, et al. GRADE Evidence to Decision (EtD) frameworks for adoption, adaptation, and de novo development of trustworthy recommendations: GRADE-ADOLOPMENT. J Clin Epidemiol. 2017;81:101-10.

89. Okely AD, Salmon, J., Vella, S.A., Cliff, D., Timperio, A., Tremblay, M., Trost, S.G., Shilton, T., Hinkley, T., Ridgers, N., Phillipson, L., Hesketh, K., Parrish, A-M., Janssen, X., Brown, M., Emmel, J. and Marino, N. A Systematic Review to update the Australian Physical Activity Guidelines for Children and Young People. In: Health AGDo, editor. Canberra: Australian Government Department of Health; 2012

90. Health Council of the Netherlands. Physical Activity Guidelines 2017. The Hague: Health Council of the Netherlands; 2017. Publication no.: 2017/08e.

91. Bachl N, Bauer, R., Dorner, T.E., Gäbler, C., Gollner, E., Halbwachs, C., Lercher, P., Miko, H., Ring-Dimitriou, S., Samitz, G., Schober, P.H., Stein, K.V., Titze, S. and Windhaber, J. Österreichische Empfehlungen für gesundheitswirksame Bewegung. Vienna: Arbeitsgruppe Körperliche Aktivität/Bewegung/Sport der Österreichischen Gesellschaft für Public Health; 2010.

92. The Flemish Expert Group. Flemish Health Recommendations for Physical Activity and Sedentary Behaviour. Brussels: Flemish Institute for Healthy Living; 2017.

93. Pedersen BK, and Andersen, B. Physical Activity - Handbook on Prevention and Treatment. Copenhagen: National Board of Health; 2011.

94. Pfeifer K, Banzer, W., Ferrari, N., Füzéki, E., Geidl, W., Graf, C., Hartung, V., Klamroth, S., Völker, K., Vogt, L., Rütten, A., Abu-Omar, K., Burlacu, I., Gediga, G., Messing, S. and Ungerer-Röhrich, U. National Recommendations for Physical Activity and Physical Activity Promotion. Erlangen: Federal Ministry of Health; 2016.

95. Musumeci G. Physical Activity for Health - An Overview and an Update of the Physical Activity Guidelines of the Italian Ministry of Health. Journal of Functional Morphology and Kinesiology. 2016;1:269-75.

96. Owe K, Ekelund, U. and Ariansen, I. Physical Activity Public Health Report: Folkehelseinstituttet; 2014 [updated 27/09/17. Available from:

https://www.fhi.no/nettpub/hin/levevaner/fysisk-aktivitet-i-noreg---folkehel/#om-artikkelen.

97. Ministry of Health, Social Services and Equality. Physical Activity for Health and Sedentary Reduction. Recommendations for the population. Strategy of Health Promotion and Prevention in the SNS. Madrid; 2015.

98. Federal Office of Sport FOSPO, Federal Office of Public Health FOPH, Health Promotion Switzerland, bfu - Swiss Council for Accident Prevention, Swiss Accident Insurance Fund (Suva). Health-Enhancing Physical Activity. Core document for Switzerland. Magglingen; 2013.

99. Ministry of Health. Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years): A background paper. Wellington; 2012 Partial revision: 2015.

100. Al-Khudairy L, Loveman E, Colquitt JL, Mead E, Johnson RE, Fraser H, et al. Diet, physical activity and behavioural interventions for the treatment of overweight or obese adolescents aged 12 to 17 years. Cochrane Db Syst Rev. 2017(6).

101. Braaksma P, Stuive I, Garst RME, Wesselink CF, van der Sluis CK, Dekker R, et al. Characteristics of physical activity interventions and effects on cardiorespiratory fitness in children aged 6-12 years-A systematic review. J Sci Med Sport. 2018;21(3):296-306.

102. Catala-Lopez F, Hutton B, Nunez-Beltran A, Page MJ, Ridao M, Macias Saint-Gerons D, et al. The pharmacological and non-pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: A systematic review with network meta-analyses of randomised trials. PLoS One. 2017;12(7):e0180355.

103. Cattuzzo MT, Dos Santos Henrique R, Re AH, de Oliveira IS, Melo BM, de Sousa Moura M, et al. Motor competence and health related physical fitness in youth: A systematic review. J Sci Med Sport. 2016;19(2):123-9.

104. Dennison M, Sisson SB, Morris A. Obesogenic behaviours and depressive symptoms in children: a narrative literature review. Obes Rev. 2016;17(8):735-57.

105. Donnelly JE, Hillman CH, Castelli D, Etnier JL, Lee S, Tomporowski P, et al. Physical Activity, Fitness, Cognitive Function, and Academic Achievement in Children: A Systematic Review. Med Sci Sports Exerc. 2016;48(6):1223-4.

106. Lozano-Berges G, Matute-Llorente A, Gonzalez-Aguero A, Gomez-Bruton A, Gomez-Cabello A, Vicente-Rodriguez G, et al. Soccer helps build strong bones during growth: a systematic review and meta-analysis. Eur J Pediatr. 2018;177(3):295-310.

107. Marques A, Santos, D.A., Hillman, C.H., Sardinha, L.B. How does academic achievement relate to cardiorespiratory fitness, self-reported physical activity and objectively reported physical activity: a systematic review in children and adolescents aged 6–18 years. British Journal of Sports Medicine. 2017

108. Martin R, Murtagh EM. Effect of Active Lessons on Physical Activity, Academic, and Health Outcomes: A Systematic Review. Res Q Exerc Sport. 2017;88(2):149-68.

109. Ng QX, Ho CYX, Chan HW, Yong BZJ, Yeo WS. Managing childhood and adolescent attention-deficit/hyperactivity disorder (ADHD) with exercise: A systematic review. Complement Ther Med. 2017;34:123-8.

110. Santana CCA, Azevedo LB, Cattuzzo MT, Hill JO, Andrade LP, Prado WL. Physical fitness and academic performance in youth: A systematic review. Scand J Med Sci Sports. 2017;27(6):579-603.

111. Saunders TJ, Gray CE, Poitras VJ, Chaput JP, Janssen I, Katzmarzyk PT, et al. Combinations of physical activity, sedentary behaviour and sleep: relationships with health indicators in school-aged children and youth. Appl Physiol Nutr Metab. 2016;41(6 Suppl 3):S283-93.

112. Sibley KM, Beauchamp MK, Van Ooteghem K, Paterson M, Wittmeier KD. Components of Standing Postural Control Evaluated in Pediatric Balance Measures: A Scoping Review. Arch Phys Med Rehabil. 2017;98(10):2066-78 e4.

113. Strain T, Milton, K., Dall, P., Standage, M. and Mutrie, N. How are we measuring physical activity and sedentary behaviour in the four home nations of the UK? A narrative review of current surveillance measures and future directions. British Journal of Sports Medicine. 2019;0:1-9.

114. Royal National Osteoporosis Society. Strong, Steady and Straight: an expert consensus statement on physical activity and exercise for osteoporosis. Royal National Osteoporosis Society,Bath. Dec 2018. https://theros.org.uk/forms/documents/strong-steady-and-straight/

© Crown copyright 2019

This publication is licensed under the terms of the Open Government Licence v3.0 except where otherwise stated. To view this licence, visit nationalarchives.gov.uk/doc/open-government-licence/version/3

Where we have identified any third party copyright information you will need to obtain permission from the copyright holders concerned.

Published to GOV.UK in pdf format only.

Department of Health and Social Care, Llwodraeth Cymru Welsh Government, Department of Health Northern Ireland and the Scottish Government

www.gov.uk/dhsc