WHO GUIDELINES ON **PHYSICAL ACTIVITY AND SEDENTARY BEHAVIOUR**

World Health Organization

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CONTENTS

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ABBREVIATIONS AND ACRONYMS

ADHD	attention deficit hyperactive disorder
AOR	adjusted odds ratio
BMI	body mass index
CI	confidence interval
CVD	cardiovascular disease
DBP	diastolic blood pressure
EtD	Evidence to Decisions
GDG	Guideline Development Group
GRADE	Grading of Recommendations Assessment, Development and Evaluation
HR	hazards ratio
MET	Metabolic Equivalent of Task
MD	mean difference
MICT	moderate intensity continuous training
NCD	noncommunicable disease
OR	odds ratio
PA	physical activity
PAGAC	United States Physical Activity Guidelines Advisory Committee
PI/ECO	Population, Intervention/Exposure, Comparison, Outcome
RaR	Relative attributable risk
RCT	randomized control trial
RR	relative risk
SBP	systolic blood pressure
SMD	standardized mean difference
SPPB	short physical performance battery
TV	television
WHA	World Health Assembly
WHO	World Health Organization

GLOSSARY OF TERMS

Term	Definition
Aerobic physical activity	Activity in which the body's large muscles move in a rhythmic manner for a sustained period of time. Aerobic activity – also called endurance activity – improves cardiorespiratory fitness. Examples include walking, running, swimming, and bicycling.
Anaerobic physical activity	Anaerobic physical activity consists of brief intense bursts of exercise, such as weightlifting and sprints, where oxygen demand surpasses oxygen supply.
Balance training	Static and dynamic exercises that are designed to improve an individual's ability to withstand challenges from postural sway or destabilizing stimuli caused by self-motion, the environment, or other objects.
Body mass index (BMI)	Weight (kg) / height $(m)^2$
BMI-for-age or BMI z-score	BMI adjusted for age, standardized for children. BMI standard deviation scores are measures of relative weight adjusted for child age and sex. Given a child's age, sex, BMI, and an appropriate reference standard, a BMI z-score (or its equivalent BMI-for-age percentile) can be determined.
Bone-strengthening activity	Physical activity primarily designed to increase the strength of specific sites in bones that make up the skeletal system. Bone-strengthening activities produce an impact or tension force on the bones that promotes bone growth and strength. Running, jumping rope, and lifting weights are examples of bone-strengthening activities.
Cardiometabolic health	The interplay of blood pressure, blood lipids, blood glucose and insulin on health.
Cardiorespiratory fitness (endurance)	A health-related component of physical fitness. The ability of the circulatory and respiratory systems to supply oxygen during sustained physical activity. Usually expressed as measured or estimated maximal oxygen uptake (VO_2 max).
Cognitive function	Cerebral activities, i.e. reasoning, memory, attention, and language that lead to the attainment of information and knowledge. This can also include learning.
Disability	From the International Classification of Functioning, Disability and Health, an umbrella term for impairments, activity limitations, and participation restrictions, denoting the negative aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).
Domains of physical activity	Physical activity levels can be assessed in various domains, including one of more of the following: leisure-time, occupation, education, household and/or transportation.
Exercise	A subcategory of physical activity that is planned, structured, repetitive, and purposeful in the sense that the improvement or maintenance of one or more components of physical fitness is the objective. "Exercise" and "exercise training" frequently are used interchangeably and generally refer to physical activity performed during leisure time with the primary purpose of improving or maintaining physical fitness, physical performance, or health.
Executive function	Includes constructs such as: working memory, cognitive flexibility (also called flexible thinking) and inhibitory control (which includes self-control).
Fitness	A measure of the body's ability to function efficiently and effectively in work and leisure activities, and includes, for example, physical fitness and cardiorespiratory fitness.
Flexibility	A health- and performance-related component of physical fitness that is the range of motion possible at a joint. Flexibility is specific to each joint and depends on a number of specific variables including, but not limited to, the tightness of specific ligaments and tendons. Flexibility exercises enhance the ability of a joint to move through its full range of motion.
Functional exercises	Exercises that can be embedded into everyday tasks to improve lower-body strength, balance, and motor performance. Examples include tandem and one-leg stands, squatting, chair stands, toe raises, and stepping over obstacles.
Household domain physical activity	Physical activity undertaken in the home for domestic duties (such as cleaning, caring for children, gardening etc.).
Leisure-domain physical activity	Physical activity performed by an individual that is not required as an essential activity of daily living and is performed at the discretion of the individual. Such activities include sports participation, exercise conditioning or training, and recreational activities such as going for a walk, dancing, and gardening.

Term	Definition
Light-intensity physical activity	Light-intensity physical activity is between 1.5 and 3 METs, i.e. activities with energy cost less than 3 times the energy expenditure at rest for that person. This can include slow walking, bathing, or other incidental activities that do not result in a substantial increase in heart rate or breathing rate.
Major muscle groups	Major muscle groups include the legs, back, abdomen, chest, shoulders and arms.
Metabolic equivalent of task (MET)	The metabolic equivalent of task, or simply metabolic equivalent, is a physiological measure expressing the intensity of physical activities. One MET is the energy equivalent expended by an individual while seated at rest.
Moderate-intensity physical activity	On an absolute scale, moderate-intensity refers to the physical activity that is performed between 3 and less than 6 times the intensity of rest. On a scale relative to an individual's personal capacity, moderate-intensity physical activity is usually a 5 or 6 on a scale of 0–10.
Muscle-strengthening activity	Physical activity and exercise that increase skeletal muscle strength, power, endurance, and mass (e.g. strength training, resistance training, or muscular strength and endurance exercises).
Multicomponent physical activity	For older adults, multicomponent physical activity is important to improve physical function and decrease the risk of falls or injury from a fall. These activities can be done at home or in a structured group setting. Many studied interventions combine all types of exercise (aerobic, muscle strengthening, and balance training) into a session, and this has been shown to be effective. An example of a multicomponent physical activity programme could include walking (aerobic activity), lifting weights (muscle strengthening), and incorporates balance training. Examples of balance training can include walking backwards or sideways or standing on one foot while doing an upper body muscle-strengthening activity, such as bicep curls. Dancing also combines aerobic and balance components.
Occupation domain physical activity	See work domain physical activity.
Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure.
Physical inactivity	An insufficient physical activity level to meet present physical activity recommendations.
Psychosocial health	Include mental, emotional and social dimensions of health.
Recreational screen time	Time spent watching screens (television (TV), computer, mobile devices) for purposes other than those related to education/study or work.
Sedentary screen time	Time spent watching screen-based entertainment (TV, computer, mobile devices). Does not include active screen-based games where physical activity or movement is required.
Sedentary behaviour	Any waking behaviour characterized by an energy expenditure of 1.5 METS or lower while sitting, reclining, or lying. Most desk-based office work, driving a car, and watching television are examples of sedentary behaviours; these can also apply to those unable to stand, such as wheelchair users. The guidelines operationalize the definition of sedentary behaviour to include self-reported low movement sitting (leisure time, occupational, and total), television (TV viewing or screen time, and low levels of movement measured by devices that assess movement or posture).
Sport	Sport covers a range of activities performed within a set of rules and undertaken as part of leisure or competition. Sporting activities involve physical activity carried out by teams or individuals and may be supported by an institutional framework, such as a sporting agency.
Transport domain physical activity	Physical activity performed for the purpose of getting to and from places, and refers to walking, cycling and wheeling (the use of non-motorized means of locomotion with wheels, such as scooters, rollerblades, manual wheelchair etc.).
Vigorous-intensity physical activity	On an absolute scale, vigorous-intensity refers to physical activity that is performed at 6.0 or more METS. On a scale relative to an individual's personal capacity, vigorous-intensity physical activity is usually a 7 or 8 on a scale of 0–10.
Work domain physical activity	Physical activity undertaken during paid or voluntary work.

EXECUTIVE SUMMARY

The *WHO Guidelines on physical activity and sedentary behaviour* provide evidence-based public health recommendations for children, adolescents, adults and older adults on the amount of physical activity (frequency, intensity and duration) required to offer significant health benefits and mitigate health risks. For the first time, recommendations are provided on the associations between sedentary behaviour and health outcomes, as well as for subpopulations, such as pregnant and postpartum women, and people living with chronic conditions or disability.

The guidelines are intended for policy-makers in high-, middle-, and low-income countries in ministries of health, education, youth, sport and/or social or family welfare; government officials responsible for developing national, sub regional or municipal plans to increase physical activity and reduce sedentary behaviour in population groups through guidance documents; people working in nongovernmental organizations, the education sector, private sector, research; and health-care providers.

The guidelines were prepared in accordance with the *WHO handbook for guideline development*. Systematic reviews of evidence were conducted for the critical and important outcomes, and recommendations were developed after consideration of the benefits and harms, values, preferences, feasibility and acceptability, and the implications for equity and resources.

The final public health recommendations presented are for all populations and age groups ranging from 5 years to 65 years and older, irrespective of gender, cultural background or socioeconomic status, and are relevant for people of all abilities. Those with chronic medical conditions and/or disability and pregnant and postpartum women should try to meet the recommendations where possible and as able.

The development of these guidelines provide a set of evidence-based recommendations that governments can adopt as part of their national policy frameworks to support comprehensive approaches to increasing population levels of physical activity. Within the adoption process, consideration should be given to the need to contextualize the guidelines. Practical tools to support adoption, dissemination, communication campaigns and implementation of the guidelines will support governments and stakeholders work together to increase physical activity and reduce sedentary behaviours across the life course. These supporting resources will be available through the WHO website following publication of the guidelines

Despite the large quantity of supporting data relating physical activity and, increasingly, sedentary behaviours to health outcomes across the life-span, important evidence gaps remain. In particular, there is less evidence from low- and middle-income countries and economically disadvantaged or underserved communities, and a dearth of evidence from subpopulations including people living with disabilities. Investment in more research is needed to build evidence particularly in these areas. In addition, the changes introduced to these recommendations will have some implications for surveillance systems and assessment instruments currently used to monitor national levels of physical activity. Existing global and national instruments should be reviewed, and reporting protocols updated, to inform future reporting against the new guidelines.

The *Global action plan on physical activity 2018–2030* set a target to reduce physical inactivity by 15% by 2030, and outlined 20 recommended policy actions and interventions. These guidelines support all countries to implement the GAPPA recommendations and "ACTIVE", the technical package of toolkits that provides guidance on how to promote physical activity across the life course and through multiple settings.

CHILDREN AND ADOLESCENTS
(aged 5–17 years)

In children and adolescents, physical activity confers benefits for the following health outcomes: improved physical fitness (cardiorespiratory and muscular fitness), cardiometabolic health (blood pressure, dyslipidaemia, glucose, and insulin resistance), bone health, cognitive outcomes (academic performance, executive function), mental health (reduced symptoms of depression); and reduced adiposity.

At least 60 minutes a day

moderate- to vigorous-intensity physical activity across the week; most of this physical activity should be aerobic.

It is recommended that:

› **Children and adolescents should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.**

Strong recommendation, moderate certainty evidence

› **Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, should be incorporated at least 3 days a week.**

Strong recommendation, moderate certainty evidence

On at least 3 days a week

vigorous-intensity aerobic activities, as well as those that **strengthen muscle and bone** should be incorporated.

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If children and adolescents are not meeting the recommendations, doing some physical activity will benefit their health.
- Children and adolescents should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- It is important to provide all children and adolescents with safe and equitable opportunities, and encouragement, to participate in physical activities that are enjoyable, offer variety, and are appropriate for their age and ability.

In children and adolescents, higher amounts of sedentary behaviour are associated with the following poor health outcomes: increased adiposity; poorer cardiometabolic health, fitness, behavioural conduct/pro-social behaviour; and reduced sleep duration.

It is recommended that:

› **Children and adolescents should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.**

Strong recommendation, low certainty evidence

LIMIT

the amount of time spent being sedentary, particularly recreational screen time.

ADULTS
(aged 18–64 years)

In adults, physical activity confers benefits for the following health outcomes: improved all-cause mortality, cardiovascular disease mortality, incident hypertension, incident site-specific cancers,[1] incident type-2 diabetes, mental health (reduced symptoms of anxiety and depression); cognitive health, and sleep; measures of adiposity may also improve.

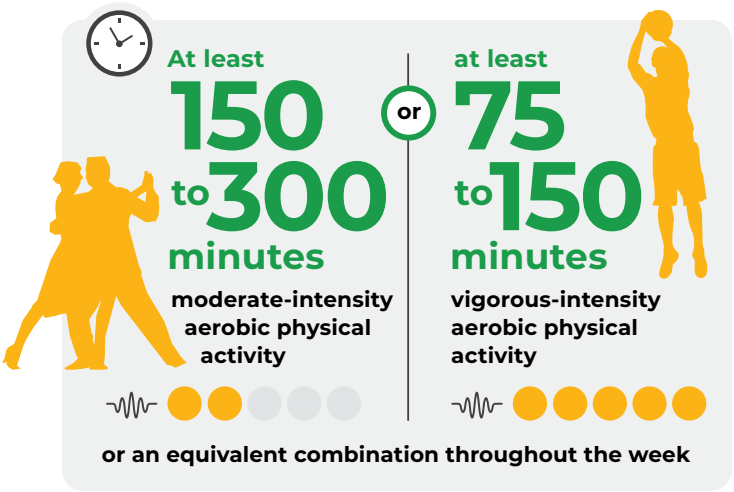
It is recommended that:

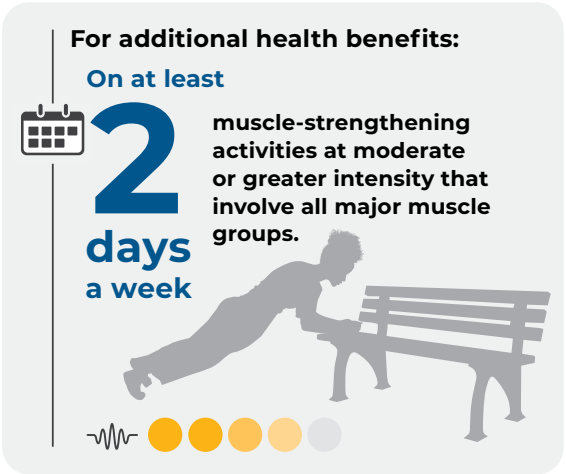
› **All adults should undertake regular physical activity.**

Strong recommendation, moderate certainty evidence

› **Adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits.**

Strong recommendation, moderate certainty evidence

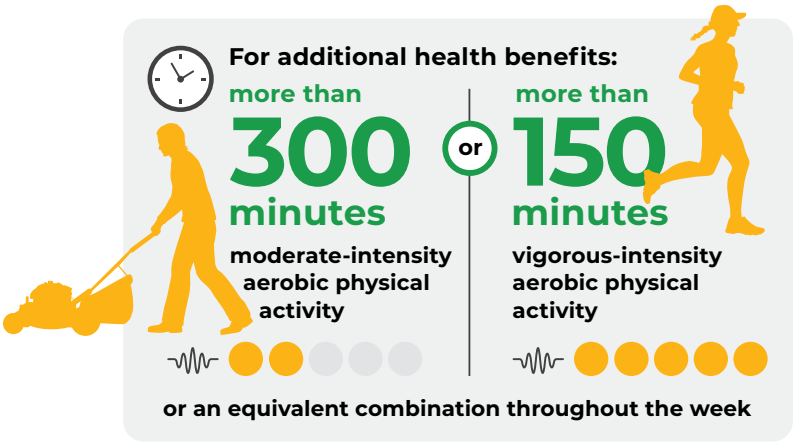




› **Adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

Strong recommendation, moderate certainty evidence

[1] *Site-specific cancers of: bladder, breast, colon, endometrial, oesophageal adenocarcinoma, gastric, and renal.*



› Adults may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.

Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If adults are not meeting these recommendations, doing some physical activity will benefit their health.
- Adults should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.

In adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and type-2 diabetes.

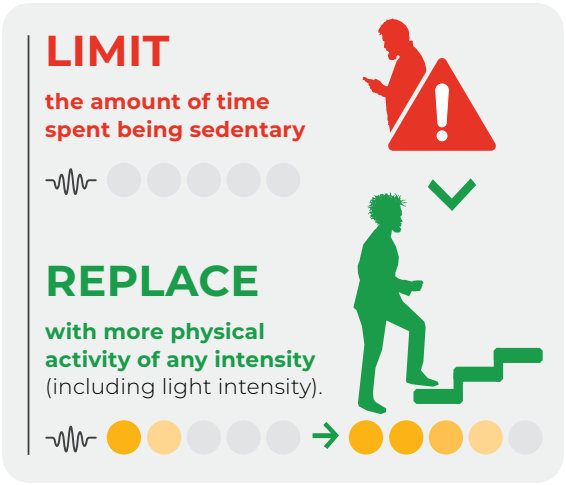
It is recommended that:

› Adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.

Strong recommendation, moderate certainty evidence

› To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.

Strong recommendation, moderate certainty evidence



OLDER ADULTS
(aged 65 years and older)

In older adults, physical activity confers benefits for the following health outcomes: improved all-cause mortality, cardiovascular disease mortality, incident hypertension, incident site-specific cancers, incident type-2 diabetes, mental health (reduced symptoms of anxiety and depression), cognitive health, and sleep; measures of adiposity may also improve. In older adults, physical activity helps prevent falls and falls-related injuries and declines in bone health and functional ability.

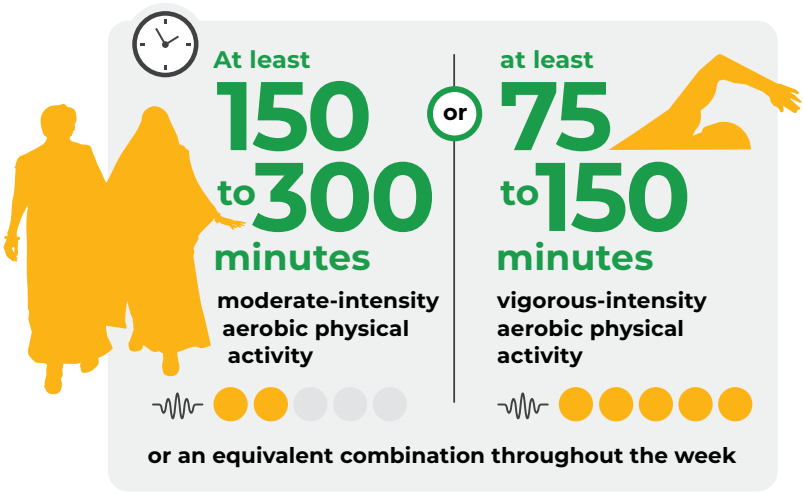
It is recommended that:

› **All older adults should undertake regular physical activity.**

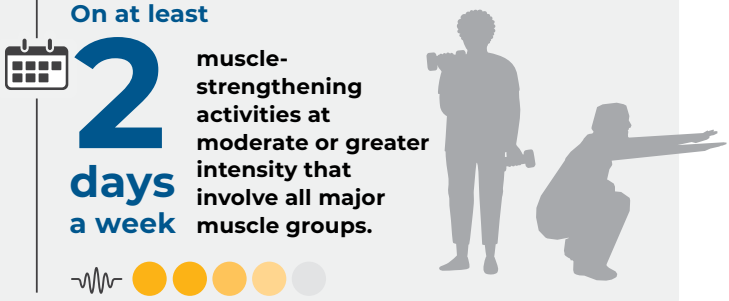
Strong recommendation, moderate certainty evidence

› **Older adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits.**

Strong recommendation, moderate certainty evidence



For additional health benefits:

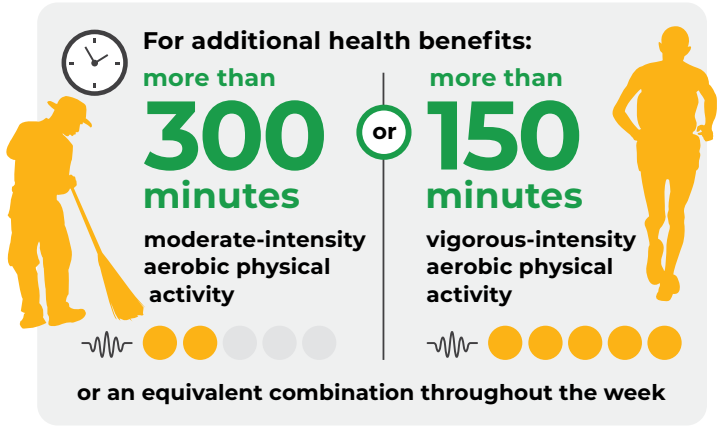


› **Older adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

Strong recommendation, moderate certainty evidence

› **As part of their weekly physical activity, older adults should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity, on 3 or more days a week, to enhance functional capacity and to prevent falls.**

Strong recommendation, moderate certainty evidence



› **Older adults may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for additional health benefits.**

Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If older adults are not meeting the recommendations, doing some physical activity will bring benefits to health.
- Older adults should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- Older adults should be as physically active as their functional ability allows, and adjust their level of effort for physical activity relative to their level of fitness.

In older adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality, and incidence of cardiovascular disease, cancer and incidence of type-2 diabetes.

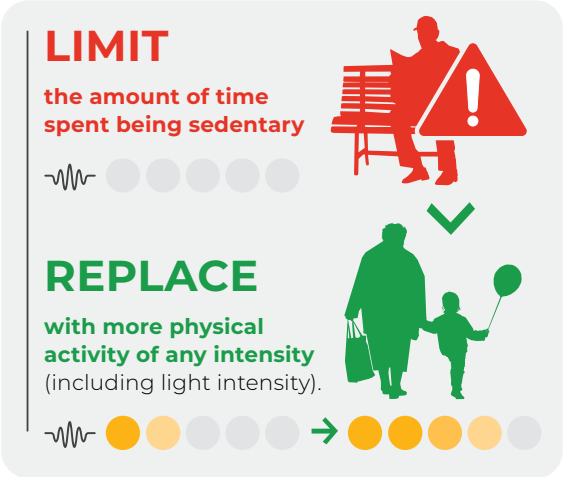
It is recommended that:

› **Older adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

Strong recommendation, moderate certainty evidence

› **To help reduce the detrimental effects of high levels of sedentary behaviour on health, older adults should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

Strong recommendation, moderate certainty evidence



PREGNANT AND POSTPARTUM WOMEN

In pregnant and postpartum women, physical activity during pregnancy and postpartum confers benefits on the following maternal and fetal health benefits: decreased risk of pre-eclampsia, gestational hypertension, gestational diabetes, excessive gestational weight gain, delivery complications and postpartum depression, and fewer newborn complications, no adverse effects on birthweight; and no increase in risk of stillbirth.

It is recommended that all pregnant and postpartum women without contraindication should:

› **Undertake regular physical activity throughout pregnancy and postpartum.**

Strong recommendation, moderate certainty evidence

› **Do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week for substantial health benefits.**

Strong recommendation, moderate certainty evidence

› **Incorporate a variety of aerobic and muscle-strengthening activities. Adding gentle stretching may also be beneficial.**

Strong recommendation, moderate certainty evidence

In addition:

› **Women who, before pregnancy, habitually engaged in vigorous-intensity aerobic activity, or who were physically active, can continue these activities during pregnancy and the postpartum period.**

Strong recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If pregnant and postpartum women are not meeting the recommendations, doing some physical activity will benefit their health.
- Pregnant and postpartum women should start by doing small amounts of physical activity, and gradually increase frequency, intensity and duration over time.
- Pelvic floor muscle training may be performed on a daily basis to reduce the risk of urinary incontinence.

Additional safety considerations for pregnant women when undertaking physical activity are:

- Avoid physical activity during excessive heat, especially with high humidity.
- Stay hydrated by drinking water before, during, and after physical activity.
- Avoid participating in activities which involve physical contact; pose a high risk of falling; or might limit oxygenation (such as activities at high altitude, when not normally living at high altitude).
- Avoid activities in supine position after the first trimester of pregnancy.
- When considering athletic competition, or exercising significantly above the recommended guidelines pregnant women should seek supervision from a specialist health-care provider.
- Pregnant women should be informed by their health-care provider of the danger signs alerting them as to when to stop; or to limit physical activity and consult a qualified health-care provider immediately should they occur.
- Return to physical activity gradually after delivery, and in consultation with a health-care provider, in the case of delivery by Caesarean section.

In pregnant and postpartum women, as in all adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and incidence of type-2 diabetes.

LIMIT

the amount of time spent being sedentary

REPLACE

with physical activity of any intensity (including light intensity).

It is recommended that:

› **Pregnant and postpartum women should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

Strong recommendation, low certainty evidence

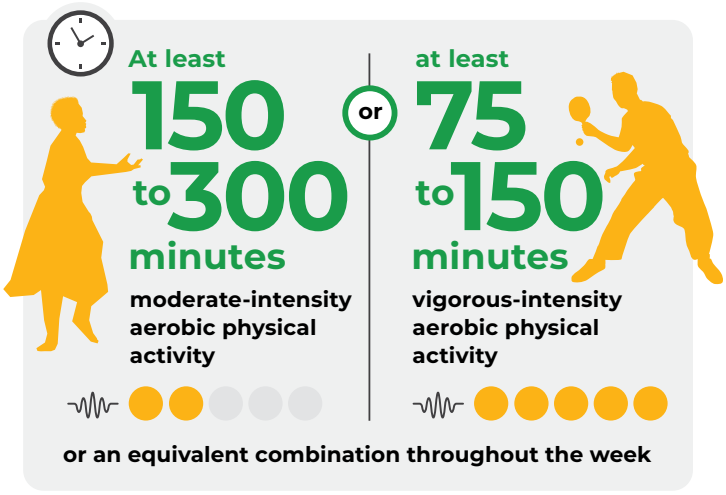
Doing some physical activity is better than doing none.

ADULTS AND OLDER ADULTS WITH CHRONIC CONDITIONS (aged 18 years and older)

Physical activity can confer health benefits for adults and older adults living with the following chronic conditions: **for cancer survivors** – physical activity improves all-cause mortality, cancer-specific mortality, and risk of cancer recurrence or second primary cancer; **for people living with hypertension** – physical activity improves cardiovascular disease mortality, disease progression, physical function, health-related quality of life; **for people living with type-2 diabetes** – physical activity reduces rates of mortality from cardiovascular disease and indicators disease progression; and **for people living with HIV** – physical activity can improve physical fitness and mental health (reduced symptoms of anxiety and depression), and does not adversely affect disease progression (CD4 count and viral load) or body composition.

It is recommended that:

› **All adults and older adults with the above chronic conditions should undertake regular physical activity.** *Strong recommendation, moderate certainty evidence*

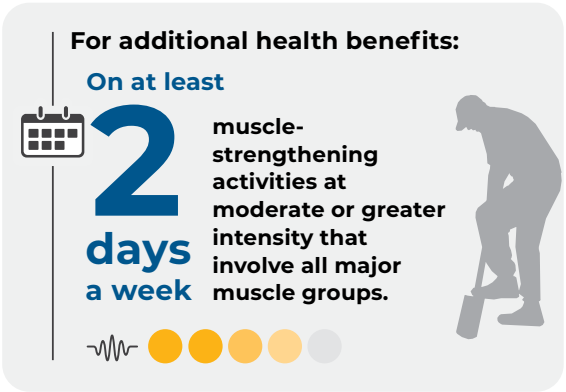


› **Adults and older adults with these chronic conditions should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for substantial health benefits.**

Strong recommendation, moderate certainty evidence

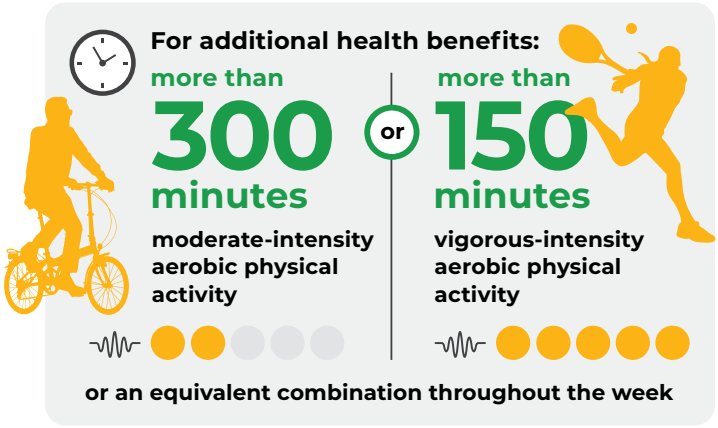
› **Adults and older adults with these chronic conditions should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional benefits.**

Strong recommendation, moderate certainty evidence



› **As part of their weekly physical activity, older adults with these chronic conditions should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity on 3 or more days a week, to enhance functional capacity and prevent falls.**

Strong recommendation, moderate certainty evidence



› **When not contraindicated, adults and older adults with these chronic conditions may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.**

Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- When not able to meet the above recommendations, adults with these chronic conditions should aim to engage in physical activity according to their abilities.
- Adults with these chronic conditions should start by doing small amounts of physical activity and gradually increase the frequency, intensity and duration over time.
- Adults with these chronic conditions may wish to consult with a physical activity specialist or health-care professional for advice on the types and amounts of activity appropriate for their individual needs, abilities, functional limitations/complications, medications, and overall treatment plan.
- Pre-exercise medical clearance is generally unnecessary for individuals without contraindications prior to beginning light- or moderate-intensity physical activity not exceeding the demands of brisk walking or everyday living.

In adults, including cancer survivors and people living with hypertension, type-2 diabetes and HIV, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality, and incidence of cardiovascular disease, cancer and incidence of type-2 diabetes.

For cancer survivors, and adults living with hypertension, type-2 diabetes and HIV, it is recommended that:

› **Adults and older adults with chronic conditions should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

Strong recommendation, low certainty evidence

› **To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults and older adults with chronic conditions should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

Strong recommendation, low certainty evidence

CHILDREN AND ADOLESCENTS (aged 5–17 years) LIVING WITH DISABILITY

Many of the health benefits of physical activity for children and adolescents, as set out in the section above, also relate to those children and adolescents living with disability. Additional benefits of physical activity to health outcomes for those living with disability include: improved cognition in individuals with diseases or disorders that impair cognitive function, including attention-deficit/hyperactivity disorder (ADHD); improvements in physical function may occur in children with intellectual disability.

It is recommended that:

› **Children and adolescents living with disability should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.**

Strong recommendation, moderate certainty evidence

› **Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone should be incorporated at least 3 days a week.**

Strong recommendation, moderate certainty evidence

Doing some physical activity is better than doing none.

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If children and adolescents living with disability are not meeting these recommendations, doing some physical activity will bring benefits to health.
- Children and adolescents living with disability should start by doing small amounts of physical activity and gradually increase the frequency, intensity and duration over time.
- There are no major risks for children and adolescents living with disability engaging in physical activity when it is appropriate to an individual's current activity level, health status and physical function; and the health benefits accrued outweigh the risks.
- Children and adolescents living with disability may need to consult a health-care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them.

In children and adolescents, higher amounts of sedentary behaviour are associated with the following poor health outcomes: increased adiposity; poorer cardiometabolic health, fitness, and behavioural conduct/pro-social behaviour; and reduced sleep duration.

It is recommended that:

› **Children and adolescents living with disability should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.**

Strong recommendation, low certainty evidence

LIMIT

the amount of time spent being sedentary, particularly recreational screen time.

Start by doing small amounts of physical activity.

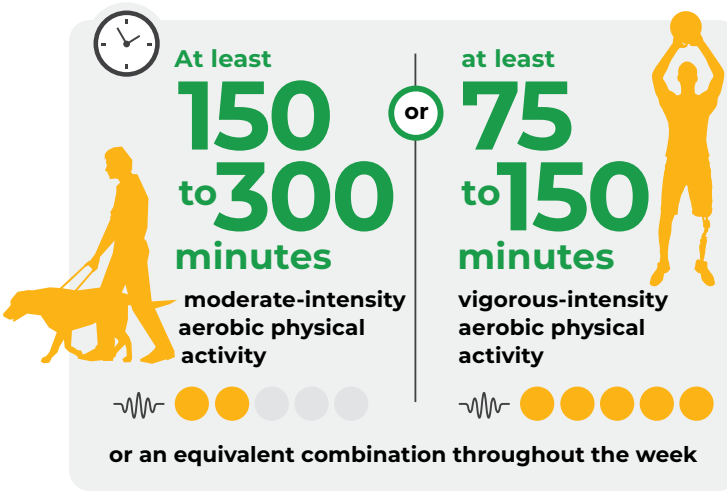
ADULTS (aged 18 years and older)
LIVING WITH DISABILITY

Many of the health benefits of physical activity for adults, as set out in the section above, also relate to adults living with disability. Additional benefits of physical activity to health outcomes for those living with disability include the following: **for adults with multiple sclerosis** – improved physical function, and physical, mental, and social domains of health-related quality of life; **for individuals with spinal cord injury** – improved walking function, muscular strength, and upper extremity function; and enhanced health-related quality of life; **for individuals with diseases or disorders that impair cognitive function** – improved physical function and cognition (in individuals with Parkinson's disease and those with a history of stroke); beneficial effects on cognition; and may improve quality of life (in adults with schizophrenia); and may improve physical function (in adults with intellectual disability); and improves quality of life (in adults with major clinical depression).

It is recommended that:

› **All adults living with disability should undertake regular physical activity.**

Strong recommendation, moderate certainty evidence

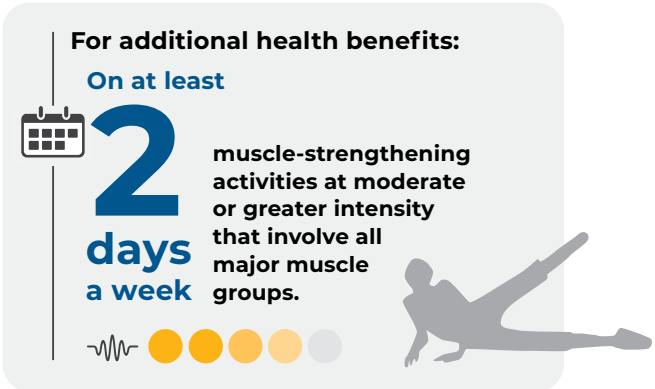


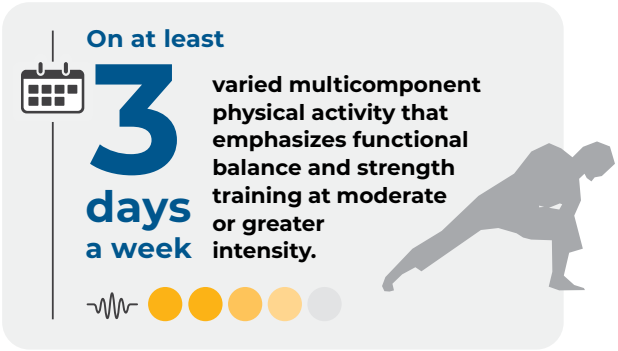
› **Adults living with disability should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for substantial health benefits.**

Strong recommendation, moderate certainty evidence

› **Adults living with disability should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

Strong recommendation, moderate certainty evidence



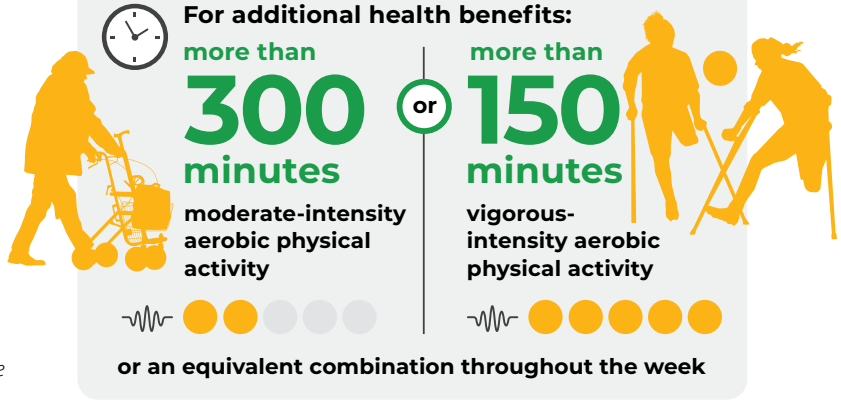


› **As part of their weekly physical activity, older adults living with disability should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity on 3 or more days a week, to enhance functional capacity and prevent falls.**

Strong recommendation, moderate certainty evidence

› **Adults living with disability may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.**

Conditional recommendation, moderate certainty evidence



GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If adults living with disability are not meeting these recommendations, doing some physical activity will bring benefits to health.
- Adults living with disability should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- There are no major risks to adults living with disability engaging in physical activity when it is appropriate to the individual's current activity level, health status and physical function; and when the health benefits accrued outweigh the risks.
- Adults living with disability may need to consult a health-care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them.

In adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and type-2 diabetes.

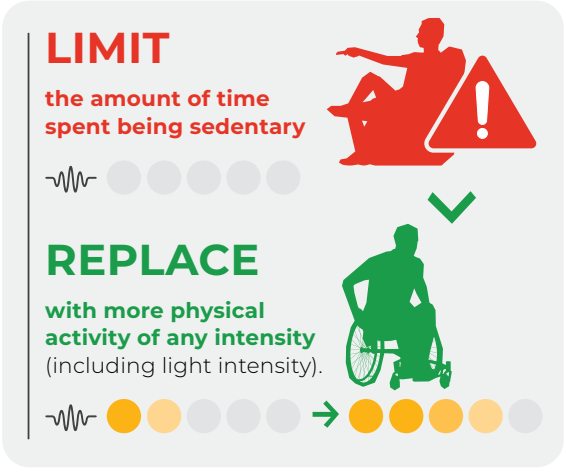
It is recommended that:

› **Adults living with disability should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

Strong recommendation, low certainty evidence

› **To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults living with disability should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

Strong recommendation, low certainty evidence



BACKGROUND

Regular physical activity is a known protective factor for the prevention and management of noncommunicable diseases such as cardiovascular disease, type-2 diabetes, breast and colon cancer *(1–3)*. Physical activity also has benefits for mental health *(4)*, delays the onset of dementia *(5)*, and can contribute to the maintenance of healthy weight *(1)* and general well-being *(6)*.

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure *(1)* and can be performed at a variety of intensities, as part of work, domestic chores, transportation or during leisure time, or when participating in exercise or sports activities. At the low end of the intensity range, sedentary behaviour is defined as any waking behaviour while in a sitting, reclining or lying posture with low energy expenditure *(7)*. Emerging new evidence indicates that high levels of sedentary behaviour are associated with cardiovascular disease and type-2 diabetes as well as cardiovascular, cancer and all-cause mortality *(8–10)*.

Physical inactivity is defined as not meeting the 2010 *Global recommendations on physical activity for health (1)* and is a leading contributor to global mortality. It is estimated that between four and five million deaths per year could be averted if the global population was more active *(2, 11)*. Global estimates of physical inactivity indicate that in 2016, 27.5% of adults *(12)* and 81% of adolescents *(13)* did not meet the 2010 WHO recommendations *(1)*, and trend data show limited global improvement during the past decade. The data also highlight that women are less active than men in most countries and that there are significant differences in levels of physical activity within and between countries and regions. These differences can be explained by inequities in access to opportunities to be physically active, further amplifying inequalities in health.

Currently, there are no global estimates of sedentary behaviour, but technological innovation and the transition towards more sedentary occupations and recreation, and the increasing use of personal motorized transportation are contributing to changing patterns of physical activity and increased sedentary behaviour across the world. The *Global action plan on physical activity 2018–2030 (14)* sets out 4 strategic objectives and 20 policy actions to achieve a 15% relative reduction in the global prevalence of physical inactivity in adults and adolescents by 2030.

In 2010, WHO published the *Global recommendations on physical activity for health (1)*, the first population-based public health guidelines for children and adolescents, adults and older adults. In 2018, the World Health Assembly, in resolution WHA71.6,[1] called for WHO to update the 2010 recommendations.

In 2019, WHO published *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age (15)*. The guidelines were called for by the Commission on Ending Childhood Obesity (recommendation 4.12) *(16)*, and address the omission of this younger age group in the 2010 *Global recommendations on physical activity for health (1)*.

The 2020 WHO *Guidelines on physical activity and sedentary behaviour,* replace the 2010 guidelines and are based on the most recent advances in the evidence for the selected behaviours and associated health consequences. They will form part of the overall set of global recommendations on physical activity and sedentary behaviour.

[1] *WHA71.6 WHO Global Action Plan on Physical Activity 2018–2030.*

OTHER KEY WHO GUIDELINES

The importance of physical activity for health is recognized in other WHO guidelines. The *WHO Package of essential noncommunicable disease interventions for primary health care in low-resource settings (17)* provides a protocol for the clinical management of hypertension, type-2 diabetes, raised cardiovascular risk, asthma, and chronic obstructive pulmonary disease, and includes counselling to progressively increase physical activity to moderate levels (such as brisk walking) and at least 150 minutes per week, in line with the 2010 global recommendations. Recent WHO guidance in *Risk reduction of cognitive decline and dementia (18)* states that physical activity should be recommended to adults with normal cognition (strong recommendation) and those with mild cognitive impairment (conditional recommendation) to reduce the risk of cognitive decline. WHO *Integrated care for older people: guidelines on community-level interventions to manage declines in intrinsic capacity (19)* recommend multimodal exercises to prevent falls, and exercises for older adults with declining mobility. *WHO recommendations on antenatal care for a positive pregnancy experience (20)* recommend counselling on healthy eating and being physically active during pregnancy to stay healthy and to prevent excessive weight gain, but do not address the wider health benefits of physical activity during pregnancy and the postpartum period.

The existing WHO guidelines, combined with these updated guidelines, provide an increasingly comprehensive set of global guidance on the contribution of physical activity and sedentary behaviours to the prevention and management of key diseases and to the promotion of health and well-being across the life course.

RATIONALE AND PURPOSE

The past 10 years has seen a significant increase in the body of evidence on the health impact of different types, amounts and durations of physical activity, as well as on the impact of sedentary behaviours and its interrelationship with levels of physical activity and health. In addition, the evidence base for physical activity in subpopulations, such as pregnant women and those living with chronic conditions and/or disability now permits the examination of the relationship between physical activity and health outcomes in these groups.

In the *Global action plan on physical activity 2018–2030 (14)*, action 4.1 calls for WHO to develop and disseminate global recommendations for physical activity and sedentary behaviours in children under 5 years of age, young people, adults, older adults and specific subpopulations, such as pregnant women, people living with chronic conditions and disability. Updating and broadening the scope of the guidelines, as requested by the World Health Assembly, ensures that population groups not included in the 2010 recommendations are provided with specific recommendations for physical activity. This aligns with the key principles and goals of the global action plan on physical activity, namely to reduce inequalities and to support all people to be more physically active every day.

The overarching purpose of these guidelines is to provide evidence-based public health recommendations on how much and what type of physical activity children and adolescents, adults, older adults and subpopulations such as pregnant women and those living with chronic conditions or disability, should do for significant health benefits and mitigation of health risks. The guidelines also provide evidence-based recommendations on the associations between sedentary behaviour and health outcomes.

The guidelines have been developed for children and adolescents (aged 5–17 years), adults (aged 18–64 years), older adults (aged 65 years and above), and include for the first time specific recommendations on physical activity for subpopulations such as pregnant women and those living with chronic conditions or disability. Recommendations are made for each specific age group and subpopulation, to provide those working with particular communities easy access to the relevant information. Providing separate recommendations for subpopulations, especially people living with chronic conditions or with disability, highlights the importance of including these subpopulations in policy and planning of physical activity and sedentary behaviour interventions.

These guidelines do not address sleep as a behaviour. Sleep is an important health-related issue and an emerging topic within population health science. However, it was deemed beyond the scope of the mandate to include sleep in the updated recommendations. Nonetheless, the importance of sleep is recognized and was included as an important health *outcome* when considering the impact of physical activity and sedentary behaviour.

TARGET AUDIENCE

This document reports the process and summarizes the evidence-base reviewed to develop the recommendations. **The primary audiences are:**

1. Policy-makers in ministries of health, education, youth, sport and/or social or family welfare, working in high as well as low- and middle-income countries, who formulate country-specific guidelines, and who plan health, education, workplace, residential or community-based intervention programmes across the life course.
2. Government officials who develop national, subregional or municipal plans to increase physical activity and reduce sedentary behaviours in population groups through guidance documents.
3. Persons working in nongovernmental organizations, education and workplace organizations or research.
4. Persons working in health services and those providing advice and guidance, such as community, family, primary or tertiary nurses or doctors, or allied health and exercise professionals working beyond the health sector. These guidelines can inform the content of their advice on these topics, if national guidance is not available.

The recommendations on physical activity and sedentary behaviour contained within the guidelines should be used to inform pre-service training and professional development courses for health-care workers, physical activity specialists and education professionals.

Derivative products are needed that convey these guidelines to specific end-users, stakeholders in sectors outside of health, and the wider community, that use tailored communications to meet the specific needs of each audience.

METHODS

These guidelines were developed in accordance with the *WHO Handbook for guideline development* (2nd edition) *(21)*. A WHO Steering Group, led by the Department of Health Promotion, was established, with representation from WHO regional offices and relevant WHO departments. A Guideline Development Group (GDG) was formed, consisting of 27 experts and stakeholders, taking into account gender balance and geographical diversity. The draft guidelines were externally reviewed by seven independent reviewers, who provided feedback on the scientific evidence, its interpretation and content. In addition, an online public consultation was conducted on the draft guidelines, and feedback was received from over 400 contributors. These inputs from scientists, practitioners and the general public were collated and used by the GDG to finalize the guidelines. Full details of the management of the guideline development process are available in Annex 1.

SCOPE OF GUIDELINES AND QUESTIONS OF INTEREST

The GDG reviewed the scope of the guidelines and, at their first meeting, agreed on the most relevant PI/ECO (**P**opulation, **I**ntervention/**E**xposure, **C**omparison, **O**utcome) questions. The key questions addressed for each subpopulation are summarized as follows:

For physical activity:

a. What is the association between physical activity and health-related outcomes?

b. Is there a dose-response association (volume, duration, frequency, intensity)?

c. Does the association vary by type or domain of physical activity?

For sedentary behaviour:

a. What is the association between sedentary behaviour and health-related outcomes?

b. Is there a dose-response association (total volume, frequency, duration and intensity of interruption)?

c. Does the association vary by type and domain of sedentary behaviour?

d. In adults only: Does physical activity modify the effect of sedentary behaviour on mortality?

For each population (P), the exposure (E) was greater volume, duration, frequency or intensity of physical activity; for, as comparison (C) no physical activity or lesser volume, frequency, intensity or duration of physical activity. The critical and important outcomes for each population are summarized in Table 1 and the details of each PI/ECO question in the relevant section of the Web Annex: Evidence profiles.

Available online at https://apps.who.int/iris/bitstream/handle/10665/336657/9789240015111-eng.pdf

Table 1: ***Summary of critical and important* health outcomes addressed by population groups***

Outcomes (in alphabetical order)	Children and adolescents aged 5–17 years: PA and sedentary	Adults aged 18–64 years: PA	Adults aged over 18 years: sedentary	Adults aged over 65 years: PA[a]	Pregnancy and postpartum	Chronic conditions[b]	Children and adults with disability[c]
Adiposity (weight gain, weight change, weight control, weight stability, weight status and weight maintenance)	Critical	Critical	Critical	Critical[a]	Critical	Critical – HIV	–
Adverse events	Critical	Critical	–	Critical[a]	Critical (fetal outcomes)	–	–
All-cause and cause-specific mortality	–	Critical (cancer and CVD specific)	Critical	Critical[a]	–	Critical	–
Bone health	Critical	–	Important	–	–	–	–
Cardiometabolic health	Critical	–	–	–	–	–	–
Cognitive outcomes	Critical	Critical	Important	Critical[a]	–	–	Critical – MS, PD, Stk, Sch, ADHD
Delivery complications	–	–	–	–	Important	–	–
Disease progression	–	–	–	–	–	Critical – HT, T2D, HIV, Critical – cancer recurrence	–
Falls and fall-related injuries	–	–	–	Critical	–	–	–
Fetal outcomes (birthweight, preterm birth)	–	–	–	–	Critical	–	–
Functional ability	–	–	–	Critical	–	–	–
Gestational diabetes mellitus	–	–	–	–	Critical	–	–
Gestational hypertension/ preeclampsia	–	–	–	–	Critical	–	–
Health-related quality of life	–	Important	Important	Important[a]	–	Critical – HT, T2D, HIV	Critical – MS, SCI, ID, MCD, Sch
Incidence of cancer	–	Critical	Critical	Critical[a]	–	–	–
Incidence of CVD	–	Critical	Critical	Critical[a]	–	–	–
Incidence of hypertension	–	Important		Important[a]	–	–	–
Incidence of type-2 diabetes	–	Critical	Critical	Critical[a]	–	–	–
Mental health (symptoms of anxiety and depression)	Critical	Critical	Important	Critical[a]	Critical	–	–
Osteoporosis	–	–	–	Critical	–	–	–
Physical fitness	Critical	–	Important	–	–	–	–
Physical function	–	–	Important	–	–	Critical – HT, T2D, HIV	Critical – MS, SCI, ID, PD, Stk
Pro-social behaviour	Important	–	–	–	–	–	–
Psychosocial outcomes	–	–	–	Important	–	–	–
Risk of co-morbid conditions	–	–	–	–	–	Critical – HT, T2D, HIV	Critical – MS, SCI, ID
Sleep	Important	Important	Important	Important[a]	–	–	–

* Critical outcome: an outcome that is critical to decision-making; Important outcome: an outcome that is important, but not critical to decision-making.

[a] The critical and important outcomes considered for the adult population, including older adults.

[b] Outcomes are for subpopulation condition as listed: Cancer – cancer survivors; HT – hypertension; T2D – type-2 diabetes; HIV.

[c] Outcomes are for subpopulation condition as listed: MS – muscular sclerosis; SCI – spinal cord injury; ID – intellectual disability; PD – Parkinson's disease; Stk – in stroke survivors; Sch – schizophrenia; ADHD – attention deficit/hyperactivity disorder. Critical and important outcomes for the age-specific population were considered and extrapolated.

THE EVIDENCE

The revision of the 2010 WHO recommendations on physical activity was conducted by identifying, and then updating, the most recent, relevant umbrella reviews related to the scope of these guidelines.

This approach was adopted due to an extensive body of recent systematic reviews which were conducted to inform the development of several national physical activity guidelines. The additional updating was undertaken to ensure the new WHO guidelines reflect the most recent available data in a rapidly developing field of public health.

Umbrella reviews were selected if they met the following three criteria: **i)** the evidence reviews had been conducted according to standard systematic processes that were well documented; **ii)** the assessment of the certainty of the evidence used the Grading of Recommendations Assessment, Development and Evaluation (GRADE) method or an equivalent methodology that was clearly described and documented; and **iii)** the evidence reviews addressed the populations of interest with no restrictions to country or country income level.

The PI/ECO questions and the critical and important health outcomes were mapped against existing evidence reviews and, where needed, additional new reviews were commissioned to address gaps. The GDG requested that the evidence reviews be updated, using the same search terms, search languages, and databases as the original reviews.

The following evidence reviews were identified as meeting the above three criteria and were chosen for recency and comprehensiveness:

- A systematic review of the literature conducted by Poitras et al. (2016) on the association between physical activity and health indicators in school-aged children and youth *(22)* as part of the process for developing the *Canadian 24-hour movement guidelines for children and youth (23)*. This review focused solely on studies that used objective measurements of physical activity. A total of 162 studies were included, representing 204 171 participants from 31 countries.
- A systematic review of the literature of the association between sedentary behaviour and health indicators in school-aged children conducted by Carson et al. (2016) *(24)*, as part of the process for developing the *Canadian 24-hour movement guidelines for children and youth (23)*. A total of 235 studies (194 unique samples) were included representing 1 657 064 unique participants from 71 countries.
- A systematic review conducted by Okely et al. (2019) *(25)* undertaken to update Poitras et al. (2016) *(22)* and Carson et al. (2018) *(24)* as part of the development of the 2019 *Australian 24-hour movement guidelines for children and young people* (aged 5–17 years) *(26)*. This report identified an additional 42 studies on physical activity, and 32 on sedentary behaviour, published through to July 2918 *(25)*. The GRADE tables developed by Okely et al. were used as the basis for the commissioned update conducted for WHO. The GRADE tables along with the evidence profiles are presented in the Web Annex: Evidence profiles.
- The 12 systematic reviews conducted and synthesized as part of the development of the *2019 Canadian guideline for physical activity throughout pregnancy (27)*. These 12 reviews assessed over 25 000 related studies in English, Spanish and French language on maternal physical activity during pregnancy that reported on maternal, fetal, or neonatal morbidity, or fetal mortality outcomes. Seven of these systematic reviews addressed outcomes deemed critical and important by the GDG *(28–34)* The GRADE tables from these evidence reviews were used as the basis for the literature search conducted to update and inform the development of WHO recommendations. The updated evidence profiles are presented in the Web Annex: Evidence profiles.
- The scientific report of the Physical Activity Guidelines Advisory Group (PAGAC) *(35)* which provides a systematic update of evidence on physical activity and sedentary behaviours and health outcomes published 2008–2016 as part of the development of the 2018 *Physical activity guidelines for Americans, 2nd Edition (36)*. The evidence summarized addressed a total of 38 main research questions and 104 subquestions selected for their public health relevance. The evidence comprised results from systematic reviews which consisted of a total of 1130 articles, each abstracted to answer the 38 research questions *(35)*. The protocols used a modified version of "A Measurement Tool to Assess Systematic Reviews" (AMSTARExBP) to assess the methodological quality of systematic reviews and meta-analyses. Risk of bias, or internal validity, was assessed for each original study using an adapted version of the USDA NEL Bias Assessment Tool (BAT) *(37)*. The new evidence identified in the updated searches conducted for these WHO guidelines is presented in the evidence profiles in the Web Annex: Evidence profiles; links are provided to the report and supplementary materials of PAGAC *(35)*.

Available online at https://apps.who.int/iris/bitstream/handle/10665/336657/9789240015111-eng.pdf

Methods for updating the evidence and data extraction

A search for systematic reviews and pooled analyses of cohort studies was conducted for studies published from the date of the last searches carried out for each of the included reviews (listed above) to September 2019; standardized data extraction protocols were developed and employed.

To update the searches conducted by Poitras et al. (2016) *(22)*, Carson et al. (2016) *(24)*, and Okely et al. (2019) *(25)*, the databases MEDLINE, EMBASE, PsycINFO, and SportDiscus were searched to identify reviews that were peer-reviewed, written in English or French. To update the searches conducted by PAGAC *(35),* PubMed, CINAHL and Cochrane databases were searched to identify reviews that were peer-reviewed, written in English. A de novo search for important outcomes, where these were not included by PAGAC *(35)*, was not conducted due to resource constraints.

Searches were performed with no restriction by country or country income status, and inclusive of reviews addressing any subjectively or objectively measured physical activity or sedentary behaviour. It was decided not to conduct searches in languages other than those of the original searches, due to resource constraints and previous experience in the field indicating that such searches yielded very few, if any, additional reviews. Reviews were considered that examined an association between physical activity or sedentary behaviour and health-related outcomes (based on levels above or below a threshold of physical activity or sedentary behaviour), and that explored the dose-response relationship between these and health-related outcomes.

An external team of reviewers used the AMSTAR 2 (Assessment of Multiple Systematic Reviews) instrument to rate the credibility of the systematic reviews under consideration for inclusion *(38)*. The AMSTAR 2 tool contains 16 items that relate to the planning and conduct of the review. The overall confidence in the results of each review was rated according to published guidance: a rating of "high" reflects that the review had zero or one noncritical weakness; "moderate" indicates the review was judged to have more than one noncritical weakness; "low" means the review was judged to have one critical flaw with or without noncritical weaknesses, or multiple noncritical weaknesses; and "critically low" signifies that more than one critical flaw was present. One reviewer completed the AMSTAR 2 tool for all provisionally included reviews. Reviews that were rated critically low by one reviewer were reviewed by a second reviewer using the same tool. Reviews ultimately rated as critically low were excluded because they were judged to be too unreliable to provide an accurate and comprehensive summary of the available evidence, unless it was the only review available for a particular outcome.

This body of evidence also included pooled cohort studies. An external team of reviewers used the Newcastle-Ottawa Scale to assess the quality of the studies *(39)*. Each study was given a quality rating of "good", "fair", or "poor". In general, a good-quality study met all criteria on the Newcastle-Ottawa scale. A fair-quality study did not meet, or it was unclear whether it met, at least one criterion, but also had no known important limitations that could invalidate its results. A poor-quality study had a single fatal flaw, or multiple important limitations. Poor-quality studies were excluded.

There was an assessment for overlap, recognizing potential for duplication of studies in multiple reviews. Reviews containing redundant bodies of evidence, overviews of reviews, and some pooled cohort studies were excluded, where other more comprehensive and/or recent reviews were identified.

Methods for new reviews

Where gaps in existing evidence were identified, new umbrella reviews were commissioned to examine:

1. the relationship between occupational (i.e. work-related) physical activity and health-related outcomes *(40);* and
2. the association between leisure-domain physical activity and adverse health outcomes *(41)*.

(For numbers 1 and 2 above, searches were undertaken using PubMed, SportDiscus and EMBASE for reviews published from 2009 to December 2019.)

3. the association between physical activity and falls prevention; the 2019 Cochrane Collaboration Systematic Review by Sherrington et al. *(42)* was used, and updated with evidence published from the end search date of their original review, through to November 2019.
4. the association between physical activity and osteoporosis and sarcopenia. The search for existing systematic reviews on osteoporosis and sarcopenia, conducted in PubMed for reviews published from 2008 up to November 2019, identified no new reviews and eight new primary studies.
5. the evidence on associations between physical activity and health outcomes in people living with HIV. A scoping review ascertained the availability of

evidence on physical activity and health-related outcomes among people living with HIV to support conducting an umbrella review which was conducted for evidence published up to October 2019 with no start date limitation using PubMed, CINAHL and Web of Science.

Summary of characteristics of the evidence and assessment methods of physical activity and sedentary behaviour

Until recently, the primary methods for measuring physical activity and sedentary behaviours in adults has been by self-report (i.e. survey) and, for children, either self-report or parental recall. Although these methods have well-established strengths, limitations include being prone to reporting bias and measurement error *(43)*. In recent years, with digital technology rapidly growing in this area, there has been an increase in the use of device-based measures for assessing physical activity and sedentary time and their associations with health outcomes. However, challenges remain in comparing results between studies due to differences between the technical features and placement of different devices (accelerometers), and differences in the analyses and reporting of the data. For example, when measuring sedentary time with device-based measures, miscalculation may occur as many of the devices do not currently distinguish between positions (e.g. lying, sitting and standing still). Difficulties also exist when comparing findings from studies using device-based measures with those reporting results from self-report measures.

Self-report instruments vary in content, in the examples of physical activity, response options and domains covered. Until recently, studies focused primarily on assessing either total physical activity, or physical activity in the leisure/recreation domain only, but now increasingly include other domains such as physical activity for transport (e.g. walking and cycling), at work, and in the household. The majority of evidence reports on associations between aerobic physical activity and health outcomes, however studies are now assessing the benefits of muscle-strengthening exercise, as well as combinations of different types of activity and other domains.

Results on the association between physical activity levels and health outcomes are reported and compared in different ways. Many studies report comparisons between quartiles or quintiles of physical activity, other studies compare those "meeting" versus "not meeting" national guidelines. Calculation of total physical activity, when reported, is usually estimated in MET-hours per week and some studies compare "highest" versus "lowest", although categories also vary across studies. The literature frequently reports results from analyses that apply data cut points based on an existing guideline, or the current WHO Global recommendation, or metrics from previous research (for example the cut points of 60 minutes per day in research on youth populations, or the frequency of 2–3 times per week for strength training intervention). When such cut points become commonplace the building of evidence on the associations of higher or lower levels of physical activity exposure on health outcomes can be limited.

Most of the evidence assessing the associations between sedentary behaviours and health outcomes for children and adolescents is cross-sectional in nature, and a majority of studies rely on self- or parent-reported measures of sedentary time that are subject to measurement errors and recall biases.

Evidence from longitudinal observational studies and intervention trials was prioritized, and reviews that solely or primarily synthesized cross-sectional evidence were not considered. Greater emphasis was given to evidence provided by reviews graded moderate certainty and above, and to those providing evidence from studies using device-based measures of exposure.

Grading the body of evidence

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) method was used to rate the certainty of the evidence for each PI/ECO *(44)*, based on the underlying evidence in the reviews. When available, the GRADE "Evidence Profiles" or "Summary of Findings" tables from each review, were used as a starting point. If no table was available within the existing systematic reviews, "Evidence Profile" tables for each population and outcome of interest were constructed.

The GRADE method was used to rate the certainty of the evidence for each PI/ECO *(44)* with the following criteria considered: study design; risk of bias; consistency of effect; indirectness; precision of effect; and other limitations, including publication bias and factors for upgrading observational evidence (magnitude of effect, dose-response, and effects of confounders). Observational evidence from well-conducted longitudinal studies was also upgraded to reflect more appropriately the increased certainty in findings regarding associations between physical

activity or sedentary behaviour and outcomes from such studies. Studies that evaluated intermediate/indirect outcomes were not necessarily downgraded, as the outcomes (including intermediate outcomes) were prioritized by the GDG; the GRADE rating reflects the certainty in effects on those outcomes. In some cases, the GRADE ratings from existing reviews were modified to ensure consistency in application of GRADE methods. The certainty in the body of evidence for each outcome was assigned based on the following guidance *(45):*

High	Very confident that the true effect lies close to that of the estimate of the effect.
Moderate	Moderately confident in the effect estimate: The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	Confidence in the effect estimate is limited: The true effect may be substantially different from the estimate of the effect.
Very low	Very little confidence in the effect estimate: The true effect is likely to be substantially different from the estimate of effect.

Going from evidence to recommendations

The GDG employed the GRADE Evidence to Decisions (EtD) framework for generating question-specific recommendations. The EtD framework is a systematic, structured and transparent approach to decision-making. The framework uses explicit criteria for generating guideline recommendations considering research evidence, certainty of evidence and, where required, expert opinion and topical knowledge from the perspective of the target audience. The criteria elicit judgments about the balance between the observed evidence of desirable and undesirable outcomes, overall certainty of evidence, relative values of patients for desirable and undesirable outcomes, resource use (cost considerations) where applicable, potential impact on inequities in health, acceptability and feasibility of recommendations.

The GDG considered the body of evidence in totality for each recommendation for all critical outcomes, and all available important outcomes. For a particular exposure/intervention and outcome link, studies differed widely in the specific exposure/intervention assessed, outcomes assessed, study design, and analytic methods, resulting in heterogeneity in the available evidence. Therefore, it was not possible to apply the classic GRADE approach to each specific exposure/intervention and outcome link; rather, GRADE was applied for the overall body of evidence addressing each exposure/intervention and outcome link, across study design types and variations in exposure/intervention measurements and analyses. When these factors resulted in concerns regarding the coherence of the evidence (i.e. that the evidence for a particular exposure/intervention and outcome link did not correspond when looked at in different ways), the panel downgraded the certainty of evidence *(21)*.

The GDG prioritized the following health outcomes to consider the effects of physical activity and sedentary behaviour: reduced all-cause and cause-specific mortality (cardiovascular disease and cancer); reduced incidence of cardiovascular disease; cancer (site-specific); type-2 diabetes; improved physical fitness (e.g. cardiorespiratory, motor development, muscular fitness); improved cardiometabolic health (e.g. blood pressure, dyslipidaemia, glucose, insulin resistance); bone health; mental health (e.g. reduction in depressive symptoms, self-esteem, anxiety symptoms, ADHD); and improved cognitive outcomes (e.g. academic performance, executive function); and reduced adiposity. Adverse effects (e.g. injuries and harms) were also considered.

Additional considerations

For each population and all PI/ECO questions, the GDG also considered values and preferences of those affected by the guidelines; the resource implications of the recommendations; the impact on health equity; and the acceptability and feasibility of the recommendations. As there was considerable duplication in these considerations, and in the GDG's assessment, for each population group, a summary of the discussions regarding assessments for these elements are described in the "Evidence to recommendations" section.

RECOMMENDATIONS

The public health recommendations presented in the *WHO Guidelines on physical activity and sedentary behaviour* are for all populations and age groups ranging from 5 years to 65 years and older, irrespective of gender, cultural background or socioeconomic status, and are relevant for people of all abilities.

The new guidelines are presented by age group and behaviour (physical activity and sedentary). For each set of recommendations, an introductory statement summarizes the health outcomes associated with physical activity and sedentary behaviour respectively; the recommendations then follow. A set of good practice statements is provided to further clarify how the recommendation can be met safely by the target population. These good practice statements are not "graded recommendations" per se, but are derived from scientific evidence and from practical considerations reviewed and recommended by the GDG.

For each set of recommendations, a summary of the supporting scientific evidence is provided, structured by the three PI/ECO questions; presenting first the evidence on the associations with the critical health outcomes, followed by a summary of evidence on dose response. Finally, a summary of evidence on the relationships between different types or domains of exposure and health outcomes is presented, where this exists.

CHILDREN AND ADOLESCENTS
(aged 5–17 years)

PHYSICAL ACTIVITY RECOMMENDATION

For children and adolescents, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), physical education, transportation (wheeling, walking and cycling) or household chores, in the context of educational, home, and community settings.

In children and adolescents, physical activity confers benefits for the following health outcomes: improved physical fitness (cardiorespiratory and muscular fitness), cardiometabolic health (blood pressure, dyslipidaemia, glucose, and insulin resistance), bone health, cognitive outcomes (academic performance, executive function), mental health (reduced symptoms of depression); and reduced adiposity.

It is recommended that:

- **Children and adolescents should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.**

  Strong recommendation, moderate certainty evidence

- **Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone, should be incorporated at least 3 days a week.**

  Strong recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If children and adolescents are not meeting the recommendations, doing some physical activity will benefit their health.
- Children and adolescents should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- It is important to provide all children and adolescents with safe and equitable opportunities, and encouragement, to participate in physical activities that are enjoyable, offer variety, and are appropriate for their age and ability.

Supporting evidence and rationale

For these guidelines for children and adolescents, systematic reviews *(22, 25, 35)* were used and updated with 16 new reviews identified that met inclusion criteria. Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

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In children and adolescents (aged 5–17 years), what is the association between physical activity and health-related outcomes?

A large body of evidence previously established that greater amounts and higher intensities of physical activity in children and adolescents are associated with multiple beneficial health outcomes *(1)*. Recent evidence reaffirms that increased physical activity improves **cardiorespiratory fitness** and **musculoskeletal fitness** in children and adolescents *(22, 35)*. For example, positive impacts are obtained when participating in moderate- to vigorous-intensity physical activity for 3 or more days per week, for 30 to 60 minutes *(22, 35)*.

Regular physical activity, largely aerobic, in children and adolescents is positively associated with beneficial **cardiometabolic health** outcomes, including improved blood pressure, lipid profile, glucose control and insulin resistance *(35)*. Recent reviews examined the effectiveness of school-based physical activity programmes *(46)*, high-intensity interval training *(47)* and resistance training *(48)*, versus no intervention on measures of cardiometabolic health. Within all 3 reviews, there was consistent evidence that interventions were associated with better cardiometabolic outcome measures, although there was varied precision in effect sizes and few individual trials found statistically significant benefits of physical activity across all cardiometabolic outcomes. One review of 19 RCTs (n= 11 988) *(46)* reported that school-based physical activity programmes were associated with statistically significant improvements in diastolic blood pressure (ES= 0.21 [95% CI: 0.42 to 0.01]; p= 0.04) and fasting insulin (ES= 0.12 [95% CI: 0.42 to 0.04]; p= 0.03) compared with no physical activity interventions.

Physical activity has been reported to be favourably associated with **adiposity**, and higher levels of activity may be associated with healthy weight status in children and adolescents *(22, 35)*. The results are generally strongest in cross-sectional studies, while the results are more mixed from prospective observational studies, which limits understanding of the directionality of the reported associations. More recent reviews of physical activity interventions trials (laboratory-based high-intensity interval training [HIIT], classroom-based active learning, resistance training) reported inconsistent results with the majority of the studies included in the reviews not reporting an effect *(47, 49, 50)*. However, a review of longitudinal and cross-sectional studies reported a negative relationship between pedometer-measured physical activity and measures of adiposity, BMI or waist circumference *(51)*. Overall there is low certainty evidence that physical activity is associated with the management of a healthy weight status and more research is needed to determine directionality and strength of association.

There is less evidence examining the association between physical activity and **motor skill development** in children and adolescents, with current reviews demonstrating null findings *(22)*. More research is needed with motor development as an outcome to inform future guidelines.

For children and adolescents, bone-loading activities can be performed as part of playing games, running, turning, or jumping. Physical activity is positively associated with bone mass accrual and/or bone structure, and recent evidence supports that children and adolescents who are more physically active than their peers have greater bone mass, higher bone mineral content or density, and greater bone strength *(35)*. Maximizing **bone health** in childhood and adolescence can help protect from osteoporosis and related fractures later in life.

Developing and maintaining cognitive function is essential across the entire lifespan. In children and adolescents, physical activity has positive effects on **cognitive function** and **academic outcomes** (e.g. school performance, memory and executive function) *(22, 35)*. One recent review (19 RCTs; n= 5038) demonstrated that exercise interventions with multiple sessions per week, for 6 weeks or longer, were associated with greater change in measures of cognitive function such as inhibitory control (SMD 0.26 [95% CI: 0.08 to 0.45], p= < 0.01); working memory (SMD 0.10 [95% CI: -0.05 to 0.25], p= < 0.02), and cognitive flexibility (SMD 0.14 [95% CI: -0.03 to 0.31], p= < 0.04) compared with no exercise interventions *(52)*. Physical activity also reduces the risk of experiencing depression and depressive symptoms in children and adolescents with and without major **depression** *(35)*, and may be comparable to psychological and pharmaceutical therapies in reducing symptoms.

Although all physical activity comes with some **risk of adverse event** *(53)* there is limited evidence reporting harms associated with physical activity levels recommended for health benefit *(35)*. Based on available evidence and expert opinion, the potential risks associated with the amounts and types of physical activity recommended for children and adolescents

were considered to be low *(35)* and can be reduced by a progressive increase in the activity level and intensity, especially in children and adolescents who are inactive. It is known that participation in some sports increases the risk of injury, as does increasing exercise intensity *(53)*. More research is needed to strengthen the knowledge base in this area.

The GDG concluded that:

- There is moderate certainty evidence that greater amounts of moderate- and vigorous-intensity physical activity are associated with improved cardiorespiratory fitness and muscular fitness, cardiometabolic health and bone health in children and adolescents.
- There is moderate certainty evidence that both short- and long-term moderate- to vigorous-intensity physical activity have positive effects on cognitive function, academic outcomes and mental health.
- There is low certainty evidence that physical activity is favourably associated with the management of healthy weight status in children and adolescents.
- There is low-certainty evidence that the risks for the amounts and types of physical activity recommended for children and adolescents are low and are outweighed by the benefits.

Is there a dose-response association (volume, duration, frequency, intensity)?

Although there is a substantial body of evidence demonstrating a positive association between physical activity and health outcomes in children and adolescents, very few studies have addressed the issue of dose-response. Therefore, the exact shape of the dose-response curve and/or the presence of threshold values (that differentiate lower versus higher risk) for physical activity and specific health outcomes is less well understood in children and adolescents compared with adult populations. Nonetheless, a substantial body of evidence shows that many of the health benefits occur with 60 minutes of physical activity daily *(22, 35)*, and given no contradictory evidence, it was concluded that the updated evidence reaffirms the current WHO recommendation for 60 minutes of moderate- to vigorous-intensity physical activity per day *(1)*.

However, the review of all evidence, including recent results from studies using device-based measures of physical activity, did not support retaining the specification of a "minimum" daily threshold of 60 minutes of moderate- to vigorous-intensity physical activity for health benefits, given that studies broadly used "an average" threshold of 60 minutes per day, not a *minimum* daily threshold of 60 minutes, to assess the benefits of physical activity on health outcomes. The review concluded that the new guideline should be amended to more closely reflect this evidence.

The benefits of regular vigorous-intensity activity on cardiometabolic health outcomes has been previously established *(1)* and recent reviews provided further supporting evidence *(35)*. For example, a recent review *(54)* showed that high-intensity interval training, compared with moderate-intensity continuous training, had a moderate beneficial effect on cardiorespiratory fitness (SMD= 0.51 [95% CI: 0.33 to 0.69], p= < 0.01; I^2= 0%). There was no evidence that intervention duration, exercise modality, exercise and rest ratio, and total bouts modified the effect on cardiorespiratory fitness. These results were consistent overall with other recent reviews *(22, 35, 47)* and provide support to retaining the recommendation that youth and adolescents should do regular vigorous-intensity activity to improve cardiorespiratory fitness.

The GDG concluded that:

- Evidence affirms the previous WHO recommendation for 60 minutes of moderate- to vigorous-intensity physical activity per day.
- Evidence supports amending the previous specification of a minimum daily threshold of 60 minutes of physical activity to an average of 60 minutes per day per week, which more closely reflects the evidence.
- There is moderate certainty evidence that greater amounts of vigorous-intensity physical activity are associated with improved cardiorespiratory fitness.

Does the association vary by type or domain of physical activity?

For children and adolescents, physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities. However, few studies have directly compared different types or domains of physical activity in children and adolescents and thus there is insufficient evidence to determine if the association between physical activity and health outcomes varies by type of activity (e.g. aerobic versus muscle-strengthening exercise) or domain of physical activity (e.g. active transport (walking and cycling) versus physical education, versus sports/recreation).

There is evidence showing that both increased levels of aerobic moderate- to vigorous-intensity physical activity are associated with increased cardiorespiratory fitness, and that increased muscle-strengthening activity increases muscular fitness in children and adolescents. This evidence informed the 2010 WHO *Global recommendations on physical activity for health (1)* which recommended incorporating activities that strengthen muscles and bones at least 3 days per week. Updated evidence reaffirmed that regular muscle-strengthening activity 3 times per week was effective for improving indicators of muscular fitness; however, there is insufficient evidence to state specific details of session duration and intensity, largely due to the heterogeneity of exposures assessed in the literature *(22, 35)*. There is less evidence for a protective effect of resistance training on cardiometabolic health. Given the absence of new evidence on characteristics other than the frequency of muscle strengthening activities for children and adolescents, such as duration, it was not possible to specify any further details. Future research should address the health benefits of specific types and domains of physical activity in order to provide more specificity to this component of the guidelines.

The GDG concluded that:

- There is moderate certainty evidence that muscle-strengthening activities should be incorporated at least 3 days a week.

SEDENTARY BEHAVIOUR RECOMMENDATION

Sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of educational, home, and community settings and transportation.

In children and adolescents, higher amounts of sedentary behaviour are associated with the following poor health outcomes: increased adiposity; poorer cardiometabolic health, fitness, behavioural conduct/pro-social behaviour; and reduced sleep duration.

It is recommended that:

› **Children and adolescents should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.**

Strong recommendation, low certainty evidence

Supporting evidence and rationale

Sedentary behaviour was not included in the WHO 2010 recommendations, yet during the past decade, there has been a growing body of research examining the health outcomes associated with different measures and types of sedentary behaviours. Technology and digital communications have influenced how people work, study, travel and spend leisure-time. In most countries, children and adolescents are spending greater time engaged in sedentary behaviours, particularly for recreation, such as screen-based entertainment (television and computers) and digital communications, such as mobile phones.

For these guidelines for children and adolescents, systematic reviews *(24, 25)* were used and updated with seven new reviews identified that met inclusion criteria. Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

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In children and adolescents (aged 5–17 years), what is the association between sedentary behaviour and health-related outcomes?

Evidence indicates that greater time spent in sedentary behaviour, especially recreational screen time, is related to poorer health outcomes *(24, 35)*. For example, higher duration of screen time (including television viewing) is associated with poorer **fitness** and **cardiometabolic health** *(24, 25)* in children and adolescents. Evidence from device-based assessment of association with sedentary behaviour and interventions studies showed modest effects, although stronger effects for those already living with obesity *(55)*. There is limited evidence suggesting that sedentary behaviour is not related to bone health in children and adolescents.

Despite more mixed results, evidence also suggests that sedentary behaviour may be associated with unfavourable measures of **adiposity** *(24, 25)*. One review of largely cross-sectional studies, reported that sedentary behaviour (measured as total screen time) of more than 2 hours per day was positively associated with childhood overweight/obesity compared with lower levels (< 2 hours/day) *(56)*. However, another review of 20 cross-sectional studies *(57)* found no statistically significant association between sedentary video gaming and body mass index among children or adolescents. A large review of 29 systematic reviews concluded that many studies report unfavourable associations between sedentary behaviour and markers of adiposity in young people when the behaviour is self-reported as some form of screen time *(55)*. However, the review noted that the magnitude of such associations was small and, for studies using device-based assessment of sedentary time, largely zero *(55)*. Intervention studies showed modest effects, although stronger effects for those already living with obesity *(55)*. Further research is needed to inform the association between sedentary behaviours and measures of adiposity.

Although still an emerging area of research, some evidence shows that there may be a negative association between sedentary behaviour and **well-being and quality of life**, as well as an unfavourable relationship between **depression** and leisure screen time in children and adolescents *(58, 59)*. For example, higher durations of sedentary behaviour, assessed as screen time, and some aspects of computer use, can be associated with poorer mental health *(24)*. In another recent review, an association between sedentary behaviour and anxiety symptoms was found in 5 of 8 studies, although results were inconsistent across different measures of sedentary behaviour within studies *(60)*. Other evidence demonstrates that higher durations of television viewing and video game use were significantly associated with unfavourable measures of **behavioural conduct/pro-social behaviour** *(24)*; and more screen time and television viewing is associated with shorter **sleep** duration, although there was no association between computer use/gaming and sleep duration *(61)*. Investigations into the relationship between sedentary behaviours and mental health is a rapidly developing field with many unknowns, and reverse causality is likely to be in evidence. Further research is needed to inform on the direction and strength of this association.

The GDG concluded that:

- There is low certainty evidence that higher duration of sedentary behaviour (screen time) is significantly associated with lower physical fitness and cardiometabolic health in children and adolescents.
- There is very low to moderate certainty evidence that higher durations of sedentary behaviour (screen time, television viewing and video game use) are significantly associated with unfavourable measures of mental health and behavioural conduct/pro-social behaviour in children and adolescents.
- There is low certainty evidence that greater time spent in sedentary behaviour (screen time and television viewing) is associated with detrimental effects on sleep duration in children and adolescents.
- The benefits of limiting the amount of sedentary behaviour for children and adolescents outweigh the harms.

Is there a dose-response association (total volume, duration, frequency, intensity of interruption)?

There is insufficient evidence available to determine whether a dose-response relationship exists between sedentary time (including recreational screen time) and health outcomes in children and adolescents. Most of the evidence assessing the associations between sedentary behaviours and health outcomes in children and adolescents is cross-sectional in nature, with low certainty evidence according to GRADE, and a majority of studies relied on self- or parent-reported measures of sedentary time that are subject to measurement errors and recall biases. There is, however, evidence that less time spent in sedentary behaviours appears to be

better for health outcomes, and the association between sedentary behaviour and adverse health outcomes is generally stronger for sedentary behaviour when assessed as television viewing or recreational screen time as the exposure variable, than for total sedentary time. However, overall the evidence was considered insufficient to support specifying time limits.

Evidence that sedentary behaviours are linked to adverse health outcomes could be the result of either direct effects of the sedentary behaviours, displacement of time spent in more physically active behaviours, or both. Although there are studies that have reported associations between screen time and adverse health outcomes in children and adolescents, total sedentary time (as assessed in studies using device-based measurements of sedentary behaviour) has consistently not been associated with health outcomes when time in moderate- to vigorous-intensity physical activity is taken into account *(62)*. Conversely, the evidence linking moderate- to vigorous-intensity physical activity to positive health outcomes is strong and well documented across diverse settings; replacing some sedentary behaviour with physical activity (especially moderate- to vigorous-intensity physical activity) may improve health outcomes.

Research investigating the associations and interplay between sedentary behaviour, physical activity and health outcomes is rapidly growing, and evidence from device-based measures of sedentary behaviour and cardiometabolic health show the association is attenuated when moderate- to vigorous-intensity physical activity is taken into account (i.e. statistically adjusted for) *(62–64)*. There is therefore a need for further prospective studies using device-based measures of exposure, to advance knowledge of these associations and inform future recommendations.

The GDG concluded that:

- There is low certainty evidence that greater time spent in sedentary behaviour is related to poorer health outcomes.
- There is insufficient evidence to specify time limits on sedentary behaviour.
- Replacing sedentary time with moderate- to vigorous-intensity physical activity may provide health benefits.

Does the association vary by type or domain of sedentary behaviour?

The study of health effects of sedentary behaviour is a relatively new field of research. As such the findings are from studies using different instruments and measures of exposure. Exposure assessed as "total time spent doing sedentary behaviours" is frequently used, as is sedentary time spent using "screens" or "television viewing". Available evidence suggests that the association between sedentary behaviour and adverse health outcomes is generally stronger for television viewing or recreational screen time than for total sedentary time *(24, 35)*. The increased use of device-based assessment of sedentary behaviour in the more recent research is advancing knowledge, and when combined with standardized reporting will help inform future guidelines.

It is acknowledged that not all sedentary behaviour is harmful. Evidence suggests certain types of sedentary behaviour, such as reading and doing homework outside of school, are associated with higher academic achievement, indicating that there are differences in outcome depending on the activity *(24, 25)*. Sedentary behaviour may include time spent engaged in educational pursuits/study or quiet play, or social interaction without electronic media. These pursuits (e.g. reading, doing puzzles, drawing, crafting, singing, music) are important for child development and have cognitive as well as other benefits.

The GDG acknowledged that:

- Some sedentary activities confer benefits for cognitive function and social interaction in children and adolescents.
- Evidence on the adverse health effects of sedentary behaviour is generally stronger for television viewing or recreational screen time than for total sedentary time.

PHYSICAL ACTIVITY RECOMMENDATION

For adults, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), transportation (wheeling, walking and cycling), work or household chores, in the context of daily occupational, educational, home and community settings.

In adults, physical activity confers benefits for the following health outcomes: improved all-cause mortality, cardiovascular disease mortality, incident hypertension, incident site-specific cancers,[1] incident type-2 diabetes, mental health (reduced symptoms of anxiety and depression); cognitive health, and sleep; measures of adiposity may also improve.

It is recommended that:

- **All adults should undertake regular physical activity.**

  Strong recommendation, moderate certainty evidence

- **Adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits.**

  Strong recommendation, moderate certainty evidence

- **Adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

  Strong recommendation, moderate certainty evidence

- **Adults may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.**

  Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If adults are not meeting these recommendations, doing some physical activity will benefit their health.
- Adults should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.

[1] *Site-specific cancers of: bladder, breast, colon, endometrial, oesophageal adenocarcinoma, gastric, and renal.*

Supporting evidence and rationale

For these guidelines, the synthesis of evidence undertaken by the United States Physical Activity Guidelines Advisory Committee (PAGAC) *(35)* was used and updated.

The GDG considered the entire body of evidence, including both the findings reported by PAGAC and the 28 reviews and 3 pooled cohort studies, published from 2017 through to November 2019, that met inclusion criteria, and contributed evidence on the association between physical activity and health-related outcomes in adults. In addition, two umbrella reviews were commissioned to address evidence gaps and examine **i)** the relationship between occupational (i.e. work-related) physical activity and health-related outcomes *(40)*; and **ii)** the association between leisure-domain physical activity and adverse health outcomes *(41)*. The umbrella reviews identified 36 and 15 systematic reviews respectively. Evidence from longitudinal observational studies and intervention trials was prioritized, and reviews that solely, or primarily, synthesized cross-sectional evidence were not considered. Greater emphasis was given to evidence provided by reviews graded moderate certainty and above, and to those providing evidence from studies using device-based measures of exposure.

Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

In adults (aged 18–64 years), what is the association between physical activity and health-related outcomes?

The association between physical activity and **all-cause mortality and cardiovascular disease mortality** in adults is already well-established *(1)*. Findings from recent reviews reaffirmed that compared with the lowest levels of physical activity, higher levels of physical activity were associated with a lower risk of mortality. New evidence from studies using device-based measures of physical activity reaffirmed and extended the evidence showing that compared with the lowest levels of physical activity, *any* level and *all intensities* (including light intensity) of physical activity, were associated with a lower risk of mortality *(65)*. For example, compared with the least active (referent, 1.00), adjusted HR for quartiles of total physical activity improved across quartiles of physical activity: 2nd quartile (0.48 [95% CI: 0.43 to 0.54]); 3rd quartile (0.34 [95% CI: 0.26 to 0.45]); and 4th quartile (0.27 [95% CI: 0.23 to 0.32]) *(65)*. New evidence also reaffirmed the well-established *(1)* inverse relationship between physical activity and **cardiovascular disease mortality** *(66)*.

The benefits of physical activity for reducing cardiovascular disease and hypertension incidence is well-documented *(1)*. Physical activity promotes many physiological responses that cause beneficial short- and long-term autonomic and haemodynamic adaptations, resulting in lowered risk of **hypertension**, which is a key risk factor for **cardiovascular disease**.

Evidence reaffirmed an inverse relationship between physical activity and incident hypertension among adults with normal blood pressure, and that physical activity reduces blood pressure among adults with prehypertension and normal blood pressure *(35)*.

The inverse association between physical activity and developing **type-2 diabetes** in adults is well-established *(1)*. Recent evidence reaffirmed an inverse curvilinear relationship between higher volumes of physical activity and incidence of type-2 diabetes *(35)*, with a decreasing slope at higher levels of physical activity. A new review found that this effect is consistent across individuals of different backgrounds with a reduced risk of developing type-2 diabetes in "highest" versus "lowest" levels of physical activity among non-Hispanic whites (RR= 0.71 [95% CI: 0.60 to 0.85]); Asians (RR= 0.76 [95% CI: 0.67 to 0.85]); Hispanics (RR = 0.74 [95% CI 0.64 to 0.84]); and American Indians (RR = 0.73 [95% CI: 0.60 to 0.88]), although the effect among non-Hispanic blacks was not significant (RR = 0.91 [95% CI: 0.76 to 1.08]) *(67)*. Evidence suggests there is no effect modification by weight status and that the inverse relationship between a higher volume of physical activity and lower incidence of type-2 diabetes exists for people who have normal weight, overweight or obesity *(35)*.

The associations between higher levels of physical activity and reduced risks of **colon cancer and breast cancer** have been well-established *(1)*. In previous reviews of the evidence, higher levels of physical activity have been found to be associated with a reduced risk of

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developing breast cancer and colon cancer *(1)*. Following an extensive increase in physical activity and cancer research, there is new evidence demonstrating higher levels of physical activity are also associated with reduced risk of developing bladder, endometrial, oesophageal adenocarcinoma, gastric and renal cancers, as well as reaffirming that physical activity is protective for breast cancer and colon cancer *(35)*. Higher levels of physical activity are associated with risk reductions ranging from approximately 10–20% *(35)*. For example, one review reported an inverse association with liver cancer risk when comparing high levels of physical activity to low levels of physical activity (HR= 0.75 [95% CI: 0.63 to 0.89]) *(68)*. There is insufficient evidence on the association between increased physical activity and decreased risks of hematologic, head and neck, ovary, pancreas, prostate, thyroid, rectal and brain cancer *(35)*. While evidence suggests a reduction in risk of lung cancer between the highest versus lowest levels of physical activity, these findings may be confounded by tobacco use and it was determined that overall there is insufficient evidence to establish an association.

The association between physical activity and **adiposity** in adult populations is less well established despite a large, but heterogenous, body of evidence assessing this relationship across various outcome measures (weight gain, weight change, weight control, weight stability, weight status and weight maintenance) *(35, 69, 70)*. Overall the evidence shows that higher levels of physical activity may be associated with more favourable measures of adiposity and attenuation of weight gain in adults *(35)*. Further research is needed to establish consistent results and strength of associations.

Research on physical activity and **mental health, cognition and sleep** has increased substantially since the development of the 2010 *Global recommendations on physical activity for health (1)*. At that time, there was sufficient evidence to conclude only that physical activity may reduce the risk of depression and cognitive decline in adults. New evidence reviewed for these guidelines showed that adults engaging in higher versus lower physical activity are at reduced risk of developing anxiety and depression. For example, adults with high, versus low, levels of physical activity were at reduced odds of developing anxiety (AOR= 0.81 [95% CI: 0.69 to 0.95]) *(71)* or depression (AOR= 0.78 [95% CI: 0.70 to 0.87) *(72)*. Greater amounts of moderate- to vigorous-intensity physical activity are associated with improvements in cognition (e.g. processing speed, memory, and executive function) *(35)*, brain function and structure, and a reduced risk of developing **cognitive impairment**, including Alzheimer's disease *(73–76)*. The evidence included several adult populations representing a gradient of normal to impaired cognitive health status and the beneficial effects of physical activity were reported across a variety of types, including aerobic activity, walking, muscle-strengthening activity, and yoga *(74)*. There is evidence that both acute bouts and regular physical activity improve **sleep and health-related quality of life** outcomes in adults *(35)*.

Evidence examining physical activity and **symptoms of depression, symptoms of anxiety, and the development of anxiety and depression** indicated that physical activity was associated with reduced symptoms of anxiety *(77, 78)* and reduced symptoms of depression *(77, 79)*.

All physical activity comes with some risk. Evidence from a commissioned review on the adverse effects, injuries and harms associated with leisure physical activity in adults *(41)* suggests an unfavourable association between levels of leisure-time physical activity and musculoskeletal injuries, and a favourable relationship between leisure-time physical activity and risk of fracture and onset of knee or hip osteoarthritis. Additional existing evidence *(35)* indicates sudden cardiac adverse events are rare and associated with acute sessions of relatively vigorous-intensity physical activity. Generally, the risks of adverse events are very low with moderate-intensity physical activity and when increases in physical activity frequency, intensity and duration are gradual *(35)*.

The GDG concluded that:

- There is high certainty evidence that any level and any intensity of physical activity is associated with lower risk of all-cause mortality and cardiovascular disease mortality, incidence of hypertension, cardiovascular disease and type-2 diabetes.
- There is moderate to high certainty evidence on the associations between higher levels of physical activity and lower risk of incidence of site-specific cancers.
- There is moderate certainty evidence supporting an association between physical activity and improvements in mental health, cognitive health and sleep outcomes.
- There is evidence of an association between higher levels of physical activity and more favourable measures of adiposity and attenuation of weight gain in adults.
- There is low certainty evidence that physical activity recommended for adults will not be harmful and that the health benefits from such activity outweigh the risks.

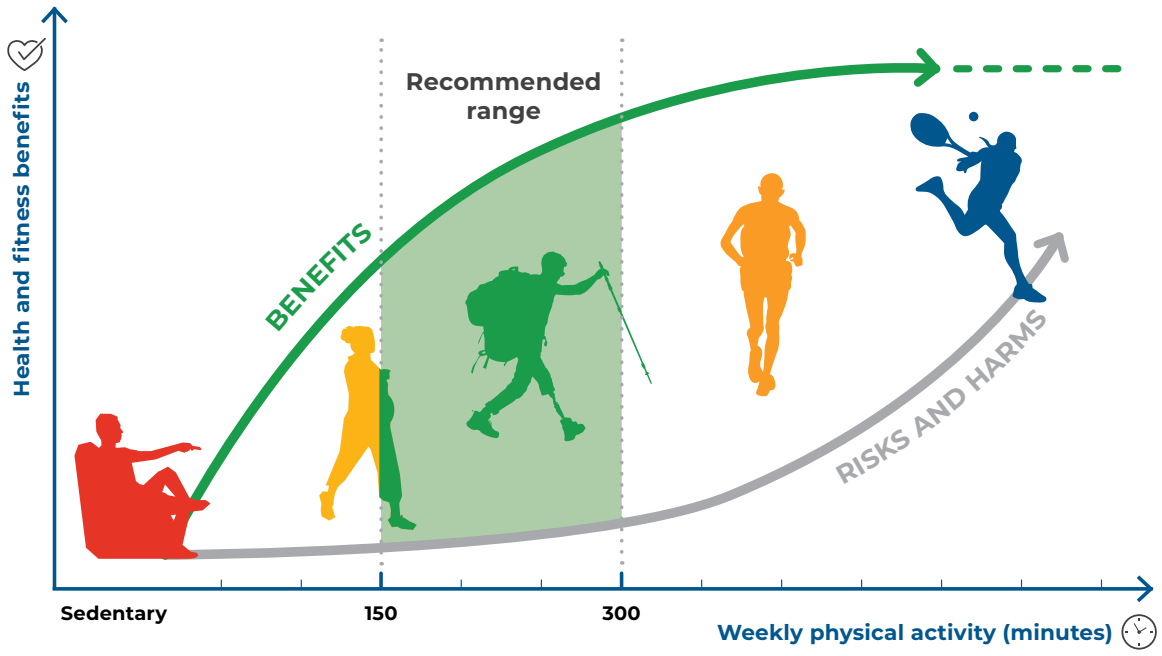

Figure 1: ***Dose response curve***

Is there a dose-response association (volume, duration, frequency, intensity)?

Overall the evidence across cardiovascular and metabolic health outcomes shows a consistent curvilinear inverse dose-response relationship between physical activity and major outcomes such as all-cause mortality, cardiovascular disease mortality, incident type-2 diabetes *(67),* and incident site-specific cancers in adults. As described in **Figure 1**, the shape of the dose-response curve indicates that there is no lower threshold for benefit, and the greatest benefits are seen at the lower end of the dose-response curve *(65)*. The curvilinear inverse association is consistently reported and across studies using different measures of physical activity. Important new evidence was provided in a meta-analysis of eight prospective cohort studies, with mean follow-up of 5.8 years (range 3–14.5 years) *(65)* that reported the adjusted HR for quartiles of total physical activity using device-based measures of exposure and **all-cause mortality**. The results showed a dose-response with increasing volume of physical activity and benefits of higher levels of *any* intensity of physical activity compared with the least active (referent, 1.00): 2nd quartile (adjusted HR= 0.48 [95% CI: 0.43 to 0.54]); 3rd quartile (adjusted HR= 0.34 [95% CI: 0.26 to 0.45]); and 4th quartile (adjusted HR= 0.27 [95% CI: 0.23 to 0.32]). Maximal risk reductions for moderate- to vigorous-intensity physical activity were observed at 24 minutes per day (equivalent to 168 minutes per week), which closely reflects the recommendation of 150 minutes per week, and provides new device-based evidence reinforcing the existing global guidance to adults of 150–300 minutes of physical activity per week *(65)*. These findings are consistent with the evidence from existing reviews *(35)* and the other new identified reviews *(66)*.

At the upper end, higher levels of physical activity continue to provide benefits in terms of reduced risk of mortality with no increased risk of harms. For example, evidence from a new review with findings from a meta-analysis of individual data from device-based measures of exposure *(65)*, indicates that although reduced risk of mortality is observed up to 750 minutes of moderate- to vigorous-intensity physical activity per week, the relative risk of mortality levels off beyond 300 minutes per week. These results accord with previous evidence which consistently showed that more physical activity is associated with further health benefits, although the relative benefits are reduced at higher levels of physical activity *(35, 80, 81)*. There is, however, insufficient evidence to identify the exact physical activity level where diminished returns of health benefits begin for adults.

Evidence also reaffirmed the well-established inverse relationship between physical activity and **cardiovascular disease mortality**, providing additional evidence of a dose-response relationship well beyond current recommended volumes of physical activity.

A meta-analysis of 48 prospective studies assessing physical activity (total, leisure, and occupational) provided additional evidence of a dose-response relationship *(66)* well beyond current recommended volumes of physical activity. Compared with the recommended level of 750 MET minutes per week, participation in 5000 MET minutes per week (1000 minutes of moderate-intensity activity) resulted in a significantly lower risk for cardiovascular disease mortality (HR= 0.73 [95% CI: 0.56 to 0.95]) *(66)*.Previous WHO recommendations *(1)* concluded that aerobic activity should be performed in bouts of at least 10 minutes duration. However, new evidence, using device-based assessments, demonstrates that physical activity of *any* duration, without a minimum threshold, is associated with improved health outcomes, including all-cause mortality *(65, 82)*. For example, new evidence from reviews of studies assessing physical activity by accelerometry reaffirms similar associations between all indices of physical activity and all-cause mortality, with hazard ratios of 0.27 for total physical activity, 0.28 for 5-minute bouts, and 0.35 for 10-minute bouts, comparing the highest versus lowest quartiles *(83)*. These results, reaffirmed by findings in the new review by Ekelund et al. 2019 *(65)*, provide evidence that physical activity of any bout duration is associated with improved health outcomes, including all-cause mortality *(82)*. Based on new evidence, the recommendation for bouts of least 10 minutes duration has been removed.

Although evidence showing the associations between higher levels of physical activity and lower risk of incidence of **site-specific cancers** was deemed to be consistent overall, there is insufficient evidence to determine the specific levels of physical activity that correspond to the reported risk reduction due to the large heterogeneity in the assessment and classification of exposure across studies. There is however, no evidence to suggest that there is a lower threshold below which no beneficial effect of physical activity is evident, thus suggesting that any level of physical activity can confer benefit on reducing the risk of site-specific cancers. Future research assessing the nature of the dose-response and using more consistent measures and reporting is needed to inform future guidelines.

Although there is a large body of evidence on the associations between physical activity and various measures of adiposity, weight gain and the management of a healthy weight status *(35)*, currently there is insufficient evidence to describe more specifically the dose-response relationship or identify a threshold of effect. Further research is needed to inform future guidelines.

Greater amounts of moderate- to vigorous-intensity physical activity are associated with improvements in **cognition** (e.g. processing speed, memory, and executive function) *(35)*, brain function and structure, and a reduced risk of developing **cognitive impairment**, including Alzheimer's disease *(73–76)*. There is evidence that both acute bouts and regular physical activity improve **sleep and health-related quality of life** outcomes in adults *(35)*. There is however insufficient evidence to describe more specifically the dose-response relationship between physical activity and individual mental and cognitive health outcomes. Similarly, more evidence is needed to further describe the dose-response relationship between volume and/or intensity of aerobic physical activity and muscle-strength training and specific health outcomes. Such information is key to establishing minimal effective doses and maximum safety thresholds of physical activity for different population subgroups.

The GDG concluded that:

- There is evidence that more physical activity is associated with larger effects on health outcomes, although the relative benefits level off at higher levels of physical activity. There was insufficient evidence to identify the exact level where diminished returns start to occur.
- There is high certainty evidence that higher levels of physical activity are associated with lower risk of all-cause mortality, cardiovascular disease mortality, cancer mortality, cardiovascular disease incidence, and incidence of hypertension and type-2 diabetes, with no increased risk of harms.
- There is moderate certainty evidence that physical activity of any duration is associated with improved health outcomes, and prior specification that aerobic activity should be performed in bouts of at least 10 minutes duration should be removed.
- There is evidence that higher amounts of physical activity may be associated with more favourable measures of adiposity and attenuation of weight gain in adults and there is a low risk that physical activity will be harmful for the management of healthy weight status in adults.
- There is moderate certainty evidence that 150–300 minutes of moderate intensity aerobic physical activity or equivalent, per week, reduces risk for multiple health outcomes, and risk reduction continues, but starts to plateau, beyond 300 minutes per week.

Does the association vary by type or domain of physical activity?

Evidence shows that different types of physical activity and physical activity undertaken in different domains (i.e. occupation, transport, or leisure) can provide favourable health outcomes. For all-cause and cardiovascular disease mortality, undertaking aerobic physical activity alone, or combining with strength-promoting exercise shows beneficial associations, although performing recommended levels of both types is optimal *(84)*.

More recent moderate certainty evidence indicates that muscle-strengthening physical activity, independent of aerobic physical activity, is also associated with lower risk of all-cause mortality. Results reported by Stamatakis et al. (2018), from a pooled analysis of 11 cohorts examining the 2 days per week muscle-strengthening exercise recommendation against all-cause mortality, showed that undertaking both aerobic and muscle-strengthening physical activity at recommended levels *(1)* versus not meeting either recommendation (adjusted HR= 0.71 [95% CI: 0.57 to 0.87]) as well as adherence to just the strength exercise recommendation versus not adhering (HR= 0.80 [95% CI: 0.70 to 0.91]) was associated with significantly lower risk of all-cause mortality *(84)*. These data affirm that health benefits associated with muscle-strengthening exercise were independent of aerobic physical activity and also provide evidence to support recommending a frequency of 2 days per week of muscle-strengthening exercise. Other findings reported by Dinu et al. (2019) provided supporting evidence reaffirming that physical activity undertaken in domains other than leisure (or recreation) can be beneficial and specifically showed that active commuting (i.e. walking and cycling for transport) can significantly lower risk of all-cause mortality (RR= 0.92 [95% CI: 0.85–0.98]) *(85)*.

Recent research provides evidence demonstrating that for those who participate in active commuting (i.e. walking or cycling for transport), there is reduced risk of cardiovascular disease (coronary heart disease, stroke and heart failure) compared with those participating in no active commuting (RR= 0.91 [95% CI 0.83 to 0.99]) *(85)*; and that there is sufficient evidence from these health outcomes to conclude that activity in different domains can be beneficial. However, there is insufficient evidence to differentiate the effect of different domains of physical activity on every health outcome. For example, there is insufficient evidence to determine if the association between physical activity and cancer risk or type-2 diabetes incidence varies by type or domain of physical activity.

For mental health outcomes, evidence *(35)* shows that a variety of types of physical activity, including aerobic activity, walking, muscle-strengthening activity, and yoga can provide beneficial effects for reducing symptoms of depression and development of anxiety *(74, 79, 86)*. For example recent evidence for the beneficial effects of resistance exercise interventions and mental health was provided by two reviews reporting moderately large reductions in symptoms of depression (77) and small reductions in symptoms of anxiety *(78)* compared with control conditions.

Evidence from a new review affirmed that high levels of occupational physical activity is associated with reduced risk of many cancers, coronary heart disease, and type-2 diabetes *(40)*. However, higher levels of occupational physical activity may also be associated with an increased risk of osteoarthritis, poor sleep quality, and all-cause mortality among males (but not among females). There is insufficient evidence to determine the relationship between occupational physical activity and adiposity, prevention of body weight gain, mental health, and health-related quality of life *(40)*. There is also insufficient evidence to determine if the association between physical activity and cancer risk varies by type or domain of physical activity. There is less evidence on associations by different domains of physical activity, and therefore it was difficult to differentiate the effect of different domains of physical activity on various health outcomes.

The GDG concluded that:

- There is moderate certainty evidence that muscle-strengthening activities undertaken on 2 or more days a week, provide additional health benefits, but there is insufficient evidence to specify a specific duration for optimal health benefits.
- There is moderate certainty evidence that physical activity undertaken in different domains (e.g. leisure, transport, occupational) can provide health benefits, although currently it is not possible to differentiate the effect of different domains of physical activity on various health outcomes.
- Although higher levels of occupational physical activity may be associated with an increased risk of osteoarthritis, poor sleep quality, and all-cause mortality among males (but not among females), overall there is moderate certainty evidence that occupational physical activity can provide health benefits.

SEDENTARY BEHAVIOUR RECOMMENDATION

For adults, sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of occupational, educational, home and community settings, and transportation.

In adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and type-2 diabetes.

It is recommended that:

- **Adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

  Strong recommendation, moderate certainty evidence

- **To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

  Strong recommendation, moderate certainty evidence

Supporting evidence and rationale

For these guidelines, the synthesis of evidence undertaken by PAGAC *(35)* was used and updated. The GDG considered the entire body of evidence, including both the findings reported by PAGAC and the 13 new reviews that met inclusion criteria, to contribute evidence on the association between sedentary behaviour and health-related outcomes in adults. Investigating the association between sedentary behaviour and health outcomes is a relatively new field of public health compared with that of physical inactivity, yet it has developed rapidly in the past decade. Studies have typically measured sedentary behaviour using either **i)** self-report questionnaires which ask about "total time" spent in sedentary behaviours, or time spent in specific behaviours, such as television viewing, computer/screen use, and sitting; or **ii)** device-based assessments. There are no standardized measures or analytical protocols for sedentary behaviour and thus the reporting of results is heterogeneous. Recent methodological developments include the use of device-based assessment of time spent sedentary which can reduce measurement error and other biases inherent in self-reported recall.

In considering the total body of evidence, the GDG gave greater emphasis to evidence provided by reviews graded moderate and above, taken from reviews providing evidence from studies using measures of total sedentary or sitting time, or device-based measures of sedentary behaviour where available.

Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

Research on the potential adverse health effects associated with sedentary behaviour has rapidly accumulated during the past decade. In more recent studies, notable developments include an increase in evidence reporting on dose-response relationships between sedentary behaviour and multiple health outcomes, and on the interplay between sedentary behaviour and physical activity.

Available online at https://apps.who.int/iris/bitstream/handle/10665/336657/9789240015111-eng.pdf

In adults (aged over 18 years), what is the association between sedentary behaviour and health-related outcomes?

Overall, there is evidence of an association between greater time spent in sedentary behaviour (examined mostly via self-reporting or device-based assessments of sitting or television viewing time) and higher all-cause mortality, cardiovascular mortality, cardiovascular disease incidence and type-2 diabetes incidence *(8, 35, 65, 87)*. For example, supporting evidence includes results from a recent large meta-analysis (*n*= 36 383; mean age 62.6 years; 72.8% women) of accelerometer assessed total sedentary time and **all-cause mortality** *(65)* and showed that increasing time spent in sedentary behaviour was significantly associated with all-cause mortality. Similar findings from a meta-analysis comprising more than 1 million participants *(87)* showed associations for total sedentary behaviour with **all-cause mortality**, and **cardiovascular disease mortality**, after adjustment for physical activity *(87)*, although in this study the associations with **cancer mortality** were not statistically significant after adjustment for physical activity *(87)*.

Another recent meta-analysis *(8)* reported significant associations between sedentary behaviour (assessed as sitting) and **cardiovascular disease and cancer mortality**, with results indicating a 9–32% (*p* for trend < 0.001) higher risk of cardiovascular disease mortality with higher levels of sedentary behaviour when measured as sitting time in the "inactive", lowest quartile of physical activity (~ 5 min/day). The study reported that adults who were sedentary (sitting) for more than 8 hours per day had a higher risk of cardiovascular disease mortality, except for those who were "most active" (i.e. > 35.5 MET-hours/week, or ~ 60–75 mins/day), where the association was mitigated. Results on the associations between sedentary behaviours and **cancer mortality** were generally weaker, although a 6–21% higher dose-related risk was observed with longer sitting time (particularly > 8 hours/day), but only among those in the lowest quartile of physical activity (< 2.5 MET-hours/week) *(8)*.

Evidence supports an association between sedentary behaviour (measured as total sitting time) and increased **incident cardiovascular disease** (HR= 1.29 [95% CI: 1.27 to 1.30]) which was attenuated following adjustment for potential covariates, including level of physical activity (HR= 1.14 [95% CI: 1.04 to 1.23]) *(88)*. A review of studies in south-east Asian populations provided evidence of low certainly that greater sedentary time was associated with an increased likelihood of unfavourable **cardiometabolic indicators** (including type-2 diabetes, higher BMI, higher blood pressure) *(89)*.

Two recent reviews report on the association of total daily sitting time *(88)* and total sedentary behaviour and television viewing *(87)* with **type-2 diabetes incidence**. Both studies found a higher level of sedentary behaviour was associated with increased risk of type-2 diabetes incidence. For example, a linear association with type-2 diabetes was observed for total sedentary behaviour (RR= 1.01 [95% CI: 1.00 to 1.01] *p*= < 0.001) and television viewing (RR= 1.09 [95% CI: 1.07 to 1.12] *p*= < 0.001), when adjusted for physical activity *(87)*.

There is also supporting evidence for a significant association between sedentary behaviour (when measured as time spent viewing television) and **cancer mortality** *(35, 87)*. Several more recent reviews, of low and very low certainty, provide supporting evidence for an association between sedentary behaviours and colorectal cancer *(90)*, but no associations with incident prostate, breast or rectal cancer *(90–93)*. Additional evidence *(35)* reported significant associations between greater time spent in sedentary behaviour and higher risk of developing endometrial, colon and lung cancers *(35)*.

There is low certainty evidence of an unfavourable relationship between time spent in sedentary behaviour and **adiposity** and other indicators of weight status, and whether the relationship between sedentary behaviour and weight status varies by amount of moderate- to vigorous-intensity physical activity. Overall, it was concluded that there was insufficient evidence to inform these recommendations/guidelines and that further research is needed.

There is limited evidence assessing adverse effects of reducing sedentary time. Expert opinion informed the conclusion that recommending the reduction in sedentary time would be unlikely to increase risk of injury, especially if replaced with light-intensity physical activity.

The GDG concluded that:

- Overall there is sufficient evidence to support the development of a new WHO recommendation to limit sedentary behaviour to reduce health risks.
- There is moderate certainty evidence of an association between greater time spent in sedentary behaviour and higher all-cause mortality, cardiovascular disease mortality, cancer mortality and incidence of cardiovascular disease and type-2 diabetes.
- There is low to moderate certainty evidence of an association between greater time spent in sedentary behaviour and higher risk of incident endometrial, colon, and lung cancers.
- There is insufficient evidence on the association between sedentary behaviour and measures of adiposity and further research is needed.
- The benefits of limiting sedentary behaviour outweigh any potential risks.

Is there a dose-response association (total volume, frequency, duration, intensity of interruption)?

Overall, moderate certainty evidence indicates a non-linear dose-response relationship between sedentary time (sitting or television viewing time assessed by self-reporting, or by device-based assessments) and all-cause mortality, cardiovascular disease mortality, cancer mortality, and incident cardiovascular disease *(8, 35, 87)*.

A recent meta-analysis provided high certainty evidence on the dose-response relationship between accelerometer assessed total sedentary time and **all-cause mortality** *(65)* reporting that increasing time spent in sedentary behaviour was significantly associated with all-cause mortality. The hazard ratios for increasing quartiles of sedentary time were 1.00 (referent; least sedentary); 1.28 (1.09– 1.51); 1.71 (1.36–2.15); and 2.63 (1.94–3.56), after adjustment for potential confounders including time spent in moderate- to vigorous-intensity physical activity *(65)*. This analysis of dose-response relations between sedentary time and mortality showed risk increased gradually from about 7.5–9 hours and was more pronounced at greater than 9.5 hours. Sedentary behaviour of 10 hours and 12 hours each day were associated with 1.48 (1.22–1.79) and 2.92 (2.24–3.83) higher risk of death, respectively *(65)*.

Another recent meta-analysis assessed dose-response and reported non-linear associations for total sedentary time and **all-cause mortality** (RR per 1 hour/day = 1.01 (1.00–1.01) for ≤ 8 hours/day; and 1.04 (1.03–1.05) for > 8 hours/day of exposure); and **cardiovascular disease mortality** (RR= 1.01 (0.99–1.02) for ≤ 6 hours/day; and RR= 1.04 (1.03–1.04) for > 6 hours/day) after adjustment for physical activity *(87)*. In this same study, a small linear dose-response association between **type-2 diabetes** was observed for total sedentary behaviour (1.01 (1.00–1.01)) when adjusted for physical activity and television viewing (1.09 (1.07–1.12)) *(87)*.

Overall, evidence supports that higher amounts of sedentary behaviour are associated with less favourable health outcomes and it was concluded that there is sufficient evidence to support minimizing sedentary time to reduce health risks. However, given the considerable variations in how sedentary behaviour was assessed across reviews (via self-reported sitting time, television viewing time, or device-based (accelerometer) assessments) and the probability that thresholds for sedentary time might vary across health outcomes, by levels of moderate- to vigorous-intensity physical activity, and among population subgroups, there is insufficient evidence to set a time-based (quantified) recommendation.

In addition to overall volume of sedentary behaviour, evidence on the patterns by which sedentary behaviour is accrued was reviewed. However, there was limited evidence to make recommendations on the frequency and/or duration of breaks in sedentary behaviour.

The GDG concluded that:

- There is insufficient evidence to set quantified (time-based) recommendations on sedentary behaviours.
- There is insufficient evidence to make recommendations on the frequency and/or duration of breaks in sedentary behaviour.

Does the association vary by type and domain of sedentary behaviour?

Some domains or different types of sedentary behaviour may be more detrimental than others, both in terms of their direct associations and in their potential to displace time spent in more healthful physical activity. Although there has been a rapid growth in research on sedentary behaviour, there is limited evidence available directly comparing the association between different types of sedentary behaviour and different health outcomes. For example, some studies report stronger results with sedentary behaviour measured as television viewing compared with total sitting time *(87)*. This may be due to the differential measurement error or residual confounding associated with self-report measures and instruments. Currently, there is insufficient evidence to determine the different associations with different health outcomes and how these may vary by subpopulation.

A growing number of studies are using device-based measures of physical activity and sedentary time in relation to health outcomes. However, some misclassification may occur from device-based measures of sedentary time as many of these device placements (e.g. wrist, waist) do not currently distinguish between positions (e.g. lying, sitting and standing still). Future research using harmonized reporting, and methods that distinguish between positions, will help to strengthen the knowledge on the patterns of sedentary behaviour.

The GDG concluded that:

- There is insufficient evidence to make recommendations on different types or domains of sedentary behaviour.

Does level of physical activity modify the effect of sedentary behaviour on mortality?

The increased interest in the impact of sedentary behaviour on health outcomes has stimulated investigation into the potential interplay between different levels of physical activity and levels of sedentary behaviour. Based on available research, there is moderate certainty evidence that the relationship between sedentary behaviour and **all-cause mortality**, **cardiovascular disease mortality** and **cancer mortality** varies by amount of moderate- to vigorous-intensity physical activity *(8, 9, 35)*. Overall findings show that the effect of sedentary behaviour is stronger in those who do low amounts of moderate- to vigorous-intensity physical activity or, phrased conversely, that higher amounts of moderate- to vigorous-intensity physical activity can mitigate the unfavourable health outcomes associated with higher levels of sedentary behaviours.

The risk associated with sedentary time and all-cause mortality has been shown to be more pronounced at lower levels of physical activity than at higher levels *(35)*. In a harmonized meta-analysis, Ekelund et al. investigated the joint and stratified effects of sedentary behaviour and physical activity with **all-cause mortality** in more than 1 million men and women, and showed that the associations differed depending on the level of physical activity *(9)*. The analyses used quartiles of sedentary behaviour (sitting) and quartiles of moderate- to vigorous-intensity physical activity, and found that compared with the referent (< 4 hours of sitting per day and highest quartile of moderate- to vigorous-intensity physical activity [> 35.5 MET-hours/week]), there was no increased risk of dying during follow-up in those who sat for more than 8 hours per day but who also reported more than 35.5 MET-hours per week of activity (HR= 1.04 [95% CI: 0.99 to 1.10]). In contrast, those who sat the least (< 4 hours/day) and were in the lowest (< 2.5 MET-hours/week) physical activity quartile had a significantly increased risk of dying during follow-up (HR= 1.27 [95% CI: 1.22 to 1.31]). The study concluded that levels of moderate- to vigorous-intensity physical activity of about 60–75 minutes per day (the highest quartile) can attenuate, and even eliminate, the detrimental association between sedentary behaviour and health outcomes *(9)*.

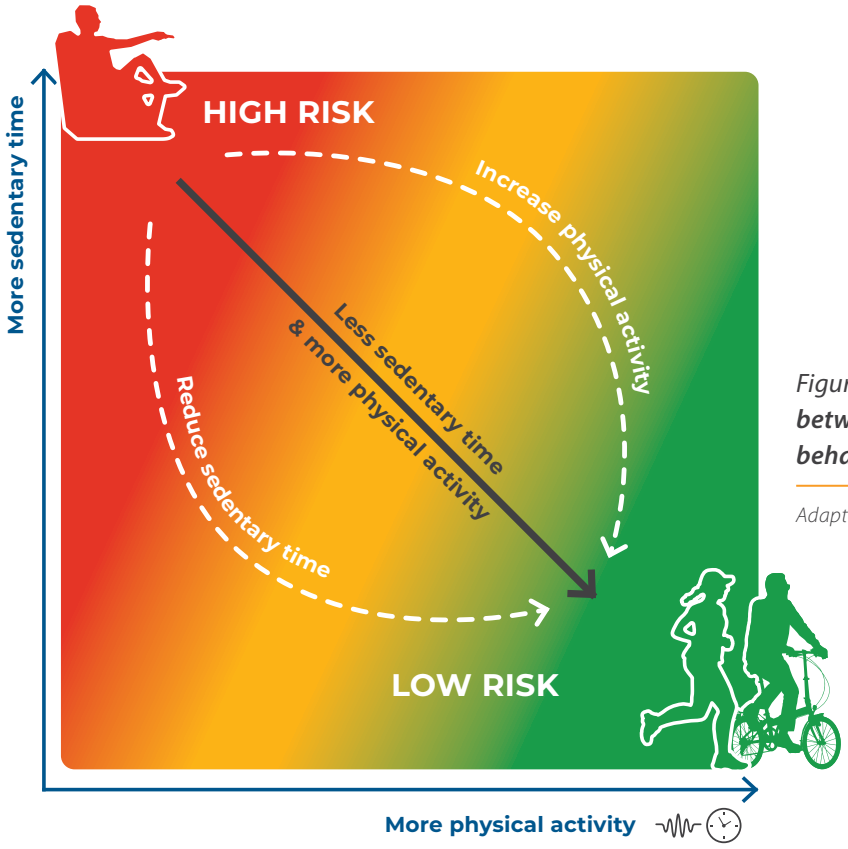

Figure 2: ***The relationship between levels of sedentary behaviour and physical activity***

Adapted from PAGAC

This relationship between levels of sedentary behaviour and moderate- to vigorous-intensity physical activity was summarized in the systematic review by PAGAC *(35)* as shown in **Figure 2**.

Another recent study provided new evidence investigating the same associations with cause-specific mortality and showed similar findings *(8)*. In a large harmonized meta-analysis (9 studies, *n*= 850 000, CVD mortality; 8 studies, *n*= 777 000, cancer mortality), results showed that higher levels of moderate- to vigorous-intensity physical activity mitigated the increased risk of **cardiovascular disease mortality** with high levels of sedentary behaviour, whether measured as time spent sitting or time spent viewing television *(8)*. The study showed that in individuals who were sitting for more than 8 hours per day, there was an association with higher risk of death, except in the most active quartile, where the association was mitigated. More specifically, the hazard of cardiovascular disease mortality was 32% higher in those who sat for more than 8 hours per day compared with the reference group (< 4 hours/day) (*p* for trend < 0.001). The results were less pronounced but remained significant compared with the reference group for the other quartiles of physical activity (2nd quartile, HR= 1.11 [95% CI: 1.03 to 1.20]; 3rd quartile, HR= 1.14 [95% CI: 1.03 to 1.26]). Similar associations were observed for television time and cardiovascular disease mortality across strata of moderate- to vigorous-intensity physical activity *(8)*. The associations for **cancer mortality** were more mixed, although generally showed that higher levels of physical activity attenuated the detrimental effects of sedentary behaviour when assessed as total sitting time.

Based on this evidence, it was agreed that higher levels of moderate- to vigorous-intensity physical activity should be recommended for those individuals who undertake high levels of sedentary behaviour and that the benefits would outweigh the risks.

The GDG concluded that:

- There is moderate certainty evidence that the relationship between sedentary behaviour and all-cause mortality, cardiovascular disease and cancer mortality varies by amount of moderate- to vigorous-intensity physical activity.
- Higher amounts of moderate- to vigorous-intensity physical activity can attenuate the detrimental association between sedentary behaviour and health outcomes.

OLDER ADULTS
(aged 65 years and older)

PHYSICAL ACTIVITY RECOMMENDATION

For older adults, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), transportation (wheeling, walking and cycling), work, or household chores, in the context of daily occupational, educational, home or community settings.

In older adults, physical activity confers benefits for the following health outcomes: improved all-cause mortality, cardiovascular disease mortality, incident hypertension, incident site-specific cancers, incident type-2 diabetes, mental health (reduced symptoms of anxiety and depression), cognitive health, and sleep; measures of adiposity may also improve. In older adults, physical activity helps prevent falls and falls-related injuries and declines in bone health and functional ability.

It is recommended that:

- **All older adults should undertake regular physical activity.**

  Strong recommendation, moderate certainty evidence

- **Older adults should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for substantial health benefits.**

  Strong recommendation, moderate certainty evidence

- **Older adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

  Strong recommendation, moderate certainty evidence

- **As part of their weekly physical activity, older adults should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity, on 3 or more days a week, to enhance functional capacity and to prevent falls.**

  Strong recommendation, moderate certainty evidence

- **Older adults may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week, for additional health benefits.**

  Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If older adults are not meeting the recommendations, doing some physical activity will bring benefits to health.
- Older adults should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- Older adults should be as physically active as their functional ability allows, and adjust their level of effort for physical activity relative to their level of fitness.

Supporting evidence and rationale

For these guidelines, for older adults, the comprehensive synthesis of evidence undertaken by PAGAC *(35)* was used and updated. Fifteen reviews met the inclusion criteria and informed the examination of the association between physical activity and health-related outcomes specific to older adults (falls prevention, fall-related injuries, physical function, frailty, and osteoporosis).

The evidence for falls prevention used and updated the 2019 Cochrane Collaboration Systematic Review by Sherrington et al. *(42)*, with evidence published from the end search date of their original review, to November 2019 (9 new studies). A search for existing systematic reviews on osteoporosis and sarcopenia was conducted in PubMed for reviews published from 2008 through to November 2019 and identified no new reviews and 8 new studies.

Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

In older adults (aged 65 years and over), what is the association between physical activity and health-related outcomes?

The primary evidence base for assessing the associations between physical activity and health outcomes, such as all-cause and cause-specific mortality, cardiovascular disease, type-2 diabetes, cancer incidence, adiposity, mental health, and cognitive outcomes in older adult populations was the same scientific literature collated and reviewed for adult populations. This same body of evidence was accepted and extrapolated to older adults because the majority of studies stated no upper age limit criterion and therefore included adults over the age of 65 years.

A further review of evidence was conducted to examine and inform on the association between physical activity and health-related outcomes specific to older adults, including falls prevention, fall-related injuries, physical function, frailty and osteoporosis.

Declining physical capacity in older people often manifests in falls and fall-related injuries that can have serious consequences. Accidental falls are due to a combination of extrinsic (environmental) and intrinsic (e.g. musculoskeletal or nervous system abnormalities affecting postural control) factors. Evidence demonstrates that physical activity – in particular multicomponent physical activity programmes that include combinations of balance, strength, endurance, gait, and physical function training – is associated with a reduced rate of **falls** and risk of **injury from falls** in older adults. Recent evidence demonstrates that exercise may reduce the rate of falls by as much as 23% (pooled rate ratio (RaR) 0.77 [95% CI: 0.71 to 0.83]) in older adults, which can significantly reduce the risk of injury from falls, including severe falls that result in bone fracture, head trauma, open wound, soft tissue injury, or any other injury requiring medical care or admission to hospital *(42)*. This evidence was consistent with, and reaffirmed findings in, other reviews *(35)*.

After reaching a peak in early adulthood, muscle and bone mass tends to decline with increasing age (i.e. sarcopaenia and osteopaenia/osteoporosis), and this can be associated with declining strength and physical function. Evidence demonstrates that regular physical activity improves **physical function** and reduces the risk of age-related loss of physical function in older adults. Findings show beneficial effects on dynamic balance (SMD= 1.10 [95% CI: 0.29 to 1.90]); muscle strength (SMD= 1.13 [95% CI: 0.30 to 1.96]); flexibility (SMD= 1.22 [95% CI: 0.39 to 2.04]); and cardiorespiratory fitness (SMD= 1.48 [95% CI: 0.42 to 2.54]) *(94)*. Evidence also shows that higher levels of physical activity may improve bone health and thus prevent **osteoporosis** in older adults (pooled standardized effect size 0.21 [95% CI: 0.06 to 0.36]) *(95)*. Physical activity interventions may improve lumbar spine and femoral neck (hip) bone mineral density.

The GDG concluded that:

- There is moderate certainty evidence that physical activity improves physical function and reduces risk of age-related loss of physical function in the general ageing population.
- There is low-certainty evidence that the risks for the amounts and types of physical activity recommended for older adults are low and are outweighed by the benefits.

Available online at https://apps.who.int/iris/bitstream/handle/10665/336657/9789240015111-eng.pdf

Is there a dose-response association (volume, duration, frequency, intensity)?

Evidence shows an inverse relationship between the amount of physical activity performed by older adults and the risk of physical function limitations. In general, more physical activity (frequency, duration and/or volume) is associated with greater benefits *(35)*. Evidence suggests that fast-intended velocity resistance training may be superior to moderate-velocity resistance training for improvements in general functional capacity (SMD= 0.41 [95% CI: 0.18 to 0.65]; and SPPB (SMD= 0.52 [95% CI: 0.10 to 0.94])) *(96)*.

There is limited evidence examining the dose-response relationship between physical activity and prevention of falls; however the majority of studies providing supportive evidence show testing a programme consistent with 3 days per week.

The GDG concluded that:

- There is high certainty evidence of an inverse dose-response relationship between volume of aerobic physical activity and risk of physical functional limitations in the general older adult population.

Does the association vary by type or domain of physical activity?

Physical activity programmes that include combinations of balance, strength, endurance, gait, and physical function training are associated with a reduced rate of falls and risk of injury from falls in older adults.

Evidence from a review of 11 RCT showed that by engaging in a variety of different physical activity interventions (commonly balance and functional exercises plus resistance exercises), older adults can reduce rate of falls by up to 28% (RaR= 0.72 [95% CI: 0.56 to 0.93]) *(42)*. The effect of resistance exercises was uncertain and based on limited data (RR= 0.97 [95% CI: 0.14 to 6.49]; 1 trial; *n*= 73) *(42)*.

Evidence also suggests that programmes which include multiple exercise types have greater positive effects on bone health (standardized effect size 0.45 [95% CI: 0.20 to 0.71]; *p*= 0.001), compared with those which do not *(95)*.

The GDG concluded that:

- There is high certainty evidence that higher levels of physical activity that combines balance, strength, gait, and functional training (e.g. multicomponent physical activity) are associated with a reduced rate of falls and risk of injury from falls in older adults.
- There is moderate certainty evidence that programmes involving multiple exercise types may have significant effects on bone health and osteoporosis prevention.

SEDENTARY BEHAVIOUR RECOMMENDATION

For older adults, sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of occupational, educational, home and community settings and transportation.

In older adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality, and incidence of cardiovascular disease, cancer and incidence of type-2 diabetes.

It is recommended that:

- **Older adults should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

  Strong recommendation, moderate certainty evidence

- **To help reduce the detrimental effects of high levels of sedentary behaviour on health, older adults should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

  Strong recommendation, moderate certainty evidence

Supporting evidence and rationale

Sedentary behaviour was not included in the 2010 *Global recommendations on physical activity for health (1)*. Due to a lack of population-specific evidence, the primary evidence base for assessing the associations between sedentary behaviour and health outcomes in older adult populations was the same scientific literature collated and reviewed for adult populations because the majority of studies stated no upper age limit criterion and therefore included adults over the age of 65 years. The findings from evidence on sedentary behaviours in the general adult population were reviewed, including assessing if there was evidence that the outcomes would be any different, or would not apply to, or would be contraindicated, for older adults.

Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

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PREGNANT AND POSTPARTUM WOMEN

These guidelines address physical activity and maternal and fetal health outcomes during pregnancy and the postpartum period. They are for all pregnant and postpartum women, irrespective of age, cultural background, or socioeconomic status. Pregnancy and the period after delivery are stages in a woman's life, and the benefits of being physically active throughout adulthood are detailed in the recommendations provided for adults.

Pregnant and postpartum women should be under the care of a health-care provider for antenatal and postnatal care who can advise on special considerations given their medical history and any contraindications to participating in physical activity during pregnancy or in the postpartum period. These guidelines are public health and population-based. Clinical guidance should be sought for women with complications associated with pregnancy or delivery.

Pregnant and postpartum women should try to meet these recommendations where possible, as able, and without contraindication.

PHYSICAL ACTIVITY RECOMMENDATION

For pregnant and postpartum women, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), transportation (wheeling, walking and cycling), work, household chores, in the context of daily occupational, educational, home and community settings.

> In pregnant and postpartum women, physical activity during pregnancy and postpartum confers benefits on the following maternal and fetal health benefits: decreased risk of pre-eclampsia, gestational hypertension, gestational diabetes, excessive gestational weight gain, delivery complications and postpartum depression, and fewer newborn complications, no adverse effects on birthweight; and no increase in risk of stillbirth.

It is recommended that all pregnant and postpartum women without contraindication should:

- **undertake regular physical activity throughout pregnancy and postpartum;**

  Strong recommendation, moderate certainty evidence

- **do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week for substantial health benefits; and**

  Strong recommendation, moderate certainty evidence

- **incorporate a variety of aerobic and muscle-strengthening activities. Adding gentle stretching may also be beneficial.**

  Strong recommendation, moderate certainty evidence

In addition:

- **Women who, before pregnancy, habitually engaged in vigorous-intensity aerobic activity, or who were physically active, can continue these activities during pregnancy and the postpartum period.**

  Strong recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If pregnant and postpartum women are not meeting the recommendations, doing some physical activity will benefit their health.
- Pregnant and postpartum women should start by doing small amounts of physical activity, and gradually increase frequency, intensity and duration over time.
- Pelvic floor muscle training may be performed on a daily basis to reduce the risk of urinary incontinence.

Additional safety considerations for pregnant women when undertaking physical activity are:

- Avoid physical activity during excessive heat, especially with high humidity;
- Stay hydrated by drinking water before, during, and after physical activity;
- Avoid participating in activities which involve physical contact; pose a high risk of falling; or might limit oxygenation (such as activities at high altitude, when not normally living at high altitude);
- Avoid activities in supine position after the first trimester of pregnancy;
- When considering athletic competition, or exercising significantly above the recommended guidelines pregnant women should seek supervision from a specialist health-care provider;
- Pregnant women should be informed by their health-care provider of the danger signs alerting them as to when to stop; or to limit physical activity and consult a qualified health-care provider immediately should they occur;
- Return to physical activity gradually after delivery, and in consultation with a health-care provider, in the case of delivery by Caesarean section.

Supporting evidence and rationale

For these *Guidelines on physical activity and sedentary behaviour* (2020) for pregnant and postpartum women, the evidence syntheses from 7 systematic reviews addressing the critical and important outcomes *(28–34)* were used and updated. Four of the 7 reviews met inclusion criteria.

Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

In pregnant and postpartum women, what is the association between physical activity and health-related outcomes?

Physical activity before and during pregnancy can help reduce the risk of common complications of pregnancy. Engaging in physical activity during pregnancy is significantly associated with reduced **gestational weight gain** (MD= 1.14 kg [95% CI: 1.67 to 0.62]) *(97)*, and a reduced risk of **gestational diabetes** (RR= 0.71 [95% CI: 0.57 to 0.89]) *(97)*, as is being physically active before pregnancy (OR= 0.70 [95% CI: 0.57 to 0.85]) *(31, 34, 97)*, including in women with overweight or obesity *(97)*.

Physical activity during pregnancy does not appear to increase the incidence of **gestational hypertension or preeclampsia** *(31)*. Evidence suggests that among pregnant women with overweight or obesity, there is no significant difference in the incidence of gestational hypertension (RR= 0.63 [95% CI: 0.38 to 1.05]) or in preeclampsia (RR= 1.39 [95% CI: 0.66 to 2.93]) between physical activity intervention groups versus standard antenatal care *(97)*.

There have been long-standing concerns about potential adverse effects of maternal physical activity on the developing fetus and delivery. However, recent evidence demonstrates that physical activity is not associated with increased risk of the incidence of **miscarriage, stillbirth or delivery complications** *(32)*. Evidence suggests no difference in the incidence of Caesarean delivery among pregnant women with overweight or obesity between physical activity intervention groups versus standard antenatal care *(97)*.

Physical activity during pregnancy is not associated with increased risk of adverse effects on **birthweight** *(98)* or preterm birth *(32)*, and may even be protective, reducing the overall risk *(98)*, even among pregnant women with overweight or obesity (RR= 1.02 [95% CI: 0.54 to 1.92]) or

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large-for-gestational-age babies (RR= 0.90 [95% CI: 0.65 to 1.25]) between physical activity intervention groups versus standard antenatal care) *(97)*.

In the postpartum period, mothers can experience many physical and emotional changes. Evidence demonstrates that physical activity during pregnancy may be inversely associated with **postpartum depression** *(29)*. Evidence from a meta-analysis of 6 trials and 11 observational studies of physical activity during pregnancy *(99)* showed a significant inverse relationship between physical activity during pregnancy and postpartum depression (SMD= 0.58 [95% CI: 1.09 to 0.08]). The effect was stronger when limited to 5 studies with at least moderate-intensity interventions (SMD= 0.70 [95% CI: 1.19 to 0.22]) *(99)*.

The GDG concluded that:

- There is high certainty evidence that physical activity during pregnancy may reduce gestational weight gain and risk of gestational diabetes mellitus.
- There is moderate to high certainty evidence that physical activity does not increase the incidence of gestational hypertension.
- There is moderate certainty evidence that physical activity does not increase the incidence of miscarriage, stillbirth or delivery complications; and moderate certainty evidence of a reduced risk of preterm birth for mothers engaged in vigorous-intensity physical activity.
- There is low to moderate certainty evidence that physical activity does not increase the risk of low birth weight, or small-for-gestational-age, or large-for-gestational-age babies.
- There is low certainty evidence that physical activity during pregnancy is associated with lower levels of postpartum depression.
- The risks for the amounts and types of physical activity recommended for pregnant and postpartum women are low and are outweighed by the benefits.

Is there a dose-response association (volume, duration, frequency, intensity)?

Across the evidence on physical activity during pregnancy and the postpartum period, the interventions varied in the amount (i.e. dose) of physical activity, both in duration in minutes and frequency per week. In general, the evidence available reflected a frequency of aerobic physical activity of at least 3 times per week, typically for between 30 and 60 minutes. This evidence is taken from studies assessing the health impact of a dose broadly consistent with the amount of activity recommended for the general adult population – namely 150 minutes of moderate-intensity physical activity per week.

While more physical activity (frequency, duration and/or volume) is generally found to be associated with greater benefits, further research is needed to understand in more detail the dose-response relationship. Participating in higher versus lower amounts of leisure time physical activity pre-pregnancy is associated with a significantly lower risk of gestational diabetes (OR= 0.54 [95% CI: 0.34 to 0.87]) *(100)*. There is also evidence of a small, but significant, reduced risk of preterm birth in babies of mothers who engaged in vigorous-intensity physical activity (RR= 0.20 [95% CI: 0.36 to 0.03]) *(98)*. No evidence was identified regarding the safety or additional benefit of exercising at levels significantly above the recommendations.

The GDG concluded that:

- There is insufficient evidence to determine a dose-response association between physical activity and specific critical health outcomes during pregnancy and the postpartum period.
- The overall evidence shows benefits to critical health outcomes and is based on interventions that are broadly consistent with the amount of physical activity recommended for the general adult population, namely 150 minutes of moderate-intensity physical activity per week.
- There was no reason to alter the amount or frequency of recommended moderate-intensity physical activity for pregnant and postpartum women compared with the general adult population.
- There is moderate certainty evidence of a reduced risk of preterm birth for mothers engaged in vigorous-intensity physical activity.

Does the association vary by type or domain or timing (pre-pregnancy, antenatal or postnatal) of physical activity?

Evidence is available from studies that mostly assessed leisure domain physical activity; the type of activity was mostly aerobic (such as walking or swimming), although there is some evidence from studies assessing interventions that also included strength training (e.g. circuit training), or combinations of aerobic and muscle-strengthening exercise. However, overall there is insufficient evidence to determine if the associations between physical activity and health outcomes vary by type or domain or timing (pre-pregnancy, antenatal or postnatal) of physical activity.

The GDG concluded that:

- There is moderate certainty evidence that pregnant and postpartum women should incorporate a variety of aerobic and muscle-strengthening activities. Gentle stretching may also be beneficial.

SEDENTARY BEHAVIOUR RECOMMENDATION

For pregnant and postpartum women, sedentary behaviour is defined as time spent sitting or lying with low energy expenditure while awake, in the context of occupational, educational, home and community settings and transportation.

In pregnant and postpartum women, as in all adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality and incidence of cardiovascular disease, cancer and incidence of type-2 diabetes.

It is recommended that:

› **Pregnant and postpartum women should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

Strong recommendation, low certainty evidence

Supporting evidence and rationale

Sedentary behaviour was not included in the 2020 *Global recommendations on physical activity for health (1)*. Due to a lack of population-specific evidence, the primary evidence base for assessing the associations between sedentary behaviour and health outcomes in pregnant and postpartum women was the scientific literature collated and reviewed for adult populations.

The findings from evidence on sedentary behaviours in the general adult population were reviewed, including assessing whether the outcomes would be any different, or would not apply to, or would be contraindicated, for pregnant and postpartum women.

Based on available evidence and expert opinion, the evidence was extrapolated to inform the new WHO recommendations on sedentary behaviour for pregnant and postpartum women for the common set of critical health outcomes. Due to indirectness of the evidence, the level of certainty was downgraded.

Given the lack of evidence specific to this population, and that pregnant women were excluded from studies, the recommendation to increase levels of physical activity beyond recommended levels to counter the detrimental effect of high sedentary behaviour was not extrapolated for women during pregnancy and the postpartum period.

The GDG concluded that:

- The evidence on sedentary behaviours in the general adult population could be extrapolated to inform recommendations for pregnant and postpartum women for the common set of critical health outcomes.
- The benefits of minimizing sedentary behaviour outweigh the risks for pregnant and postpartum women.
- The certainty of the evidence should be downgraded due to indirectness.

ADULTS AND OLDER ADULTS WITH CHRONIC CONDITIONS (aged 18 years and older)

To date, most physical activity guidelines for people with chronic conditions have been limited to clinical or therapeutic guidance. For example, there are clinical practice recommendations and resources developed by the professional medical associations for oncology (101), type-2 diabetes (102), hypertension (103), and other chronic diseases (104). WHO also has clinical practice guidance which includes recommending physical activity to patients with chronic disease (17).

These guidelines are the first WHO population-based guidelines on physical activity for people living with chronic conditions, specifically those living with cancer (from here on referred to as "cancer survivors"), hypertension, type-2 diabetes, and HIV.

Given the advances of effective and widely available antiretroviral treatment for HIV, this condition is now also considered a chronic condition. For patients undergoing acute treatment (e.g. chemotherapy), or not yet stabilized on their chronic medication, health-care providers should also refer to clinical practice guidelines relevant to each chronic condition.

PHYSICAL ACTIVITY RECOMMENDATION

For adults living with chronic conditions, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), transportation (wheeling, walking and cycling), work or household chores, in the context of daily occupational, educational, home or community settings.

All adult cancer survivors and those living with hypertension, type-2 diabetes and HIV, should try to meet these recommendations where possible, as able and without contraindication.

Physical activity can confer health benefits for adults and older adults living with the following chronic conditions: for **cancer survivors** – physical activity improves all-cause mortality, cancer-specific mortality, and risk of cancer recurrence or second primary cancer; **for people living with hypertension** – physical activity improves cardiovascular disease mortality, disease progression, physical function, health-related quality of life; **for people living with type-2 diabetes** – physical activity reduces rates of mortality from cardiovascular disease and indicators disease progression; and **for people living with HIV** – physical activity can improve physical fitness and mental health (reduced symptoms of anxiety and depression), and does not adversely affect disease progression (CD4 count and viral load) or body composition.

It is recommended that:

- **All adults and older adults with these chronic conditions should undertake regular physical activity.**

  Strong recommendation, moderate certainty evidence

- **Adults and older adults with these chronic conditions should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for substantial health benefits.**

  Strong recommendation, moderate certainty evidence

› **Adults and older adults with these chronic conditions should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional benefits.**

Strong recommendation, moderate certainty evidence

› **As part of their weekly physical activity, older adults with these chronic conditions should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity on 3 or more days a week, to enhance functional capacity and prevent falls.**

Strong recommendation, moderate certainty evidence

› **When not contraindicated, adults and older adults with these chronic conditions may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.**

Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- When not able to meet the above recommendations, adults with these chronic conditions should aim to engage in physical activity according to their abilities.
- Adults with these chronic conditions should start by doing small amounts of physical activity and gradually increase the frequency, intensity and duration over time.
- Adults with these chronic conditions may wish to consult with a physical activity specialist or health-care professional for advice on the types and amounts of activity appropriate for their individual needs, abilities, functional limitations/complications, medications, and overall treatment plan.
- Pre-exercise medical clearance is generally unnecessary for individuals without contraindications prior to beginning light- or moderate-intensity physical activity not exceeding the demands of brisk walking or everyday living.

Supporting evidence and rationale

The scope of these guidelines assessed the associations between physical activity and the following health outcomes: **for cancer survivors** – all-cause mortality, cancer-specific mortality, and risk of cancer recurrence or second primary cancer; **for people living with hypertension** – cardiovascular disease mortality, risk of co-morbid conditions, physical function, health-related quality of life, and disease progression (here defined as the blood pressure response to physical activity); **for people living with type-2 diabetes** – cardiovascular disease mortality, risk of co-morbid conditions, physical function, health-related quality of life, and disease progression; and **for people living with HIV** – physical function (physical fitness, exercise tolerance and strength), health-related quality of life, mental health (symptoms of anxiety and depression), cardiometabolic disease risk indicators (blood lipids, blood glucose and body composition) and adverse effects on disease progression (namely CD4 count and viral load).

The evidence informing these guidelines was the report of PAGAC *(35)* which was updated with 16 new reviews identified from 2017 to 2019 for cancer (*n*= 1), hypertension (*n*= 2) and type-2 diabetes (*n*= 13). In addition, a commissioned umbrella review on physical activity and health-related outcomes among people living with HIV provided evidence from 19 eligible reviews published 2002–2018. Full details of the methods, data extraction and evidence profiles can be found in the Web Annex: Evidence profiles.

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In adults and older adults (aged 18 years and over) living with cancer (cancer survivors), hypertension, type-2 diabetes, or HIV, what is the association between physical activity and health-related outcomes?

Physical activity promotes beneficial short- and long-term changes in metabolic, hormonal, and inflammatory pathways, which are thought to be protective for **cancer** incidence and survival *(35)*. Evidence shows that higher levels of physical activity after cancer diagnosis were found to be protective for all-cause mortality following breast cancer (HR= 0.58 [95% CI: 0.52 to 0.65], 17 studies); colorectal cancer (HR= 0.63 [95% CI: 0.50 to 0.78], 10 studies), female reproductive cancer (HR= 0.66 [95% CI: 0.49 to 0.88], 4 studies); glioma (HR= 0.64 [95% CI: 0.46 to 0.91], 1 study); hematologic cancer (HR= 0.60 [95% CI: 0.51 to 0.69], 2 studies); kidney cancer (HR= 0.60 [95% CI: 0.38 to 0.95], 1 study); lung cancer (HR= 0.76 [95% CI: 0.60 to 0.97], 2 studies); prostate cancer (HR= 0.60 [95% CI: 0.46 to 0.79], 5 studies); and stomach cancer (HR= 0.75 [95% CI: 0.61 to 0.93], 1 study) *(105)*.

Greater amounts of physical activity after cancer diagnosis are also associated with lower risks of cause-specific mortality in breast cancer, colorectal cancer, and prostate cancer survivors. The meta-analysis found reduced hazards of mortality for those in the highest versus the lowest levels of postdiagnosis total physical activity for all cancers combined (HR= 0.63 [95% CI: 0.53 to 0.75], 4 studies); breast cancer (HR= 0.63 [95% CI: 0.50 to 0.78], 13 studies); colorectal cancer (HR= 0.62 [95% CI: 0.44 to 0.86], 6 studies); and prostate cancer (HR= 0.70 [95% CI: 0.55 to 0.90], 4 studies) *(105)*. There was, however, insufficient evidence to determine if physical activity is associated with cancer recurrence or second primary cancer.

Physical activity is important for both the primary prevention and management of **hypertension**, with evidence showing that physical activity improves physical function, cardiovascular disease progression (i.e. blood pressure response to physical activity), and cardiovascular disease mortality in people living with hypertension *(35)*. For example, compared with no exercise control groups, people with hypertension who are physically active can reduce systolic blood pressure by approximately 12mm Hg and diastolic blood pressure by approximately 6mm Hg (SBP MD= 12.26 mm Hg [95% CI: 15.17 to 9.34], $p = < 0.05$; DBP MD= 6.12 mm Hg [95% CI: 7.76 to 4.48], $p = < 0.05$) *(106)*. Emerging evidence demonstrates that people with hypertension who are physically active can significantly improve their health-related quality of life compared with those with hypertension who are inactive *(54)*.

Physical activity, including aerobic activity, muscle-strengthening activity, and aerobic plus muscle-strengthening activity, is associated with improved secondary indicators of risk of progression (HbA1c, blood pressure, BMI, and lipids) in adults with **type-2 diabetes** *(35)*. For example, recent research found that resistance training was associated with greater reduction in HbA1c versus control groups, and that high-intensity resistance training has significant positive effects on fasting insulin *(107)*. There is insufficient evidence to assess the effects of physical activity on health-related quality of life and physical function in adults with type-2 diabetes.

Physical activity in people living with **HIV** improves cardiorespiratory fitness. The interventions studied involved either aerobic exercise, or exercise combined with progressive muscle-strengthening exercise, for at least 30 minutes, 3 times per week *(108, 109)*. There is also evidence that physical activity interventions can improve markers of cardiometabolic risk (e.g. lipids) although results are mixed; no effects were established on insulin concentration, although glucose was lowered after aerobic training *(110)*. Physical activity, whether aerobic, or combined with muscle-strengthening exercise, in people living with HIV is positively associated with health-related quality of life *(111)* and a reduction in symptoms of depression and anxiety *(112)*. The meta-analysis for depression (9 studies) showed an SMD of 0.84 (95% CI: 1.57 to 0.11) favouring the intervention groups ($p = 0.02$). The SMD for reduction in anxiety (5 studies) was also statistically significant, favouring the intervention (1.23 [95% CI: 2.42 to 0.04], $p = 0.04$) *(112)*. Physical activity is also associated with significant standardized mean increases in lean body mass of 1.75 kg and a significant decrease in percent body fat of 1.12% for participants in the exercising control groups, as well as an increase in peripheral leg and arm muscle area, compared with participants in the non-exercising control groups *(111)*, but is not associated with changes in BMI or waist circumference in people living with HIV *(111)*. Physical activity does not adversely influence markers of HIV disease progression, such as CD4 count (cells/mm^3) or viral load *(111)*. Importantly, this evidence suggests that HIV as a chronic disease will not be adversely affected by physical activity.

The GDG concluded that:

- There is moderate certainty evidence that greater amounts of physical activity after cancer diagnosis are associated with lower risks of all-cause, cause-specific, and cancer-specific mortality in cancer survivors.
- There is high certainty evidence that physical activity reduces the risk of cardiovascular disease progression in adults with hypertension.
- There is moderate certainty evidence that physical activity improves physical function and health-related quality of life outcomes in adults with hypertension.
- There is high certainty evidence that physical activity improves markers of disease progression (HbA1c, blood pressure, BMI, and lipids) in adults with type-2 diabetes.
- There is moderate certainty evidence of an association between physical activity and improvements in fitness (maximal oxygen consumption, exercise tolerance) and muscular strength for people living with HIV, and favourable associations between physical activity and body composition, health-related quality of life, reduced symptoms of depression and anxiety, and no change in viral load or CD4 count in people living with HIV.
- The benefits associated with engaging in regular physical activity in cancer survivors and people living with hypertension, type-2 diabetes, and HIV in relation to specific health outcomes, outweigh the risks.

Is there a dose-response association (volume, duration, frequency, intensity)?

Greater amounts of physical activity after **cancer** diagnosis have been linked with lower risks of all-cause, and cancer-specific mortality. Evidence demonstrates a non-linear relationship between increasing levels of post-diagnosis physical activity and breast cancer-specific and all-cause mortality up to 10–15 MET-hours per week (consistent with 150 mins/week of moderate- to vigorous-intensity physical activity) with no evidence for harms at higher levels *(105)*. There is a suggestion of similar dose-response association for other cancer sites however there were too few studies to permit a formal meta-analysis. Further research is needed to determine strength of association.

There is a clear dose-response relationship between physical activity and cardiovascular disease mortality for people living with **hypertension** *(35)*. Findings show that as systolic blood pressure increases within hypertensive ranges, the risk of cardiovascular disease mortality increases, but this increased risk is attenuated with higher levels of physical activity *(35)*. Similar to recommendations for the general population, most of the traditional interventions are based around 30–60 minutes of moderate-intensity aerobic activity, 3 days per week, and/or 2–3 sessions of resistance training per week.

There is substantial evidence of an inverse curvilinear association between volume of physical activity and risk of cardiovascular mortality in adults with **type-2 diabetes** *(113–115)*. Higher amounts of physical activity (from both below and at, or above the recommended levels of 150 mins/week of moderate-intensity activity) progressively reduce risk. For example, compared with doing no activity, engaging in some activity was associated with a 32% reduction in risk of cardiovascular disease mortality (adjusted HR= 0.68 [95% CI: 0.51 to 0.92]), while engaging in amounts of activity meeting physical activity guidelines or above was associated with a larger 40% reduction in risk of cardiovascular disease mortality (adjusted HR= 0.60 [95% CI: 0.44 to 0.82]) *(115)*. Most interventions are based around 150–300 minutes of moderate-intensity aerobic activity or 75 minutes of vigorous-intensity activity, and/or 2–3 sessions of resistance training per week. For some outcomes (e.g. HBA1c and blood pressure) in adults with type-2 diabetes, there is evidence for a stronger effect with more aerobic activity (i.e. greater than 150 mins/week versus less than 150 mins/week), but limited evidence for intensity *(35)*.

In people living with **HIV**, there is insufficient evidence to establish a dose-response relationship between physical activity and body composition, or for intermediate markers of cardiometabolic diseases (such as blood lipid profiles, insulin resistance, fasting glucose concentrations or blood pressure). The majority of studies providing evidence involved physical activity interventions conducted at least 3 times a week for 12–48 weeks, and involved at least 30 minutes of moderate- to vigorous-intensity aerobic exercise alone or in combination with progressive resistance training. There is also insufficient evidence to establish more precisely the dose-response relationship for mental health and health-related quality of life outcomes. The available evidence is from studies typically assessing physical activity interventions of 3 or more times weekly.

Overall there was evidence ranging from moderate to high certainty to support a physical activity recommendation of 150–300 minutes of moderate-intensity physical activity (or equivalent) for the specified populations of people living with chronic disease and the specific set of health outcomes. There was clearer evidence of higher levels of activity being associated with greater benefits in the evidence addressing people living with hypertension,

type-2 diabetes and cancer survivors. The variations in the certainty and directness of the evidence according to the specific chronic condition and specific outcomes examined was acknowledged. Where evidence showed positive outcomes from strength training exercise, the frequency of activity was 2 or 3 sessions of resistance training per week.

The GDG concluded that:

- There is moderate certainty evidence of a dose-response relationship between physical activity and decreased all-cause mortality and cancer-specific mortality in cancer survivors.
- There is high certainty evidence of a dose-response relationship between physical activity and cardiovascular disease mortality for adults with hypertension.
- There is evidence of an inverse, curvilinear dose-response relationship between activity volume and risk of cardiovascular mortality among adults with type-2 diabetes.
- There is insufficient evidence for a dose-response relationship between physical activity and intermediate markers of cardiometabolic diseases, body composition, and health-related quality of life symptoms of anxiety and depression in people living with HIV.
- Interventions in the range of 150–300 minutes of moderate-intensity aerobic activity (or equivalent) provided favourable health outcomes, and positive outcomes from strength training exercise, where noted, with 2 or 3 sessions of resistance training per week.

Does the association vary by type or domain of physical activity?

There is evidence that different types and domains of physical activity provide favourable health outcomes. **Cancer survivors** who are meeting recommended levels of aerobic and muscle-strengthening physical activity, versus not meeting either recommendation, have significantly lower risk of cancer mortality (adjusted HR= 0.70 [95% CI: 0.50 to 0.98]) *(84)*. Evidence demonstrates that adhering solely to muscle-strengthening physical activity recommendations versus not adhering is also beneficial in improving cancer mortality outcomes (HR= 0.66 [95% CI: 0.48 to 0.92]) *(84)*. A meta-analysis also reported these associations by physical activity domain and found the most consistent reductions in mortality for all cancers, breast cancer, and colorectal cancer-specific mortality for recreational physical activity *(105)*. For adults living with **hypertension**, evidence supports aerobic activity, muscle-strengthening activity, and combinations of the two for improving cardiovascular disease progression. The blood pressure lowering effects between traditional modes of physical activity (i.e. aerobic and resistance activity) do not appear to vary significantly among people with hypertension *(35)*; however, this evidence is not based on direct comparisons between activity types. There is also emerging evidence to support beneficial effects of other forms of exercises in people living with hypertension (e.g. Tai Chi, yoga, Qigong), however further research is needed to explore these specific types of activity to determine strength of association.

Aerobic activity, muscle-strengthening activity, or a combination of both, is associated with improved secondary indicators of risk of progression (HbA1c, blood pressure, BMI, and lipids) among adults with **type-2 diabetes** *(35, 107)*. One review of 24 RCTs (*n*= 962) reported that resistance training was associated with greater reduction in HbA1c versus control groups (MD= 0.45 [95% CI: 0.65 to 0.25], 20 trials; *n*= 824). Statistically significant effects were found for high-intensity resistance training versus control groups on fasting insulin (MD= 4.60 [95% CI: 7.53 to 1.67], 5 trials; *n*= 174) *(107)*. Another review of 7 RCTs (*n*= 189) reported that interval training (2–5 times/week; intervals 1–4 mins duration; total session lengths 20–60 mins) was associated with statistically significantly decreased HbA1c by 0.26% (95% CI: 0.46 to 0.07%, 5 RCTs) compared with MICT, and by 0.83% (95% CI: 1.39% to 0.27%, 4 RCTs) compared with no-exercise control groups *(116)*. As with recommendations for the general population, most of these interventions are based around aerobic activity consistent with the recommendation of 150–300 minutes of moderate-intensity aerobic activity (or 75 minutes of vigorous-intensity activity) and muscle-strengthening activity conducted 2–3 sessions per week. For some outcomes (e.g. HBA1c and blood pressure), there is evidence for a stronger effect with more aerobic activity (i.e. greater than 150 mins/week versus less than 150 mins/week), but limited evidence for intensity. More recent studies provide evidence that traditional Chinese exercise, such as Tai Chi may have glycaemic benefits, but these were of moderate and variable certainty (i.e. risk of bias or inconsistency). Further research is needed to determine these associations.

Multiple types of physical activity, including aerobic and resistance-training, have been shown to have positive effects on health-related quality of life in people living with **HIV** *(111)*. Recent research examining changes in health-related quality of life in response to aerobic, progressive resistance exercise, or a combination of both, demonstrates significant improvements in general health, and mental health. There is also evidence that both aerobic and multicomponent activity is related to a reduction in symptoms of depression and anxiety in people living with HIV *(112)*. Evidence for the effects of physical activity on mental health symptoms has involved aerobic or aerobic combined with progressive muscle-strengthening activity, or yoga. Evidence also demonstrates that aerobic exercise alone, or when combined with resistance exercise, does not result in any significant change in viral load or CD4 count in people living with HIV *(111)*.

Direct evidence, from both the existing and updated literature, supports the inclusion of the recommendations for people living with type-2 diabetes and hypertension to undertake aerobic and muscle-strengthening physical activity. Although there is a lack of published evidence, there is biological plausibility for the benefits of aerobic and muscle-strengthening physical activity for adults living with HIV and cancer survivors. Furthermore, as noted by the GDG, established international clinical practice guidelines recommend aerobic and muscle-strengthening physical activity for these populations (for example ACSM "Moving Through Cancer" guidelines *(101)* based on a systematic review of evidence *(3)*). Recognizing this evidence base is still emerging, the level of certainty was downgraded.

The GDG concluded that:

- There is moderate certainty evidence for combined or additive effects of aerobic or muscle-strengthening activity for reduced cancer mortality, improvements in blood pressure among those with hypertension.
- There is high certainty evidence that aerobic activity, muscle-strengthening activity, and aerobic plus muscle-strengthening activity improve markers of disease progression (HbA1C, blood pressure, BMI, and lipids) in adults with type-2 diabetes.
- There is moderate certainty evidence that regular aerobic exercise alone, or combined with resistance exercise, does not result in any significant change in viral load or CD4 count in people living with HIV.
- There is insufficient evidence for an effect of strength training alone on health-related quality of life in people living with HIV.

SEDENTARY BEHAVIOUR RECOMMENDATION

Sedentary behaviour was not included in the 2010 *Global recommendations on physical activity for health (1)*. The scope of this new recommendation on sedentary behaviours in cancer survivors and those people living with hypertension, type-2 diabetes and HIV.

Sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of occupational, educational, home and community settings, and transportation.

In adults, including **cancer survivors** and people living with **hypertension**, **type-2 diabetes** and **HIV**, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality; cardiovascular disease mortality; cancer mortality; incidence of cardiovascular disease; cancer; and type-2 diabetes.

For cancer survivors, and adults living with hypertension, type-2 diabetes and HIV, it is recommended that:

- **Adults and older adults with chronic conditions should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light intensity) provides health benefits.**

  Strong recommendation, low certainty evidence

- **To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults and older adults with chronic conditions should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

  Strong recommendation, low certainty evidence

Supporting evidence and rationale

Due to a lack of population-specific evidence, the primary evidence base for assessing the associations between sedentary behaviour and health outcomes in adults and older adult cancer survivors and those adults and older adults living with hypertension, type-2 diabetes, and HIV, was the scientific literature collated and reviewed for adult populations.

The findings from evidence on sedentary behaviours in the general adult population were reviewed, including assessing if there was evidence that the outcomes would be any different, or would not apply to, or would be contraindicated, for adults and older adults living with chronic conditions.

ADULTS AND OLDER ADULTS WITH CHRONIC CONDITIONS (aged 18 years and older)

Based on available evidence and expert opinion, the evidence was extrapolated to inform the new WHO recommendations on sedentary behaviour for adults living with chronic conditions for the common set of critical health outcomes. The extrapolation of evidence is supported largely by the assessment that the majority of studies imposed no upper age limit criterion, included adults over the age of 65 years and may have included adults with chronic conditions, such as cancer survivors, those living with hypertension or type-2 diabetes. For people living with HIV, no reasons were identified as to why the evidence on the health impacts of sedentary behaviours would not apply. Due to indirectness of the evidence to develop these recommendations, the level of certainty was downgraded.

The applicability of evidence on the benefit of undertaking more moderate- and vigorous-intensity physical activity to help counteract the potential risks of high levels of sedentary behaviour was also considered and was also extrapolated to inform recommendations for adults with chronic conditions for the common set of critical health outcomes. Given the indirectness, the certainty of the evidence was downgraded.

The GDG concluded that:

- The evidence on sedentary behaviours in the general adult population could be extrapolated to inform recommendations for adult and older adult cancer survivors and those adults and older adults living with hypertension, type-2 diabetes, and HIV for the common set of critical outcomes, with the level of certainty of the evidence downgraded due to indirectness.
- The evidence on the benefits of undertaking more moderate- and vigorous-intensity physical activity to help counteract the potential risks of high levels of sedentary behaviour in the general adult population could be extrapolated to inform recommendations for adult and older adult cancer survivors and those adults and older adults living with hypertension, type-2 diabetes, and HIV for the common set of critical outcomes, with the level of certainty of the evidence downgraded due to indirectness.
- The benefits for minimizing sedentary behaviours outweigh the harms for cancer survivors and those people living with hypertension, type-2 diabetes, and HIV.

PHYSICAL ACTIVITY RECOMMENDATION

Children, adolescents and adults living with disability can achieve important health benefits from physical activity. Children, adolescents and adults with disability should try to meet these recommendations where possible and as able.

For children, adolescents and adults living with disability, physical activity can be undertaken as part of recreation and leisure (play, games, sports or planned exercise), physical education, transportation (wheeling, walking and cycling) or household chores, in the context of home, educational, occupational and community settings. It is important to provide all children, adolescents and adults living with disability with opportunities and encouragement to participate in physical activities appropriate for their age and ability, that are enjoyable, and that offer variety.

> Many of the health benefits of physical activity for children and adolescents, as set out in the section above, also relate to those children and adolescents living with disability. Additional benefits of physical activity to health outcomes for those living with disability include: improved cognition in individuals with diseases or disorders that impair cognitive function, including attention-deficit/hyperactivity disorder (ADHD); improvements in physical function may occur in children with intellectual disability.

It is recommended that:

- **Children and adolescents living with disability should do at least an average of 60 minutes per day of moderate- to vigorous-intensity, mostly aerobic, physical activity, across the week.**

  Strong recommendation, moderate certainty evidence

- **Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone should be incorporated at least 3 days a week.**

  Strong recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If children and adolescents living with disability are not meeting these recommendations, doing some physical activity will bring benefits to health.
- Children and adolescents living with disability should start by doing small amounts of physical activity and gradually increase the frequency, intensity and duration over time.
- There are no major risks for children and adolescents living with disability engaging in physical activity when it is appropriate to an individual's current activity level, health status and physical function; and the health benefits accrued outweigh the risks.
- Children and adolescents living with disability may need to consult a health-care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them.

Many of the health benefits of physical activity for adults, as set out in the section above, also relate to adults living with disability. Additional benefits of physical activity to health outcomes for those living with disability include the following: **for adults with multiple sclerosis** – improved physical function, and physical, mental, and social domains of health-related quality of life; **for individuals with spinal cord injury** – improved walking function, muscular strength, and upper extremity function; and enhanced health-related quality of life; **for individuals with diseases or disorders that impair cognitive function** – improved physical function and cognition (in individuals with Parkinson's disease and those with a history of stroke); beneficial effects on cognition; and may improve quality of life (in adults with schizophrenia); and may improve physical function (in adults with intellectual disability); and improves quality of life (in adults with major clinical depression).

It is recommended that:

- **All adults living with disability should undertake regular physical activity.**

  Strong recommendation, moderate certainty evidence

- **Adults living with disability should do at least 150–300 minutes of moderate-intensity aerobic physical activity; or at least 75–150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for substantial health benefits.**

  Strong recommendation, moderate certainty evidence

- **Adults living with disability should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.**

  Strong recommendation, moderate certainty evidence

- **As part of their weekly physical activity, older adults living with disability should do varied multicomponent physical activity that emphasizes functional balance and strength training at moderate or greater intensity on 3 or more days a week, to enhance functional capacity and prevent falls.**

  Strong recommendation, moderate certainty evidence

- **Adults living with disability may increase moderate-intensity aerobic physical activity to more than 300 minutes; or do more than 150 minutes of vigorous-intensity aerobic physical activity; or an equivalent combination of moderate- and vigorous-intensity activity throughout the week for additional health benefits.**

  Conditional recommendation, moderate certainty evidence

GOOD PRACTICE STATEMENTS

- Doing some physical activity is better than doing none.
- If adults living with disability are not meeting these recommendations, doing some physical activity will bring benefits to health.
- Adults living with disability should start by doing small amounts of physical activity, and gradually increase the frequency, intensity and duration over time.
- There are no major risks to adults living with disability engaging in physical activity when it is appropriate to the individual's current activity level, health status and physical function; and when the health benefits accrued outweigh the risks.
- Adults living with disability may need to consult a health-care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them.

Supporting evidence and rationale

For these guidelines for children, adolescents and adults living with disability, the comprehensive evidence synthesis undertaken by PAGAC *(35)* was used and updated. Full details of the methods, data extraction and summary evidence tables of this existing evidence on physical activity and health outcomes is available *(35)* and was reviewed by the GDG in addition to the findings of the updated search.

The update conducted for these guidelines identified 39 reviews published from 2017 to 2019. Of these, 27 met the inclusion criteria and informed the examination of the association between physical activity and health-related outcomes among children, adolescents and adults living with disability.

Full details of the methods, data extraction and summary evidence portfolios can be found in the Web Annex: Evidence profiles.

The evidence reviewed considered the association between physical activity and health-related outcomes in children, adolescents and adults living with disability resulting from the following health conditions: multiple sclerosis, spinal cord injury, intellectual disability, Parkinson's disease, stroke, major clinical depression, schizophrenia, and attention-deficit/hyperactivity disorder (ADHD). The four health-related outcomes examined included risk of co-morbid conditions, physical function, cognitive function and health-related quality of life, although not all outcomes were explored for each condition. The impact of environmental factors on disability in the context of physical activity was beyond the scope of these guidelines and was not analysed.

In children and adolescents (aged 5–17 years) and adults (aged over 18 years) living with disability, what is the association between physical activity and health-related outcomes?

For people living with **multiple sclerosis**, physical activity improves physical function, functional mobility, walking speed and endurance, and cardiorespiratory fitness, strength and balance. For example, high-intensity interval training over 3–12 weeks demonstrated improvements in cardiorespiratory fitness or muscle strength *(117)* and lower limb strength training found strength increased by 23.1% (95% CI: 11.8 to 34.4) over an average training period of 13.2 weeks *(118)* over an average of 13 weeks resulted in increases in strength, and dance interventions studies reported improvements in functional mobility and balance *(119)*. As well as physical health benefits, existing evidence demonstrates that physical activity can benefit cognition in people living with multiple sclerosis *(35)*. Newer research reveals that aerobic exercise has a small yet significant effect on physical, mental and social domains of health-related quality of life (including symptoms of fatigue and depressive symptoms) *(35, 120)*.

For people living with **spinal cord injury**, physical activity can improve walking function, muscular strength and upper extremity function *(35)*. Physical activity may also reduce shoulder pain, improve vascular function and enhance health-related quality of life *(35)*.

For people living with **Parkinson's disease**, physical activity can improve motor symptoms, functional mobility and performance, endurance, freezing of gait and velocity of forward and backward movement *(35, 121, 122)*. New evidence suggests that exercise can also help global cognitive function in individuals with Parkinson's disease *(123)*.

For people with a history of **stroke**, physical activity can improve physical function, notably upper limb function, sensory motor function of the lower limb, balance, walking speed, distance, ability and endurance, cardiorespiratory fitness, mobility and activities of daily living. Existing evidence suggests that physical activity may also have beneficial effects on cognition *(35)*.

For people with **major clinical depression**, new reviews *(124, 125)* supported existing evidence *(35)* that physical activity can improve health-related quality of life *(35, 124, 125)*.

For individuals with **diseases or disorders that impair cognitive function, including schizophrenia** –physical activity can have beneficial effects on cognition, working memory, social cognition and attention/vigilance *(35, 126)*. One review found that moderate- to vigorous-intensity physical activity delivered significant improvements in health-related quality of life and disability *(35, 124)*.

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For people living with **intellectual disability**, physical activity has been shown to improve physical function. The interventions reviewed largely focused on balance and strength activities over 6–24 weeks and reported significant improvement in static balance, dynamic balance and static-dynamic balance compared with controls *(35, 127, 128)*.

For children with **attention-deficit/hyperactivity disorder**, evidence, including one review of 5 RCTs involving ADHD *(129)*, demonstrates a positive association between exercise and attention, executive function and social disorders *(35, 129)*.

The GDG considered the evidence from the general population of children, adolescents and adults and concluded that as there is no reason to believe that there would be an effect modification due to impairment and that the same health physiological benefits will be conferred by being physically active. The GDG acknowledged that few studies include people living with disability, and that effect modification is seldom tested.

This evidence in the area disability, combined with the broader evidence for the general population, supported the general population recommendation being inclusive of people with disability, noting reference to "all adults", "all older adults" and "people of all abilities".

The GDG concluded that:

In individuals with spinal cord injury, there is:

- low certainty evidence that physical activity reduces shoulder pain and improves vascular function in paralysed limbs and enhances health-related quality of life; and
- moderate certainty evidence that physical activity improves walking function, muscular strength, and upper extremity function.

In individuals with diseases or disorders that impair cognitive function, including Parkinson's disease, there is:

- high certainty evidence that physical activity improves a number of functional outcomes including walking, balance, strength, and disease specific motor scores; and
- moderate certainty evidence that moderate- to vigorous-intensity physical activity can have beneficial effects on cognition.

In individuals with a history of stroke, there is:

- moderate certainty evidence that mobility-oriented physical activity can have beneficial effects on physical function and cognition.

In individuals with diseases or disorders that impair cognitive function, including schizophrenia, there is:

- moderate certainty evidence that physical activity improves quality of life; and
- high certainty evidence that moderate- to vigorous-intensity physical activity can have beneficial effects on cognition, working memory, social cognition and attention.

In adults with major clinical depression there is:

- moderate certainty evidence that physical activity improves quality of life.

In adults with multiple sclerosis, there is:

- high certainty evidence that physical activity, particularly aerobic and muscle-strengthening activities, improves physical function, functional mobility, walking speed and endurance, and cardiorespiratory fitness, strength and balance;
- moderate certainty evidence that physical activity can have a beneficial effect on cognition; and
- low certainty evidence that physical activity improves quality of life including symptoms of fatigue and depressive symptoms.

In children and adults with intellectual disability, there is:

- low certainty evidence that physical activity improves physical function.

In children and adolescents with ADHD, there is:

- moderate certainty evidence that moderate- to vigorous-intensity physical activity can have beneficial effects on cognition, including attention, executive function, and social disorders.

The GDG further concluded that there is sufficient scientific evidence on the positive impact of physical activity on a variety of health outcomes across a broad range of impairment areas, and that the benefits of physical activity for people living with disability outweigh the potential harms.

Due to indirectness of the evidence to develop these recommendations, the level of certainty was downgraded.

SEDENTARY BEHAVIOUR RECOMMENDATION

For children, adolescents and adults living with disability, sedentary behaviour is defined as time spent sitting or lying with low energy expenditure, while awake, in the context of educational, home and community settings, and transportation. It is possible to avoid sedentary behaviour and be physically active while sitting or lying, through, for example, upper body led activities, inclusive and/or wheelchair-specific sport and activities.

In children and adolescents, higher amounts of sedentary behaviour are associated with the following poor health outcomes: increased adiposity; poorer cardiometabolic health, fitness, and behavioural conduct/pro-social behaviour; and reduced sleep duration.

It is recommended that:

› **Children and adolescents living with disability should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.**

Strong recommendation, low certainty evidence

In adults, higher amounts of sedentary behaviour are associated with the following poor health outcomes: all-cause mortality, cardiovascular disease mortality and cancer mortality, and incidence of cardiovascular disease, cancer and type-2 diabetes.

It is recommended that:

› **Adults living with disability should limit the amount of time spent being sedentary. Replacing sedentary time with physical activity of any intensity (including light-intensity) provides health benefits.**

Strong recommendation, low certainty evidence

› **To help reduce the detrimental effects of high levels of sedentary behaviour on health, adults living with disability should aim to do more than the recommended levels of moderate- to vigorous-intensity physical activity.**

Strong recommendation, low certainty evidence

Supporting evidence and rationale

Sedentary behaviour was not included in *The Global recommendations on physical activity for health (2010)*.

Due to a lack of population-specific evidence, the primary evidence base for assessing the associations between sedentary behaviour and health outcomes in children, adolescents and adults living disability was the scientific literature collated and reviewed for populations without disability.

The findings from evidence on sedentary behaviours in the general population were reviewed including assessing if there was evidence that the outcomes would be any different, or would not apply to, or would be contraindicated for children, adolescents and adults living with disability.

Based on available evidence and expert opinion, the evidence was extrapolated to inform new WHO recommendations on sedentary behaviour for individuals living with disability for the common set of critical health outcomes, recognizing that certain population groups, such as wheelchair users, unavoidably sit for long periods of time and sitting may therefore be the norm. For these groups, sedentary behaviour should be defined as time spent with low energy expenditure, e.g. moving in a power chair or being pushed while sitting in a manual wheelchair. There is a lack of research on the association between sedentary behaviour and health outcomes in individuals living with disability. However, based on expert opinion, there are no reasons to believe that there would be an effect modification due to impairment, and therefore the same physiological health benefits will be conferred by limiting sedentary behaviour in individuals living with disability. Due to indirectness of the evidence to develop these recommendations, the level of certainty was downgraded.

The applicability of evidence on the benefit of adults undertaking more moderate- and vigorous-intensity physical activity to help counteract the potential risks of high levels of sedentary behaviour was also considered and was also extrapolated to inform recommendations for adults living with disability for the common set of critical health outcomes. Given the indirectness, the certainty of the evidence was downgraded.

The GDG concluded that:

- The evidence on sedentary behaviours in child and adolescent populations could generally be extrapolated to children and adolescents living with disability, according to their specific ability.
- The evidence on sedentary behaviours in the general adult population, including the benefit for adults of undertaking more moderate- to vigorous-intensity physical activity to help counteract the potential risks of high levels of sedentary behaviour, could generally be extrapolated to adults and older adults living with disability, according to their specific ability. However, the certainty of the evidence was downgraded due to indirectness.
- The benefits of minimizing sedentary behaviour in children, adolescents, adults and older adults living with disability outweigh the harms.

EVIDENCE TO RECOMMENDATIONS

In accordance with the GRADE process, the proposed wording of the updated recommendations, and the rating of their strength ("strong" or "conditional"), were based on consideration of the balance of benefits to harms; the certainty of evidence; sensitivity to the values and preferences of those affected by the guidelines; the potential impact on gender, social and health equity; and acceptability, feasibility and resource implications. These were considered for each population group, but given the similarity of issues and considerations discussed, are consolidated and presented here.

The strength of the recommendation was primarily based on the assessed balance of benefits to harms. Recommendations were graded "strong" if the balance of benefits to harms was assessed as substantial for the target population for the recommendation, and "conditional" if the balance of benefits to harms was small or there was important likely variability in benefits in the target population. The evidence on harms was specifically sought through the commissioning of a new systematic review. However, this was limited, as most evidence focuses on injuries and harms to elite and competitive athletes, rather than the general population. Overall, despite the limited evidence, and informed by expert opinion, it was concluded that the risk was no greater than small. The evidence generally indicated that the benefits of physical activity far outweighed the harms, and that physical activity can be an important intervention to support closing an existing health gap, particularly for disadvantaged populations.

Issues of health equity, feasibility and acceptability were also considered by the GDG and formed part of the online public consultation on the draft recommendations held between 31 March 2020 and 17 April 2020. The survey for the public consultation asked specific questions on the balance between the costs to individuals and governments of implementing the recommendations, and the potential health benefits, and whether the guidelines would improve health equity. In addition, the draft recommendations and the feedback form were sent to countries that had recently expressed an interest in developing, or had initiated the process of drafting, national guidelines on physical activity. Feedback was received from more than 420 submissions to the online consultation, and additional collation of feedback from the WHO European Regional Office, incorporating comments from WHO Collaborating Centres and Member States. The feedback from this consultation was collated, reviewed by the GDG, and used to further inform the consideration on feasibility, resource implications, and health equity through consultation with the Steering Group and the GDG.

Decisions were reached by consensus through discussion. The GDG came to consensus on each recommendation and on the strength of the recommendation; ratings and voting were not required.

ASSESSMENT OF THE CERTAINTY OF EVIDENCE

The GRADE framework was used by the GDG to examine the certainty of primary research contributing to each outcome identified in the PI/ECOs, and assessed the overall certainty of evidence taking into consideration the risk of bias, inconsistency, imprecision, indirectness of the evidence and publication bias across each outcome. GRADE tables detailing this information for each PI/ECO are available in the Web Annex: Evidence profiles. The assessment of the certainty of the evidence was based on an overall assessment across all evaluated outcomes and prioritized all-cause mortality and cardiovascular mortality as the most critical outcomes, followed by other clinical outcomes (falls, depression, cognition, health-related quality of life, etc), then intermediate outcomes (e.g. cardiometabolic markers, other metabolic markers), as well as harms. Where the evidence had not been specifically reviewed, such as for sedentary behaviour in subpopulations primarily due to a lack of evidence for these groups, the evidence for the general population was extrapolated and downgraded where this was deemed appropriate, due to indirectness.

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BENEFITS AND HARMS

The development of the recommendations included an assessment of adverse impacts or risks. Where there was limited evidence, decisions were based on the expertise of the GDG. Overall, for all populations it was concluded that the benefits of physical activity and limiting sedentary behaviour outweighed the potential harms. These guidelines are for the general population and do not address the benefits and harms experienced by athletes undertaking the types and amounts of activity necessary to improve performance-related fitness for participation in competition.

Doing some physical activity is better than doing none. If individuals are not currently meeting these recommendations, doing some physical activity will bring benefits to their health. They should start by doing small amounts of physical activity, gradually increasing frequency, intensity and duration over time. Pre-exercise medical clearance is generally unnecessary. Inactive individuals who gradually progress to undertaking moderate-intensity activity have no known risk of sudden cardiac events and very low risk of bone, muscle, or joint injuries. An individual who is habitually engaging in moderate-intensity activity can gradually increase to vigorous-intensity without needing to consult a health-care provider. Those who develop new symptoms when increasing their levels of activity should consult a health-care provider.

The choice of appropriate types and amounts of physical activity can be affected by pregnancy, chronic conditions, and disability, and should be undertaken as able and without contraindication. These individuals may wish to consult with a physical activity specialist or health-care professional for advice on the types and amounts of activity appropriate for their individual needs, abilities, functional limitations/complications, medications, and overall treatment plan. Light- and moderate-intensity physical activity are generally low risk and are recommended for all.

VALUES AND PREFERENCES

The values and preferences of those affected by the guidelines (in this case parents and caregivers, children and adolescents, adults, older adults, pregnant and postpartum women, people living with chronic conditions and/or disability) were considered. Overall it was concluded that there was little or no uncertainty about preferences regarding the main outcomes, including mortality and cardiovascular mortality.

The estimated potential benefits greatly outweighed any potential harms, and as such, the GDG considered the recommendations to be not preference-sensitive.

RESOURCE IMPLICATIONS

The expert opinion of the GDG, and a small body of evidence reporting on economic analyses of interventions and savings to the health-care systems from increasing levels of physical activity, informed discussion on the resource implications of the recommendations in different settings. In addition, results from the online public consultation showed that over 75% of respondents agreed, or strongly agreed, that the benefits of implementing the guidelines would outweigh the cost to the individual, and 81% agreed, or strongly agreed, that the benefits of implementing the guidelines would outweigh the cost to government.

Available evidence and expert opinion recognize that substantial health benefits can be achieved at low risk through activities such as walking, that require no specific equipment or cost to the individual. Further, it was acknowledged that other forms of physical activities, for example structured sports, cycling and exercise classes, may incur costs, which can be a barrier for some individuals, particularly those with lower incomes. Government implementation of policy and programmes to promote and enable physical activity also requires investments in areas such as human resources, policy development, provision of facilities and services and potentially, equipment, some of which is incurred by ministries of health, but also in sectors outside of health, such as sport, education, transport and urban planning. The resources required may be at more than one level of government (national, subnational and local levels) to ensure all communities have equal access to physical activity opportunities.

These investments may involve new resources, but also can be addressed by reallocation of existing budgets to reflect the prioritization of facilities and programmes towards increasing population levels of physical activity. Examples of budget reallocation include towards infrastructure for walking and cycling from the existing transport budget, and towards "sports for all" from the sports budgets. In key settings, such as schools and workplaces, low-cost interventions, combined with changes to the physical environment, can support participation in physical activity and would also contribute to reducing inequities in opportunities to be active,

experienced by some subpopulation groups. Overall, it was assessed that while there are resource implications to achieve these draft recommendations, implementation of actions is possible within current governance structures.

Further, evidence supports that substantial health savings are possible for the health-care system resulting from increasing levels of physical activity. In 2013 the global annual cost of physical inactivity was estimated at INT$ 54 billion due to direct health costs alone *(130)*; and at a national level, inactivity is estimated to cost between 1–3 % of health-care budgets *(131)*.

Within the wider context of noncommunicable disease (NCD) prevention, additional costs to government and nongovernmental organizations of guideline implementation may be minimized if recommended physical activity can be relatively easily incorporated by individuals into their lives; likewise if existing resources in primary and secondary care, schools, workplaces or transportation can be shifted, resulting in increased physical activity.

Analysis of the cost and benefits of physical activity promotion indicate positive returns on investment over 15 years, in terms of NCD prevention, in many countries where the investment cases have been conducted *(132)*. Interventions such as public education and awareness campaigns and physical activity counselling and referral are a "best buy" and a "good buy" respectively, of recommended interventions to address NCDs based on an update of Appendix 3 of the *Global action plan for the prevention and control of NCDs 2013–2020 (133)*. Overall, the GDG concluded that the benefits of implementing the recommendations outweigh the costs.

Delivering on physical activity guidelines for people with disability may require investment, such as the training of activity specialists, adapted equipment where needed, and facilities that need to be made accessible. These investments can facilitate the needs of a wide range of population groups. Evidence demonstrates a significant participation gradient between people with and without disability in relation to physical activity, due to multiple barriers regarding access, choice of activities offered, and the attitudes of others. Universal design principles should be applied to ensure full and effective participation by people living with disability. With innovation, it is possible to address many of these resource implications. Adopting universal design approaches would mitigate against these costs in the future.

EQUITY, ACCEPTABILITY AND FEASIBILITY

In updating the 2010 recommendations the decision was taken to explicitly include consideration of vulnerable populations, such as those living with chronic conditions and/or disability. The GDG and Steering Group included members representing such groups. The GDG discussed each recommendation at length, considering whether implementing the recommendations would decrease health equity, and the issues related to implementation, to ensure that the recommendations did not worsen equity issues (for example, ensuring that there are safe facilities and opportunities accessible for all, including people living with disability, and socioeconomically and other disadvantaged people, to engage in physical activity; addressing gender and other cultural biases that could restrict access and opportunity to participate in physical activity, etc.). Of respondents to the online public consultation, 76% agreed, or strongly agreed, that implementing the guidelines can achieve a reduction in health inequity by increasing opportunities for all to be active and improve health outcomes. It was noted that supporting environments are key to enabling participation in physical activity. A comprehensive approach to the design and implementation of policies across a number of sectors will be required to address barriers to physical activity for vulnerable groups, such as socioeconomically disadvantaged women and girls, and people with disability.

People with disability experience worse health outcomes than people without disability, yet the benefits of physical activity far outweigh the harms and can be an important intervention to close this health gap. Evidence demonstrates a significant participation gradient between people with and without disability in relation to physical activity, due to multiple barriers regarding access, choice of activities offered, and the attitudes of others. For many people with disability, it should be possible to engage in various forms of physical activity without the need for adapted equipment or facilities. However, in order for people with disability to engage in physical activity on an equal basis with others, adapted equipment may need to be obtained, facilities may need to be made accessible, and activity specialists may need to be trained.

RESEARCH NEEDS

Despite the large quantity of data relating physical activity and, increasingly, sedentary behaviours to health outcomes across the life span, the GDG discussions revealed important evidence gaps, which should be prioritized to inform future guidelines. Evidence gaps across population subgroups included a lack of information on:

1) the more precise details on the dose-response relationship between physical activity and/or sedentary behaviour and several of the health outcomes studied;
2) the health benefits of light-intensity physical activity and of breaking up sedentary time with light-intensity activity;
3) differences in the health effects of different types and domains of physical activity (leisure time; occupational; transportation; household; education) and of sedentary behaviour (occupational; screen time; television viewing); and
4) the joint association between physical activity and sedentary time with health outcomes across the life course.

It was also noted that there remains limited evidence from low- and middle-income countries, economically disadvantaged or underserved communities, and in people living with disability and/or chronic disease. Many studies are not designed or powered to test for effect modification by various sociodemographic factors (age, sex, race/ethnicity, socioeconomic status) that may modify the health effects of physical activity. Such information is important for making more specific public health recommendations and for reducing health disparities in more vulnerable sectors of the population. Further details on the research gaps arising from these new guidelines can also be found in published literature *(134)*.

ADOPTION, DISSEMINATION, IMPLEMENTATION AND EVALUATION

The goal of these guidelines is to provide policy-makers, and those who develop health-care, education, workplace and community intervention programmes, with recommendations on how much time children, adolescents, adults and older adults should spend each day being physically active, and recommendations on limiting time spent being sedentary. However, developing global guidelines is not an end in itself: without dissemination and implementation, changes in physical activity levels will not be achieved.

ADOPTION

WHO undertakes a rigorous and extensive process to develop globally relevant guidelines *(21)* for use by all countries. These *Guidelines on physical activity and sedentary behaviour* provide evidence-based recommendations on the health impacts of physical activity and sedentary behaviour that national governments can adopt and use as part of their national policy frameworks. The development of global guidelines, with extensive consultation, should largely remove the need for individual countries to use resources to undertake the lengthy scientific process. Reviewing and adopting these global physical activity and sedentary behaviour guidelines provides a rapid and cost-effective method to develop guidelines tailored to local context.

Adopting the WHO guidelines at regional or national level will ensure countries provide consistent recommendations on physical activity and sedentary behaviour, which are informed by the latest and best available scientific evidence. In addition, consistency of the recommendations across countries will facilitate national surveillance, global estimates of physical activity and sedentary behaviour, and cross-country comparisons. Throughout the adoption process, consideration should be given to the need to contextualize and tailor the guidelines. Translation into the local language is one element of adoption and contextualization. Examples of physical activities may need to be changed to be locally relevant and the use of images tailored to reflect local cultures, norms and values.

A step-by-step framework to support country adoption of the Global guidelines is under development, following a series of regional workshops with relevant stakeholders. This framework can be populated with relevant national data (for example physical activity prevalence estimates), and will provide a fast-track approach to the development of a national guidelines document. These supporting resources will be available in 2021 through the WHO website.

When considering adopting the guidelines it is recommended that the following ten-step process is applied:

1. Advocate for a review of current national guidelines on physical activity and the adoption of the WHO guidelines to secure government authorization.
2. Engage key stakeholders both within the health sector and other relevant sectors, such as sport, education, transport; engage relevant professional associations and scientists, with topic expertise.
3. Assess the applicability, acceptability and feasibility of the recommendations.
4. Adapt guidelines to the local context, including language, examples, and other cultural considerations.
5. Conduct an external review with target users, including policy-makers, practitioners, and the general public.
6. Establish a budget and clear plan for dissemination and communication.
7. Publish and promote the national guidelines, ideally alongside a launch event to generate publicity and interest.
8. Engage relevant professional bodies or organizations and support policy alignment and/or endorsement.
9. Implement national policies and practices to support implementation of national guidelines and behaviour change.
10. Agree a timeline for evaluation, review, and update of the guidelines.

DISSEMINATION

National physical activity guidelines are a core component of the governance structures for a comprehensive approach to increasing population levels of physical activity. National guidelines inform the development and priorities of national and subnational strategy planning and require dissemination of the correct information, to the relevant groups of people, in an appropriate way. Unfortunately, too often, national guidelines are not disseminated, and so awareness of recommendations among both professional audiences and the wider community can remain very low. Securing dedicated resources to support wide-scale dissemination is an important first step to changing awareness and knowledge about the importance of increasing physical activity and reducing sedentary behaviours.

Key audiences for dissemination of national guidelines on physical activity and sedentary behaviour include:

- **Policy-makers within and outside the health sector** (including transport, planning, education, workplaces, sport, parks and recreation), to increase:
  a. knowledge of the contribution that increasing physical activity and reducing sedentary behaviour can have in improving not only health, but also a range of diverse yet related agendas, including gender equity, human rights obligations, and sustainable development;
  b. integration of policy and programmes on physical activity and sedentary behaviour into all relevant policies; and
  c. investment in scaled-up and coordinated national and local actions.
- **Non-state actors** (including nongovernmental organizations, academic and research organizations, the private sector as well as the media and research funding agencies), to:
  a. raise awareness of the importance of increasing physical activity and reducing sedentary behaviours across all ages;
  b. encourage and ensure policy alignment; and
  c. increase collaboration and investment in policy implementation and local action.
- **Practitioners in health and non-health sectors** (including sport, education, transport, and planning) to increase:
  a. awareness and knowledge of national guidelines on physical activity and sedentary behaviours;
  b. knowledge, skills and confidence in promoting increased physical activity and reduction in sedentary behaviours; and
  c. integration of physical activity promotion into routine practice where applicable.
- **The general public and specific population subgroups**, to increase:
  a. awareness and knowledge of the guidelines on physical activity and sedentary behaviour;
  b. knowledge of how to achieve the physical activity and sedentary behaviour guidelines; and
  c. intentions and motivation to be more physically active and to reduce sedentary behaviour.

COMMUNICATION CAMPAIGNS

Different stakeholders will benefit from different materials; therefore to communicate guidelines to multiple audiences effectively, consideration must be given to the content, format, and delivery channels for guideline communication. When developing a guideline communication strategy, formative research can help determine the key audiences and understand the values, needs and preferences that influence levels of physical activity and sedentary behaviour. This should include exploration of the barriers to physical activity or to the integration of physical activity into policy and practice, as well as testing of draft messages and materials with different groups. This will help inform the key messages that are used, as well as the appropriate format(s) and channel(s) for communication. A comprehensive communication strategy will include a range of communications aimed at different audiences. Countries may need to prioritize specific groups depending on available resources (human and financial).

Communication campaigns on physical activity targeting the general public or specific subpopulations are a cost-effective intervention *(133)* and recommended in the WHO *Global action plan on physical activity 2018–2030 (14)*. National and subnational campaigns on physical activity typically establish an overarching campaign slogan (for example "Be Active" or "Move More"), and develop design elements or characters, which may include tailored messages for different audiences

(such as for young children, adolescents, adults or older adults, the less active, people living with disability or chronic conditions). Campaign messages and resources that are tailored to specific population groups are likely to be more effective than generic materials. Communication campaigns should consider the reach and effectiveness of both traditional media channels (such as television, radio, billboards, printed resources) as well as digital media channels (websites, mobile phones, Apps). Providing information on the national guidelines in a variety of formats is also useful. For example, a relatively new but increasingly common approach to communicating physical activity guidelines is through the use of infographics or short animated videos. WHO has supporting materials for developing and implementing such communication campaigns *(135)*.

The academic and research community are likely to be interested in the scientific report which details the epidemiological evidence on which the guidelines are based. However the specific details of the underlying research is unlikely to be of interest to other more general audiences. Policy-makers may prefer a summary of the science, or even a short briefing document. Other audiences, such as health and non-health professionals, are more likely to favour different types of resources, for example a brochure or factsheet about the guidelines, or about how to integrate physical activity promotion into routine practice (for example in patient consultations in a health-care setting, or when developing building or transport plans for urban environments). Different professionals will require resources that are tailored to their role. Health professions, in particular, may benefit from a suite of resources to reflect the diverse population groups that they work with.

IMPLEMENTATION OF POLICY AND PROGRAMMES

National guidelines on physical activity and sedentary behaviour, in isolation, are unlikely to lead to increases in population levels of physical activity and should therefore be seen as one element of a policy and planning framework. It is critical that national guidelines are disseminated to key audiences and supported by a sustained national communication strategy that will lead to increased awareness and knowledge about the multiple benefits of regular physical activity and reducing sedentary behaviours. However, in order to achieve sustained behaviour change, these actions must be supported by policies that create supportive environments that enable and encourage people to be active, along with increased local, appropriate opportunities for people to participate in physical activity. Policies and programmes must consider and be adapted to the local context, in terms of both the health system and the complex multisector institutions that have an interest in, or opportunity to support, physical activity promotion. Action should be taken using a "whole of government" approach and consider the "system" of policies and multiple actions that can, through engagement of a wide range of stakeholders, support more people to be physical active across multiple sectors and settings. Using a "systems" approach that is aligned with a sustained communication strategy ensures that increased demand for physical activity, generated through effective communication, is matched by the provision of environments and opportunities for people to be physically active.

The WHO *Global action plan on physical activity 2018–2030* set a target to reduce physical inactivity by 15% by 2030, and outlined 20 recommended policy actions and interventions *(14)*. These included recommending that all countries implement sustained national public education and awareness campaigns and the integration of physical activity counselling programmes into primary and secondary health care. Other recommendations included the creation of appropriate environments for physical activity, including walking, cycling and wheeling, for all population groups and the provision of more opportunities and programmes for physical activity in schools, workplaces and sports clubs and venues. Implementation across all 20 recommendations may not be feasible in the short term in all countries, but should be viewed as a long-term goal. To identify an appropriate and feasible set of immediate actions, WHO Member States should conduct a situational analysis of current policy and practice. This will enable multisector collaboration and help identify areas of strength as well as gaps and opportunities, and can be used as the basis for developing or updating national and subnational plans.

These new WHO guidelines support expanding the scope of actions to include additional groups, such as people living with disability or chronic conditions, and women who are pregnant or postpartum. Policy will need to support appropriate programme delivery and practice that recognizes community needs and the diversity of groups and contexts. A number of sector-specific toolkits are under development to support implementation of the ACTIVE technical package *(135)*; these will provide each sector with guidance on how to promote physical activity, for example through schools, through primary health care, or by improving provision for walking and cycling. The ACTIVE toolkit, as well as other WHO regional and national resources will support implementation of these physical activity and sedentary behaviour guidelines.

SURVEILLANCE AND EVALUATION

The WHO *Global recommendations for physical activity for health* have been used as benchmarks for population health monitoring and surveillance since 2010. The changes introduced to the recommendations in these updated guidelines will have some implications for surveillance systems and assessment instruments currently used to monitor national levels of physical activity. The publication of these new guidelines will call for a review of current instruments and reporting protocols to inform any adjustments and recommendations on future reporting against the new guidelines. Instruments, such as the Global Physical Activity Questionnaire and Global Student Health Survey, will be reviewed and protocols updated to align with these new guidelines; supporting guidance to all countries will be provided in 2021.

The WHO NCD Country Capacity Survey (CCS) is the main instrument used to monitor global progress on NCD policy implementation, and is conducted every two years. The CCS includes specific questions on population surveillance systems on physical activity for each age group covered by these WHO guidelines on physical activity and sedentary behaviour, and since 2019, on the existence of national physical activity guidelines. WHO Member States are requested to upload documentation to support their response. In 2019, of the 194 WHO Member States, 78 (40%) reported having physical activity guidelines *(136)*. A detailed document analysis of responses to the CCS in 2019 was carried out, and identified that only two thirds of the 78 Member States (52/78) with national guidelines include statements on how much physical activity their populations should do; and of these, only 42 countries aligned fully with the 2010 WHO *Global recommendations on physical activity for health (1)*. Data from the 2021 and subsequent surveys will provide information on uptake of these updated guidelines.

UPDATING

These guidelines will be updated after ten years, unless advances in the science of how physical activity is assessed using device-based measurement, and the rapidly evolving science on sedentary behaviour, prompt an earlier update.

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ANNEX 1:
MANAGEMENT OF GUIDELINE DEVELOPMENT PROCESS

Contributors to guideline development

WHO Steering Group

The Steering Group included experts in the areas of physical activity, adolescent health, ageing disability, mental health, injury prevention, cancer, pregnancy and surveillance from both headquarters and regional offices.

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The Steering Group drafted the scope of the guidelines, and the PI/ECOs. They reviewed the declaration of interests; and drafted, reviewed and finalized the guidelines.

Guideline Development Group (GDG)

The Guideline Development Group consisted of a broad group of relevant experts in the field and end users of, and persons affected by, the recommendations. The members of the Guideline Development Group included:

Dr Salih Saad Al-Ansari (advocate in health promotion and education to combat NCDs through physical activity and walking); **Dr Stuart Biddle** (physical activity and sedentary behaviour, and behaviour change); **Dr Katja Borodulin** (physical activity in pregnancy and older adults); **Dr Matthew Buman** (sleep, sedentary behaviour, and physical activity in people living with chronic conditions); **Dr Greet Cardon** (physical activity in children and adolescents); **Ms Catherine Carty** (physical activity in people living with disability); **Dr Jean-Philippe Chaput** (sleep, sedentary behaviour and physical activity in children and adolescents); **Dr Sebastien Chastin** (physical activity, sedentary behaviour and health, objective measurement of physical activity and sedentary behaviour); **Dr Paddy Dempsey** (physical activity and sedentary behaviour in adults and people living with chronic conditions); **Dr Loretta DiPietro** (physical activity in pregnancy and older adults); **Dr Ulf Ekelund** (sedentary behaviour and physical activity, physical activity in children and adolescents); **Dr Joseph Firth** (physical activity and mental health); **Dr Christine Friedenreich** (physical activity in people living with chronic conditions, physical activity and cancer risk); **Dr Leandro Garcia** (physical activity and health in adults); **Dr Muthoni Gichu** (policy implementation, national government); **Dr Russ Jago** (physical activity in children and adolescents); **Dr Peter Katzmarzyk** (physical activity and sedentary behaviour); **Dr Estelle V. Lambert** (physical activity and obesity); **Dr Michael Leitzmann** (sedentary behaviour and physical activity in people living with chronic conditions); **Dr Karen Milton** (translating recommendations into practice); **Dr Francisco B. Ortega** (physical activity in children and adolescents, mental health and objective measurement); **Dr Chathuranga Ranasinghe** (promotion of physical activity and health in the community, workplace and school settings); **Dr Emmanuel Stamatakis** (physical activity and sedentary behaviour and multiple health outcomes in adults); **Dr Anne Tiedemann** (physical activity in older adults); **Dr Richard Troiano** (policy development); **Dr Hidde van der Ploeg** (physical activity and sedentary behaviour in adults); **Ms Vicky Wari** (policy implementation – national government); **Dr Roger Chou** (Pacific Northwest Evidence-based Practice Center and Professor of Medicine, Departments of Medicine, Medical Informatics and Clinical Epidemiology of the Oregon Health and Science University) served as GRADE methodologist. Further details of the GDG are available in Annex 2.

A first GDG meeting was held 2–4 July 2019, at which the GDG decided on the PI/ECO questions, reviewed the existing systematic reviews, and identified updates required. The Group agreed on the process for decision-making on recommendations and the strength of the evidence to be applied at the second GDG meeting. The second meeting was held 11–14 February 2020; updated evidence was reviewed and final recommendations agreed upon by consensus.

External Review Group (ERG)

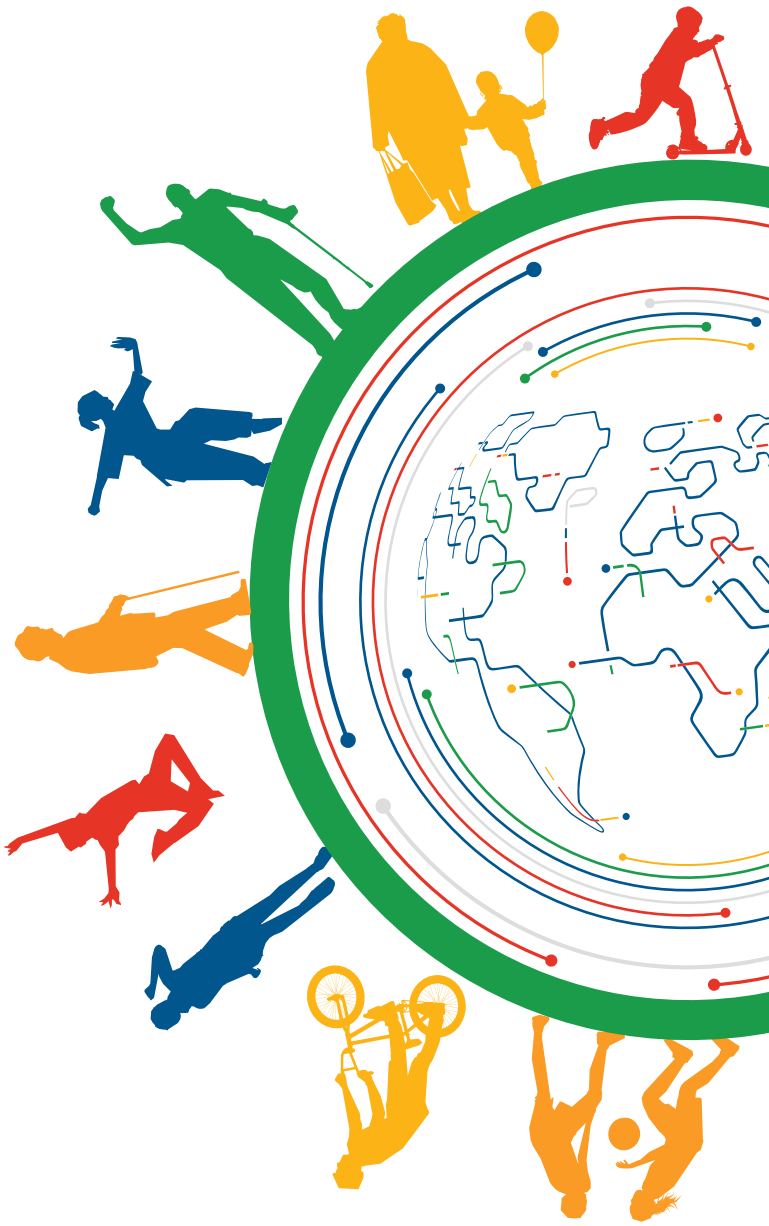
Seven peer reviewers were drawn from a list of individuals suggested by the GDG and Steering Group. They provided relevant expertise, including programme implementation and represented all six WHO regions. The ERG reviewed the draft guidelines and provided feedback to the Steering Group on issues of clarity and implementation, which was incorporated, as appropriate. External peer reviewers did not make changes to the recommendations. External peer reviewers are listed in Annex 2.

Declarations of Interest

All GDG members and external peer reviewers completed and submitted a WHO Declaration of Interests form and signed confidentiality undertakings prior to attending any GDG meetings. The Steering Group reviewed and assessed the submitted curriculum vitae and declarations of interest and performed an internet and publications search to identify any obvious public controversies or interests that may lead to compromising situations. The names and brief biographies of all proposed GDG members were published on the WHO Physical Activity webpage for public consultation for a period of 14 days. No comments were received. If additional guidance on management of any declaration or conflicts of interest had been required, the Steering Group would have consulted with colleagues in Office of Compliance, Risk Management and Ethics. If deemed necessary, individuals found to have conflicts of interest, financial or non-financial, would have been excluded from participation on any topics where interests were conflicting. The management of conflicts of interest was reviewed throughout the process. GDG members were required to update their Declaration of Interest, if necessary, before each meeting and a verbal declaration of interest was solicited at the beginning of each GDG meeting. Declared interests of the GDG and of the external peer reviewers are summarized in Annex 3. No conflict of interest was identified.

Peer review

The draft guidelines were reviewed by seven external peer reviewers identified by the GDG and Steering Group. External peer reviewers were requested to provide comments on issues of clarity, presentation of the evidence, and implementation; comments were incorporated as appropriate. External peer reviewers could not change the recommendations decided upon by the GDG. External peer reviewers are listed in Annex 2; a summary of declarations of interest are provided in Annex 3. In addition, inputs were actively sought from WHO regional offices.



ANNEX 2:

GUIDELINE DEVELOPMENT GROUP, EXTERNAL PEER REVIEWERS, AND WHO STAFF INVOLVED IN THE DEVELOPMENT OF THESE GUIDELINES

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ANNEX 3:

SUMMARY OF DECLARATION OF INTEREST AND HOW THESE WERE MANAGED

Guideline Development Group members

Name	Gender	Expertise	Disclosure of interest	Conflict of interest and management
Dr Salih Saad Al-Ansari	Male	Advocate in health promotion and education to combat NCDs through physical activity and walking	Owner and Chief Executive Officer of the Health Promotion Center	No conflict of interest identified
Dr Stuart Biddle	Male	Physical activity in youth	Research funds and paid consultancy	No conflict of interest identified
Dr Katja Borodulin	Female	Physical activity in pregnancy	Employment at National Institute for Health and Welfare and Age Institute; research funds	No conflict of interest identified
Dr Matthew Buman	Male	Sleep and physical activity in people living with chronic conditions	None declared	No conflict of interest identified
Dr Greet Cardon	Female	Physical activity in youth	None declared	No conflict of interest identified
Ms Catherine Carty	Female	Physical activity in people living with disability	Research funds	No conflict of interest identified
Dr Jean-Philippe Chaput	Male	Sleep	None declared	No conflict of interest identified
Dr Sebastien Chastin	Male	Physical activity and health, objective measurement of physical activity	Research funds	No conflict of interest identified
Dr Paddy Dempsey	Male	Physical activity and sedentary behaviour in adults and people living with chronic conditions	Employment and research funds	No conflict of interest identified
Dr Loretta DiPietro	Female	Physical activity in older adults	None declared	No conflict of interest identified
Dr Ulf Ekelund	Male	Sedentary behaviour and physical activity in youth	None declared	No conflict of interest identified
Dr Joseph Firth	Male	Physical activity and mental health	None declared	No conflict of interest identified
Dr Christine Friedenreich	Female	Physical activity in people living with chronic conditions, physical activity and cancer risk	None declared	No conflict of interest identified
Dr Leandro Garcia	Male	Physical activity and mental health	Employment and paid consultancy	No conflict of interest identified
Dr Muthoni Gichu	Female	Policy implementation (national government)	None declared	No conflict of interest identified
Dr Russ Jago	Male	Physical activity in youth	None declared	No conflict of interest identified

Name	Gender	Expertise	Disclosure of interest	Conflict of interest and management
Dr Peter Katzmarzyk	Male	Physical activity and sedentary behaviour in youth	Travel support to assist guideline committees	No conflict of interest identified
Dr Estelle V. Lambert	Female	Physical activity and obesity	None declared	No conflict of interest identified
Dr Michael Leitzmann	Male	Sedentary behaviour and chronic conditions	None declared	No conflict of interest identified
Dr Karen Milton	Female	Translating recommendations into practice	Travel support to assist guideline committee	No conflict of interest identified
Dr Francisco Ortega	Male	Physical activity in youth, mental health and objective measurement	None declared	No conflict of interest identified
Dr Chathuranga Ranasinghe	Male	Promotion of physical activity and health in the community, workplace and school settings	Research funds	No conflict of interest identified
Dr Emmanuel Stamatakis	Male	Physical activity and multiple health outcomes in adults	Grant for technology company for objective measurement of physical activity	No conflict of interest identified
Dr Anne Tiedemann	Female	Physical activity and health outcomes in older adults	None declared	No conflict of interest identified
Dr Richard Troiano	Male	Policy development	None declared	No conflict of interest identified
Dr Hidde van der Ploeg	Male	Physical activity, sedentary behaviour and health outcomes in adults	Travel support to assist 2017 Dutch Physical Activity Guidelines committee and research funds	No conflict of interest identified
Ms Vicky Wari	Female	Policy implementation (national government)	Shares (not relevant to guideline)	No conflict of interest identified

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Name	Gender	Expertise	Disclosure of interest	Conflict of interest and management
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Dr Huda Alsiyabi	Female	Policy and programme implementation	None declared	No conflict of interest identified
Dr Alberto Flórez-Pregonero	Male	Physical activity and sedentary behaviour measurement and surveillance	None declared	No conflict of interest identified
Dr Shigeru Inoue	Male	Epidemiology and physical activity promotion	None declared	No conflict of interest identified
Dr Agus Mahendra	Male	Physical activity and movement skills in children	None declared	No conflict of interest identified
Dr Deborah Salvo	Female	Health and social disparities, with a particular emphasis on chronic disease prevention	None declared	No conflict of interest identified
Dr Jasper Schipperijn	Male	Physical activity and the built environment	President-Elect of the International Society for Physical Activity and Health (ISPAH)	No conflict of interest identified

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