

WHO Guidelines on physical activity and sedentary behaviour for children and adolescents, adults and older adults

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Background

Physical inactivity is a leading risk factor for global mortality (1) and regular physical activity is a known protective factor for the prevention and management of noncommunicable diseases such as cardiovascular disease, diabetes, breast and colon cancer (2-4). Physical activity also has benefits for mental health (5), delays the onset of dementia (6), and can contribute to the maintenance of healthy weight (2) and general wellbeing (7).

Physical activity is defined as any bodily movement produced by skeletal muscles that requires energy expenditure (2) 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 any waking behaviour while in a sitting, reclining or lying posture with low energy expenditure (8). Recent 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 (9-11).

Current global estimates of physical inactivity indicate that 27.5% of adults (12) and 81% of adolescents (13) do not meet the existing WHO recommendations on physical activity for health (2), with no improvement over the last decade. There are significant differences in the patterns of inactivity across genders, regions and countries and difference in physical activity can be explained by inequities in opportunities and access, further amplifying inequities in health. Estimates from 2012 indicate that not meeting current physical activity recommendations results in more than 5 million deaths globally each year (3). There are currently no global estimates of sedentary behaviour, but technological innovation and the transition towards more sedentary occupations and entertainment, and the use of personal motorised transportation are very likely to contribute to rapidly changing patterns of activity and increased sedentary behaviour across the world.

The *Global action plan on physical activity 2018-2030* (14) sets out four 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. This action plan was endorsed by the World Health Assembly¹ and included a call for WHO to update the 2010 *Global recommendations on physical activity for health* (2).

WHO recently published *Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age* (15). These were called for by the Commission on Ending Childhood Obesity (recommendation 4.12) (16), and address the omission of this young age group in the 2010 *Global recommendations on physical activity for health* (2). The present guidelines will form part of the overall set of guidelines on physical activity and sedentary behaviour.

Other WHO guidelines also address the importance of physical activity for health. The *WHO Package of essential noncommunicable disease interventions for primary health care in low-resource settings* (17) provides a counselling protocol for the management of hypertension, diabetes, raised cardiovascular risk, asthma, and chronic obstructive pulmonary disease to progressively increase physical activity to moderate levels (such as brisk walking) and at least 150 minutes per week. The current guidelines review the evidence for adult cancer survivors and those living with hypertension

¹ WHA71.6 WHO global action plan on physical activity 2018–2030

and type-2 diabetes. WHO guidelines on *Risk reduction of cognitive decline and dementia (18)* state 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. The current guidelines consider physical health-related outcomes to complement these recommendations relating to cognitive outcomes. *WHO recommendations on antenatal care for a positive pregnancy experience (19)* also recommend counselling about healthy eating and remaining physically active during pregnancy to stay healthy and to prevent excessive weight gain, but do not address wider health benefits of physical activity during pregnancy and the postpartum period, which are considered here.

Scope and purpose of guidelines

The overarching goal of these guidelines is to provide population-based and evidence-based recommendations concerning the amount of physical activity (frequency, intensity and duration) that will offer significant health benefits and mitigate health risks. The evidence reviewed considered the associations between physical activity and a selected set of important health outcomes and how these varied according to the type (such as aerobic, muscle strengthening or activity to target particular concerns, such as balance and falls for older adults) and domain (leisure activity or work). Additionally, for the first time, these guidelines provide evidence-based recommendations on the associations between sedentary behaviour and health outcomes.

These guidelines have been developed for children and adolescents, adults, older adults and for the first time WHO guidelines make specific recommendations on physical activity in sub-populations such as pregnant women and those living with chronic conditions or disability.

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 update the 2010 *Global recommendations on physical activity for health*.

Nonetheless, the importance of sleep is recognized and has been included as an important health outcome when considering the impact of physical activity.

These guidelines will replace the recommendations on physical activity for health released in 2010 (2) with the most recent advances in the evidence base for these behaviours and associated health consequences. The recently-launched WHO guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age (15) complement this proposed update.

Target audience

The key audiences for these guidelines are:

1. policy makers in ministries of health, education, 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, sub-regional or municipal plans to increase physical activity and reduce sedentary time in population groups through guidance documents;

3. persons working in non-governmental organizations, education and workplace organizations or research; and
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.

Systematic reviews

The present update of the WHO recommendations on physical activity has been conducted by extending and updating the evidence collated for the development of national physical activity guidelines that met the following three criteria: the evidence reviews had been conducted according to standard systematic processes that were well documented; the assessment of the quality 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 the evidence reviews addressed the populations of interest. For this guideline on children and adolescents, the 2016 *Canadian 24-Hour Movement Guidelines for Children and Youth (20-22)*, the 2019 *Australian 24-Hour Movement Guidelines for Children and Young People (5-17 years) (23)* and the 2018 *Physical Activity Guidelines for Americans, 2nd Edition (24)* were updated. For adults, older adults and sub-populations, the systematic evidence collated for the development of the 2018 *Physical Activity Guidelines for Americans, 2nd Edition (24)* was updated.

In order to update the evidence base for each health outcome, an agreed set of search terms, databases and search methods, as well as standardized data extraction protocols, were developed and employed. The searches were conducted to identify systematic reviews published from 2017 through to September 2019. The GRADE method was used to rate the certainty of the evidence for each question.

The guideline development group (GDG) developed the key questions (PECO questions: Population, Exposure, Comparison, Outcome), and identified the critical and important outcomes. These are available Annex 1. The GDG reviewed the scientific evidence identified and formulated the recommendations below. These are presented by age group and sub-population, with the key recommendation, the strength of the recommendation and the quality of the evidence to support this in the text box. The text box also contains statements that provide information on additional considerations.

A summary of the evidence is provided below each recommendation, with reference to the evidence profile tables.

Recommendations

Children and adolescents (5-17 years)

These guidelines are for all children and adolescents, irrespective of gender, cultural background or socio-economic status, and are relevant for children and adolescents of all abilities.

Physical activity recommendation

For children and adolescents, physical activity can be 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. It is important to provide all children and adolescents with safe and equitable opportunities and encouragement to participate in physical activities that are appropriate for their age and ability, that are enjoyable, and that offer variety.

- Children and adolescents should do at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity, across the week; most of this physical activity should be aerobic.
- Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone should be incorporated at least 3 days per week.

Strong recommendation, moderate quality evidence

Some physical activity is better than none. If children are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time.

Summary of evidence

The WHO global recommendations on physical activity for children and adolescents update the evidence collated for the *Canadian 24-Hour Movement Guidelines for Children and Youth (20-22)*, the *Australian 24-Hour Movement Guidelines for Children and Young People (5-17 years) (23)* and the *Physical Activity Guidelines for Americans, 2nd Edition (24)*. The evidence profiles detailing the updated evidence identified are available in Annex 2, section A1.

The evidence reviewed considered the association between physical activity and health-related outcomes, if there is a dose-response association (volume, duration, frequency, intensity) and if the association varies by type or domain of physical activity.

Greater amounts and intensities of physical activity are associated with multiple beneficial health outcomes, including cardiorespiratory, muscular fitness and bone health. Moderate quality evidence indicates that physical activity is positively associated with cardiometabolic health and cognition. High quality evidence demonstrates that physical activity reduces the risk of experiencing depression, and that physical activity interventions reduce depressive symptoms in children and adolescents with and without major depression. Moderate quality evidence indicates that both short and long-term moderate- to vigorous-intensity physical activity have positive effects on brain health, cognitive function, and academic outcomes (e.g., school performance, psychometric profile of memory and executive function) in preadolescent children ages 5 to 13 years. Physical activity is associated with the management of a healthy weight status but the quality of evidence is low. Higher amounts of physical activity may be associated with smaller increases in weight and adiposity

during childhood and adolescence. However, there is a low risk that physical activity will be harmful for the management of weight status in children and adolescents.

There is evidence of a dose-response relationship but that there is insufficient evidence to determine an optimal physical activity dose. Many of the benefits occur with an average of 60 minutes of physical activity daily. However, more physical activity appears to be better.

There is insufficient evidence to determine if the association between physical activity and health outcomes varies by type or domain of physical activity in children and adolescents. High quality evidence demonstrates that increased aerobic moderate-to-vigorous (MVPA) physical activity increases cardiorespiratory fitness and that increased resistance exercise increases muscular fitness in children and adolescents.

Key issues

The current evidence base does not support a specific minimum daily threshold of 60 minutes of moderate to vigorous intensity physical activity for health benefits. The evidence base comprises studies that have mostly used metrics and analytical cut points of an average of 60 minutes per day to assess the benefits of physical activity on health outcomes. Updating the recommendations to an average number of daily minutes more closely reflects the evidence and the way it is measured. There is insufficient evidence to recommend an upper threshold of activity although there is evidence that participation in higher volumes and/or intensity of activity can provide greater health benefits.

Sedentary behaviour recommendation

For children and adolescents, sedentary behaviour includes time spent sitting or lying with low energy expenditure, while awake, in the context of educational, home, and community settings and transportation.

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

Strong recommendation, low quality evidence

Summary of evidence

The WHO global recommendations on sedentary behaviour for children and adolescents update the evidence collated for the *Canadian 24-Hour Movement Guidelines for Children and Youth (20-22)* and the *Australian 24-Hour Movement Guidelines for Children and Young People (5-17 years)* (23) and the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section A2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume and the frequency, duration and intensity of interruption) and if the association varies by type and domain of sedentary behaviour.

Low quality evidence suggests that greater time spent in sedentary behaviour is related to poorer health outcomes (including adiposity, cardiometabolic health, behavioural conduct/pro-social behaviour, fitness, self-esteem). 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.

Insufficient evidence is available to determine whether a dose-response relationship exists between sedentary time and health outcomes in children and adolescents.

Insufficient evidence is available to determine if the association between sedentary behaviour and health outcomes in children and adolescents varies by type or domain of sedentary behaviour. The association between sedentary behaviour and adverse health outcomes is generally stronger for television viewing or recreational screen time as the exposure than for total sedentary time. The committee also recognizes that time spent in sedentary behaviour may include pursuits such as reading, studying, drawing, crafting, music etc. and that these activities may have cognitive, as well as other benefits.

Key issues

Most of the evidence assessing the associations between sedentary behaviours and health outcomes in children and adolescents is cross-sectional in nature (low quality evidence); furthermore, the majority of studies rely on self- or parent-reported measures of sedentary time which is more likely to incur measurement error and recall bias.

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 MVPA is taken into account.

The evidence linking moderate-to-vigorous physical activity (MVPA) to positive health outcomes is strong, and well documented across diverse settings. Replacing some sedentary behaviour with physical activity (especially MVPA) improves health outcomes.

The GDG recognized that sedentary time may include time spent engaged in educational pursuits/study or quiet play without electronic media. These pursuits, such as reading, puzzles, drawing, craft, singing, music etc. are important for child development and these activities have cognitive as well as other benefits. In developing the recommendations, the GDG acknowledged the importance of reflecting the value of sedentary time that is known to benefit cognitive function.

Adults (18-64 years)

These guidelines are for all adults, irrespective of gender, cultural background or socio-economic status, and are relevant for adults of all abilities.

Physical activity recommendation

For adults, physical activity can be 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.

- All adults should undertake regular physical activity;
- Adults should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial health benefits;
- 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 quality evidence

- Adults may increase moderate-intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity, for additional health benefits.

Conditional recommendation, moderate quality evidence

Some physical activity is better than none. If adults are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time.

Summary of evidence

The WHO global recommendations on physical activity for adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24), and incorporate new umbrella reviews of occupational physical activity and health related outcomes and the adverse effects, injuries and harms associated with leisure-time physical activity. The evidence profiles detailing the updated evidence identified are available in Annex 2, section B1.

The evidence reviewed considered the association between physical activity and health-related outcomes, if there is a dose-response association (volume, duration, frequency, intensity) and if the association varies by type or domain of physical activity.

Moderate to high quality evidence indicates that higher levels of physical activity are associated with multiple beneficial health outcomes, including lower risk for all-cause mortality, incident CVD, site-specific incident cancer, and incident type-2 diabetes. There is an association with prevention of weight gain, reduced symptoms of depression and anxiety and reduced risk of developing

depression and anxiety overtime, improvements in cognition and brain function and a reduced risk of developing cognitive impairment. There is also high quality evidence that both acute bouts and regular physical activity improves sleep and health-related quality of life outcomes in adults, and lowers risk of incident hypertension.

Moderate quality evidence indicates a curvilinear inverse dose-response relationship between physical activity and major outcomes such as all-cause mortality, cardiovascular mortality, incident cancer, and incident diabetes in adults. More physical activity is better, although the relative benefits level off at higher levels of physical activity. It is not possible to identify the exact physical activity level where diminished returns of health benefits begin for adults. Moderate quality evidence indicates that physical activity in bouts of any duration is associated with improved health outcomes, including all-cause mortality.

Strong evidence demonstrates that the shape of the dose-response relationship is nonlinear, with the greatest benefit seen at the lower end of the dose-response curve. The relationship of moderate-to-vigorous physical activity and risk reduction has no lower limit. Risk appears to continue to decrease with increased exposure up to at least three to five times the amounts of moderate-to-vigorous physical activity recommended in the 2010 Guidelines (i.e., 150 minutes per week). Low quality evidence suggests a relationship between physical activity and weight gain in adults, with greater amounts of physical activity associated with lower risk of weight gain.

Insufficient evidence is available to determine if the association between physical activity and health outcomes varies by type of physical activity in adults. For all-cause mortality, adherence to either the current aerobic guideline alone, or the strength promoting exercise guideline alone, show beneficial associations, although adherence to both guidelines is optimal. There is also low quality evidence that shows that resistance training reduces the symptoms of depression or anxiety.

The large majority of studies use self-reported measures of physical activity, which attempt to capture activity across multiple domains which are often defined differently. This, combined with the dearth of studies that specifically analyse by domain of activity, makes it difficult to differentiate the effect of different domains of physical activity on health outcomes. Evidence from those studies investigating domain-specific physical activity and associations with health outcomes report that high levels of occupational physical activity are associated with reduced risk of many cancers, cardiovascular disease, hypertension and type-2 diabetes. However, higher levels of occupational physical activity may be associated with an increased risk of osteoarthritis, adverse sleep quality, adverse mental health outcomes and all-cause mortality among males but not among females, although there is substantial risk of confounding with, for example, socioeconomic status. The quality of the evidence (GRADE) in the review of occupational physical activity was low.

Low quality evidence suggests an association between physical activity and the risk of adverse events and injuries. Available evidence indicates that the risks are very low with moderate-intensity activities, and that the health benefits from such activity outweigh the risks. Sudden cardiac adverse events are rare and associated with acute sessions of higher volumes of relatively vigorous physical activity.

Although there is an emerging body of evidence on the impact of air quality during physical activity on health-related outcomes. Initial scoping of the evidence identified few systematic reviews, that almost all evidence was limited to high-income settings, where the levels of and exposure to air

pollution is significantly lower and the vast majority of the primary studies measure area-level air pollution levels instead of individual exposure to/inhalation of air pollution, which may result in residual confounding (e.g., socioeconomic status). This led the GDG to decide that it was beyond the scope of the current update to address this in detail.

Key issues

The 2010 *Global recommendations on physical activity for health* (24) recommended that aerobic activity should be performed in bouts of at least 10 minutes duration. However, recent evidence shows that physical activity of any bout duration is associated with improved health outcomes, including all-cause mortality (25). As such, the above recommended amounts of aerobic moderate to vigorous physical activity can be accumulated in bouts of any duration.

The majority of available evidence comes from studies using self-reported assessment of physical activity and from high-income countries and more evidence is needed, particularly on occupational physical activity, from studies in low- and middle- income countries, as well as from studies using device-based assessment methods. The use of device-based measurement of physical activity would advance the science particularly in the assessment of bout duration, physical activity of light intensity, and total volume of activity by improving completeness of the physical activity captured and reducing self-report measurement error and biases.

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.

- Adults should limit the amount of time spent being sedentary and replacing sedentary time with physical activity of any intensity (including light intensity) has health benefits;
- Adults who are highly sedentary should aim to achieve or exceed the upper levels of recommended moderate-to-vigorous intensity physical activity.

Strong recommendation, moderate quality evidence

Summary of the evidence

The WHO global recommendations on sedentary behaviour for adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section B2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume, frequency, duration, and intensity of interruptions), if the association varies by type and domain of sedentary behaviour and if physical activity modifies the effect of sedentary behaviour on mortality.

High quality evidence demonstrates a significant relationship between greater time spent in sedentary behaviour and higher all-cause mortality, cardiovascular mortality, cardiovascular disease incidence and type-2 diabetes incidence. Moderate quality evidence indicates a significant relationship between greater time spent in sedentary behaviour and higher cancer mortality, and cancer incidence.

High quality evidence demonstrates a direct, curvilinear dose-response relationship between sedentary behaviour and all-cause mortality, cardiovascular disease mortality and cardiovascular disease incidence, with an increasing slope at higher amounts of sedentary behaviour.

High quality evidence indicates that the relationship between sedentary behaviour and all-cause mortality and cardiovascular disease mortality varies by amount of moderate-to-vigorous physical activity. Higher amounts of physical activity can attenuate the detrimental association between sedentary behaviour and health outcomes. The relative reductions in risk are larger for those who are the most sedentary.

Very low quality evidence suggests a positive relationship between time spent in sedentary behaviour and adiposity and indicators of weight status, a dose-response relationship, or whether the relationship between sedentary behaviour and weight status varies by amount of moderate-to-vigorous physical activity.

Key issues

Evidence on sedentary behaviour associations with prospective health outcomes is primarily reliant on self-report questionnaires, for which there is substantial heterogeneity (affecting measurement validity and pooled estimates) and some key limitations. There are an emerging number of studies with device-based measures of physical activity and sedentary time in relation to health outcomes are emerging. Some misclassification may still be occurring with device-based measures (e.g. for non-ambulatory activities such as cycling, muscle strengthening or swimming, or devices may fail to distinguish between sitting/lying and standing still), which may lead to imprecision in effect estimates.

It is also possible that some domains/types of sedentary behaviour are more detrimental to health (e.g. sitting while reading may be advantageous for some outcomes as opposed to sedentary screen-time); however, this evidence base is still growing and may vary by health outcome.

It should be recognized 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.

Older adults (65 years and over)

These guidelines are for all older adults, irrespective of gender, cultural background or socio-economic status, and are relevant for older adults of all abilities.

Physical activity recommendation

For older adults, physical activity can be 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.

- All older adults should undertake regular physical activity;
- Older adults should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial 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;
- As part of their weekly physical activity, older adults should do varied multicomponent physical activity that emphasises functional balance and strength training at moderate or greater intensity on 3 or more days per week to enhance functional capacity and prevent falls.

Strong recommendation, moderate quality evidence

- Older adults may increase moderate-intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity, for additional health benefits.

Conditional recommendation, moderate quality evidence

Some physical activity is better than none. If older adults are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity 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.

Summary of evidence

The WHO global recommendations on physical activity for older adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24) and include a new umbrella review of evidence on the associations between physical activity and osteoporosis and sarcopenia, and an update of a recent systematic review on the association between physical activity and falls prevention. The evidence profiles detailing the updated evidence identified are available in Annex 2, section C1.

The evidence reviewed considered the association between physical activity and health-related outcomes, if there is a dose-response association (volume, duration, frequency, intensity) and if the association varies by type or domain of physical activity.

The primary evidence base for assessing the associations between physical activity and health outcomes in older adult populations was the same scientific literature collated and reviewed for adult populations. This same evidence base was accepted because the majority of studies had no upper age limit criterion and therefore included adults over age of 65 years. As such, the GDG reviewed the science and draft recommendations on physical activity and health outcomes for adult populations and considered the applicability to older adults. The GDG concluded that both the science and draft recommendations could be extrapolated to the older adult population for the common set of critical health outcomes. The key issue identified for adult physical activity are also relevant to older adults.

For the additional health-related outcomes specific to older adult populations, the evidence was reviewed for the following outcomes: fall prevention, fall-related injuries, physical function, frailty and osteoporosis.

High quality evidence demonstrates that higher levels of physical activity that targets balance, strength, functional training are associated with a reduced rate of falls and a reduced risk of injury from falls. Physical activity results in improvement in physical function and reduced risk of age-related loss of physical function in the general older adult population. In addition, higher levels of physical activity probably improve bone health among older adults and thus prevents osteoporosis.

High quality evidence demonstrates an inverse dose-response relationship between volume of aerobic physical activity and risk of physical functional limitations in the general older adult population.

High quality evidence demonstrates that balance and functional exercises reduce the rate of falls and that a variety of different physical activity interventions are associated with improvements in different aspects of physical function. Moderate quality evidence indicates that the risk of fall-related injury may be reduced using a variety of community-based group and home-based physical activities. Effective multicomponent physical activity regimens generally include combinations of balance, strength, endurance, gait, and physical function training. Moderate quality evidence indicates that programmes involving multiple exercise types probably 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.

- Older adults should limit the amount of time spent being sedentary and replacing sedentary time with physical activity of any intensity (including light intensity) has health benefits;

- Older adults who are highly sedentary should aim to achieve or exceed the upper levels of recommended moderate-to-vigorous intensity physical activity.

Strong recommendation, moderate quality evidence

Some physical activity is better than none. If older adults are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time. Older adults should be as physically active as their functional abilities allow, and determine their level of effort for physical activity relative to their level of fitness.

Summary of evidence

The WHO global recommendations on sedentary behaviour for adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section B2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume, frequency, duration, and intensity of interruptions), if the association varies by type and domain of sedentary behaviour and if physical activity modifies the effect of sedentary behaviour on mortality.

The primary evidence base for assessing the associations between sedentary behaviour and health outcomes in older adult populations was the scientific literature collated and reviewed for adult populations, because the majority of studies employed no upper age limit criterion and therefore included adults over age of 65 years. As such, the GDG reviewed the science and recommendations on sedentary behaviour and health outcomes for adult populations and considered these applicable to older adults. The GDG concluded that both the science and draft recommendations could be extrapolated to older adult population for the common set of critical health outcomes.

Pregnant and postpartum women

These guidelines are for all pregnant and postpartum women, irrespective of age, cultural background or socio-economic status. 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 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.

All pregnant and postpartum women without contraindication should:

- undertake regular physical activity throughout pregnancy and postpartum;

And for substantial health benefits, should:

- do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week;
- incorporate a variety of aerobic and muscle-strengthening activities. Adding gentle stretching may also be beneficial;
- women who habitually engaged in vigorous-intensity aerobic activity or who were physically active before pregnancy can continue these activities during pregnancy and the postpartum period.

Strong recommendation, moderate quality evidence

Some physical activity is better than none. If pregnant and postpartum women are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time. Pelvic floor muscle training may be performed on a daily basis to reduce the risk of urinary incontinence.

Summary of evidence

The WHO global recommendations on physical activity for pregnant and postpartum women update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24) and the 2019 *Canadian Guideline for Physical Activity Throughout Pregnancy* (27). The evidence profiles detailing the updated evidence identified are available in Annex 2, section D1.

The evidence reviewed considered the association between physical activity and health-related outcomes, if there is a dose-response association (volume, duration, frequency, intensity) and if the association varies by type or domain or timing (pre-pregnancy, antenatal or postnatal) of physical activity.

High quality evidence demonstrates that physical activity during pregnancy is associated with reduced gestational weight gain and reduced risk of gestational diabetes mellitus in women with overweight or obesity. High to moderate quality evidence indicates that the incidence of gestational hypertension is no different between pregnant women who received a physical activity intervention and those receiving standard antenatal care.

Low quality evidence suggests a significant inverse relationship between physical activity during pregnancy and postpartum depression.

Among pregnant women with overweight or obesity, low to moderate quality evidence suggests no significant increase in risk of low birth weight, or small for gestational age or large for gestational age babies between women who were physically active and those with standard antenatal care.

Moderate quality evidence indicates a small, but significant, reduced risk of preterm birth in babies of mothers who engaged in *vigorous* physical activity. Similarly, among pregnant women with overweight or obesity there was no significant difference in the risk of preterm birth between those who were physically active or those with standard antenatal care.

Insufficient evidence is available to determine the dose-response relationship between physical activity and health outcomes during pregnancy and the postpartum period.

Insufficient evidence is available 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.

Key issues

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.

Safety issues in pregnant women:

- Maintain adequate nutrition and hydration—drink water before, during and after physical activity;
- Avoid physical activity in excessive heat, especially with high humidity;
- Avoid activities which involve physical contact, danger of falling or poor oxygenation;
- Avoid physical activity at high altitude (>2500 m) if not residing at such altitude. Those considering physical activity above those altitudes should seek supervision from an obstetric care provider with knowledge of the impact of high altitude on maternal and fetal outcomes;
- Those considering athletic competition or exercising significantly above the recommended guidelines should seek supervision from an obstetric care provider with knowledge of the impact of high-intensity physical activity on maternal and fetal outcomes;
- Know the reasons to stop, or limit physical activity and consult a qualified healthcare provider immediately if they occur.

Sedentary behaviour recommendation

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

- 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) has health benefits.

Strong recommendation, low quality evidence

Summary of evidence

The WHO global recommendations on sedentary behaviour for adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section B2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume, frequency, duration, and intensity of interruptions), if the association varies by type and domain of sedentary behaviour and if physical activity modifies the effect of sedentary behaviour on mortality.

The literature searches and evidence reviewed for sedentary behaviour in adult populations may have included pregnant and postpartum women. The GDG reviewed the evidence and draft recommendations and concluded it was applicable and therefore the sedentary behaviour recommendations for adults are extrapolated to pregnant and postpartum women.

Adults with chronic conditions (18 years and over)

These guidelines are for all adults with chronic conditions, irrespective of age, gender, cultural background or socio-economic status, and are relevant for adults of all abilities. Adults with chronic conditions should try to meet these recommendations where possible, as able and without contraindication.

Physical activity recommendation

For adults with chronic conditions, physical activity can be 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.

- All adults with chronic conditions should undertake regular physical activity;
- Adults with chronic conditions should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial health benefits;
- Adults with 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;
- As part of their weekly physical activity, older adults with chronic conditions should do varied multicomponent physical activity that emphasises functional balance and strength training at moderate or greater intensity on 3 or more days per week to enhance functional capacity and prevent falls.

Strong recommendation, moderate quality evidence

- When not contraindicated, adults with chronic conditions may increase moderate-intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity, for additional health benefits.

Conditional recommendation, moderate quality evidence

When not able to meet the above recommendations, adults with chronic conditions should aim to engage in physical activity according to their abilities. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time.

Adults with 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.

Summary of evidence

The WHO global recommendations for adults living with chronic conditions update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition (24)* and a new umbrella review of physical activity in adults living with HIV. The evidence profiles are available in Annex 2, section E1.

The evidence reviewed considered the association between physical activity and health-related outcomes, if there is a dose-response association (volume, duration, frequency, intensity) and if the association varies by type of physical activity among adults (with no upper age limit) in four sub population groups: adults who had survived cancer, and adults living with hypertension, type-2 diabetes or HIV.

The health benefits of physical activity in secondary prevention of coronary heart disease has been previously established with a substantial evidence base. For this reason, the scope of this update of WHO recommendations focussed on cancer survivors and those living with hypertension or type-2 diabetes. Given the advancement of effective and widely available antiretroviral treatment for HIV, this condition can now also be considered a chronic condition. As there are now large numbers of people living with HIV worldwide and increasing concerns of the risks of noncommunicable disease, unhealthy body composition and metabolic health in this sub-population, the GDG proposed the inclusion of people living with HIV as a chronic condition to these guidelines. These are the first WHO guidelines on physical activity for this population.

High quality evidence demonstrates that greater amounts of physical activity before and after cancer diagnosis were associated with lower risks of all-cause and cancer-specific mortality in female breast cancer survivors and in colorectal cancer survivors. High quality evidence demonstrates that physical activity reduces the risk of progression of cardiovascular disease among adults with hypertension.

Moderate quality evidence indicates that physical activity is positively associated with health-related quality of life, maximal oxygen consumption and exercise tolerance in people living with HIV.

Moderate quality evidence indicates that physical activity is associated with a reduction in body fat percentage and an increase in lean body mass but is not associated with changes in BMI or waist circumference in people living with HIV. Moderate evidence also indicates that physical activity is

related to a reduction in symptoms of depression in people living with HIV. The evidence is particularly strong for overall measures of general health and physical functioning. These results are similar whether referring to aerobic exercise or multi-component exercise.

Moderate quality evidence indicates an inverse dose-response relationship between physical activity and cardiovascular disease mortality among adults with hypertension. High quality evidence demonstrates an inverse association between volume of physical activity and risk of cardiovascular mortality, with moderate quality evidence for an inverse, curvilinear dose-response relationship with activity volume.

High quality evidence demonstrates inverse association between aerobic activity, muscle-strengthening activity, and aerobic plus muscle-strengthening activity with markers of blood glucose management (HbA1C), blood pressure, body mass index (BMI), and lipids in adults with type 2 diabetes.

Moderate quality evidence indicates that regular physical activity, whether aerobic in nature, or combined with resistance training, did not result in any significant change in viral load or CD4+ count in people living with HIV. This suggests that HIV as a chronic disease will not be adversely affected by physical activity. There is insufficient evidence for a dose-response effect.

Key issues

To date, most physical activity guidelines have been limited to clinical or therapeutic guidance for people presenting with chronic conditions, such as the most recent clinical practice recommendations, developed by the American College of Sports Medicine (ACSM),¹ for oncology clinicians to encourage their cancer patients to “move more”. WHO also has clinical guidance on recommending physical activity to patients with chronic disease but these are the first population-based WHO guidelines on physical activity for people living with chronic conditions.

The evidence from the new systematic review of people living with HIV found that most of the studies were conducted in North America or Europe, with only one from the African region, in spite of a 10-fold higher HIV prevalence in the African region. This may reduce the applicability of evidence on physical activity in HIV infected persons in the African region, as benefits of physical activity for people living with HIV in this region may differ and be confounded by poverty, poor nutrition, unemployment or occupation-related physical activity.

Sedentary behaviour recommendation

For adults with chronic conditions, 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.

- Adults with chronic conditions should limit the amount of time spent being sedentary and replacing sedentary time with physical activity of any intensity (including light intensity) has health benefits;

- Adults with chronic conditions who are highly sedentary should aim to achieve or exceed the upper levels of recommended moderate-to-vigorous intensity physical activity.

Strong recommendation, low quality evidence

Summary of evidence

The WHO global recommendations on sedentary behaviour for adults update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section B2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume, frequency, duration, and intensity of interruptions), if the association varies by type and domain of sedentary behaviour and if physical activity modifies the effect of sedentary behaviour on mortality.

The primary evidence base for assessing the associations between sedentary behaviour and health outcomes in adults living with chronic conditions was the scientific literature collated and reviewed for adult populations. The majority of studies employed no upper age limit criterion and therefore included adults over age of 65 years and may have included adults living with chronic conditions, such as cancer survivors, those living with hypertension, type-2 diabetes or HIV. As such, the GDG reviewed the science and recommendations on sedentary behaviour and health outcomes for adult populations and considered these applicable to older adults. The GDG concluded that both the science and draft recommendations could be extrapolated to adults living with chronic conditions for the common set of critical health outcomes.

Children and adolescents (aged 5-17 years) and adults (aged 18 years and over) living with disability

Physical activity recommendation

These guidelines are for all children, adolescents and adults with disability, irrespective of gender, cultural background or socio-economic status, and are relevant for children, adolescents and adults of all abilities. Children, adolescents and adults 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 with disability, physical activity can be 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 with disability with opportunities and encouragement to participate in physical activities that are appropriate for their age and ability, that are enjoyable, and that offer variety.

- Children and adolescents with disability should do at least an average of 60 minutes per day of moderate-to-vigorous intensity physical activity, across the week;
- Most of this physical activity should be aerobic. Vigorous-intensity aerobic activities, as well as those that strengthen muscle and bone should be incorporated at least 3 days per week.
- All adults with disability should undertake regular physical activity;
- Adults with disability should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial health benefits;
- Adults 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 benefits;
- As part of their weekly physical activity, older adults with disability should do varied multicomponent physical activity that emphasises functional balance and strength training at moderate or greater intensity on 3 or more days per week to enhance functional capacity and prevent falls.

Strong recommendation, moderate quality evidence

- When not contraindicated, adults with disability may increase moderate-intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity, for additional health benefits.

Conditional recommendation, moderate quality evidence

Some physical activity is better than none. If children, adolescents and adults with disability are not currently meeting these recommendations, doing some physical activity will bring benefits to health. They should start with small amounts of physical activity and gradually increase duration, frequency and intensity over time.

There are no major risks to children, adolescents and adults 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, adolescents and adults with disability may consider consulting a health care professional or other physical activity and disability specialist to help determine the type and amount of activity appropriate for them.

Summary of evidence

The WHO global recommendations for children, adolescents and adults living with disability update the evidence collated for the *Physical Activity Guidelines for Americans, 2nd Edition* (24) and the evidence profiles are available in Annex 2, section E1.

The evidence reviewed considered the association between physical activity and health-related outcomes in children, adolescents and adults living with the following impairments: multiple sclerosis, spinal cord injury, intellectual disability, Parkinson's disease, disability as a result of a stroke, major clinical depression, schizophrenia or attention-deficit/hyperactivity disorder (ADHD). The GDG did not limit the recommendations to only this selection of health conditions or impairments for which an evidence base on the associations between physical activity and health outcomes is available. As such, findings were extrapolated to be applicable to people with disability in general. The impact of environmental factors on disability in the context of physical activity was beyond the scope of these guidelines and was not analysed.

High quality evidence demonstrates that physical activity—particularly aerobic and muscle-strengthening activities—improves physical function, including walking speed and endurance, in adults with multiple sclerosis. Aerobic exercise has small but significant effects on physical, mental, and social domains of health-related quality of life.

Low quality evidence suggests that physical activity reduces shoulder pain and improves vascular function in paralyzed limbs and enhances health-related quality of life in individuals with spinal cord injury. Moderate quality evidence indicates that physical activity improves walking function, muscular strength, and upper extremity function for persons with spinal cord injury.

Insufficient evidence was available to determine the relationship of physical activity with risk of comorbid conditions in individuals with intellectual disability and low quality evidence was found to suggest that physical activity improves physical function in children and adults with intellectual disability.

High quality evidence demonstrates that physical activity improves a number of functional outcomes including walking, balance, strength, and disease specific motor scores in individuals with Parkinson's disease and moderate quality evidence indicates that moderate-to-vigorous physical activity can have beneficial effects on cognition in individuals with diseases or disorders that impair cognitive function, including Parkinson's disease.

Moderate quality evidence indicates that mobility-oriented physical activity improves walking function and can have beneficial effects on cognition in individuals with a history of stroke.

Low quality evidence suggests that physical activity improves quality of life in adults with major clinical depression. One high credibility systematic review identified in the update showed exercise to be associated with improvement in quality of life, including physical and psychological domains.

Moderate quality evidence indicates that moderate-to-vigorous physical activity can have beneficial effects on cognition and is associated with improved quality of life in individuals with diseases or disorders that impair cognitive function, including schizophrenia.

Moderate quality evidence indicates that moderate-to-vigorous physical activity can have beneficial effects on cognition in individuals with diseases or disorders that impair cognitive function, including attention-deficit/hyperactivity disorder (ADHD).

Key issues

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 shows there is a significant participation gradient between people with and

without disability in relation to physical activity due to multiple barriers faced regarding access, choice of activities offered, and 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.

Sedentary behaviour recommendation

For children, adolescents and adults 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.

- Children and adolescents with disability should limit the amount of time spent being sedentary, particularly the amount of recreational screen time.
- Adults with disability should limit the amount of time spent being sedentary; replacing sedentary time with physical activity of any intensity (including light intensity) has health benefits;
- Adults with disability who are highly sedentary should aim to achieve or exceed the upper levels of recommended moderate-to-vigorous intensity physical activity.

Strong recommendation, low quality evidence

Summary of evidence

The WHO global recommendations on sedentary behaviour for children and disability update the evidence collated for the *Canadian 24-Hour Movement Guidelines for Children and Youth (20-22)* and the *Australian 24-Hour Movement Guidelines for Children and Young People (5-17 years)* (23) and the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section A2.

The WHO global recommendations on sedentary behaviour for adults build on work completed for the *Physical Activity Guidelines for Americans, 2nd Edition* (24). The evidence profiles detailing the updated evidence identified are available in Annex 2, section B2.

The evidence reviewed considered the association between sedentary behaviour and health-related outcomes, if there is a dose-response association (total volume, frequency, duration, and intensity of interruptions), if the association varies by type and domain of sedentary behaviour and, for adults, if physical activity modifies the effect of sedentary behaviour on mortality.

The primary evidence base for assessing the associations between sedentary behaviour and health outcomes in children, adolescents and adults living with disability was the scientific literature collated and reviewed for the general populations. The evidence review may have included children, adolescents and adults living with some of the conditions considered in this guideline. The GDG concluded that both the science and draft recommendations could be extrapolated to children, adolescents, adults and older adults living with disability.

Evidence to recommendations

In accordance with the GRADE process, the GDG considered the proposed wording of the recommendations and the rating of their strength (strong or conditional), based on the balance of benefits to harms, the quality of evidence, sensitivity to values and preferences, the potential impact on gender, social and health equity, as well as acceptability, feasibility and resource implications.

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 graded ‘conditional’ if the balance of benefits to harms was small or there was important likely variability in benefits in the target population. Overall, the evidence on harms across all age groups and sub-populations was limited but could be considered as no greater than small, generally indicating that benefits greatly outweighed harms.

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

Assessment of the quality of evidence

Using the GRADE framework, the GDG examined the quality of primary research contributing to each outcome identified in the PICO (Population, Intervention or Exposure, Control, and Outcome) questions and assessed the overall quality 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 PICO are available in Annex 1.

The assessment of the quality of the evidence was based on an overall assessment across all evaluated outcomes. However, the GDG prioritized all-cause mortality and cardiovascular mortality as the most critical outcomes, followed by other clinical outcomes (e.g. falls, depression, cognition, health-related quality of life, etc.), then intermediate outcomes (e.g., cardiometabolic markers, other metabolic markers), as well as harms. Where there was a lack of sub-population specific evidence, the evidence for the general population was extrapolated and downgraded where this was deemed appropriate due to indirectness.

Values and Preferences

The GDG also considered 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). The GDG concluded that there is little or no uncertainty about preferences regarding the main outcomes, including mortality and cardiovascular mortality. The benefits outweigh any potential harms, such that the GDG did not consider these recommendations to be preference-sensitive.

Resource implications

The expert opinion of the GDG, and a small body of evidence reporting on economic analyses of interventions and on savings to the health care systems from increasing levels of physical activity, informed discussion on the resource implications of the recommendations in different settings.

Available evidence and expert opinion recognizes that substantial health benefits can be achieved at low risk through activities that require no cost to the individual or specific equipment, such as walking. Further, it was acknowledged that other forms of physical activities, including for example, structured sports, cycling and exercise classes, may incur costs and these can be a barrier for some individuals and particularly those with lower income. Government implementation of policy and programs 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, sub national 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 programs towards increasing population levels of physical activity. Examples of reallocation include reallocation of budgets towards infrastructure for walking and cycling from the existing transport budget; reallocation of resources 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 sub population groups. Overall, it was assessed that while there are resource implications for implementation of actions to achieve these draft recommendations, it is possible within current governance structures.

Further, evidence supports that there are substantial health savings possible to the health care system resulting from increasing levels of physical activity. In 2016 the global annual cost of physical inactivity was estimated at INT\$86 billion due to direct health costs alone (28); and at a national level inactivity is estimated to cost between 1-3 % of health care budgets (29).

Within the wider context of noncommunicable disease (NCD) prevention, additional cost to government and non-government organizations of guideline implementation may be minimised, if recommended physical activity can be relatively easily incorporated by individuals into their lives, or 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 (30). 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 (31).

Delivering on physical activity guidelines for people with disability may require investment such as the training of activity specialists, adapted equipment needed, and facilities that need to be made accessible. These investments can facilitate the needs of a wide range of population groups. Evidence shows there is a significant participation gradient between people with and without disability in relation to physical activity due to multiple barriers faced regarding access, choice of activities offered, and 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 do not worsen equity issues (e.g. making sure there are safe facilities and opportunities accessible for all, including people living with disability, 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.).

There is recognition of the contribution of physical activity to both health and social inclusion objectives aligned with the Sustainable Development Goals (SDGs). The GDG felt the inclusion of guidelines for those with disability brings clarity to the amount and type of activity and associated health across varied levels of participation. In addition to the specific section on disability, the GDG included people with disability across other guidelines. The benefits of physical activity far outweigh the harms and this message should be clearly communicated to individuals and, in the case of children, their parents, caregivers and teachers. People with disability experience worse health outcomes than people without disability and physical activity is one important intervention to close this health gap.

The SDGs call for no-one to be left behind, including through the pursuit of the good health and well-being (Goal 3) and of sustainable cities and communities (Goal 11). Related rights are enshrined in treaty instruments including: the Convention on the Rights of Persons with Disabilities (CRPD), Convention on the Elimination of all Forms of Discrimination against Women (CEDAW), the Convention on the Rights of the Child (CRC), and the International Covenant on Economic Social and Cultural Rights (ICESCR) in alignment with the SDGs. Interventions in physical activity will increase health equity for the variety of population groups affected by these treaties.

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 (GDG) 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 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 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.

Glossary of terms

Term	Abbreviation	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.
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 _{2max}).
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 or more of the following: leisure-time, occupation, education, household, 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.
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.
Leisure-time 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.

Light-intensity physical activity	LPA	LPA 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 the person sweating or becoming short of breath.
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	MPA	On an absolute scale, moderate-intensity refers to the physical activity that is performed at 3.0–5.9 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) into one 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 could incorporate balance by walking backwards or sideways or by standing on one foot while doing an upper body muscle-strengthening activity, such as bicep curls. Dancing also combines aerobic and balance components.

Physical activity	PA	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.
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 sitting while watching television are examples of sedentary behaviours. The Guidelines operationalizes the definition of sedentary behaviour to include self-reported 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 are supported by an institutional framework, such as a sporting agency.
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.

References

1. World Health Organization. Global health risks: mortality and burden of disease attributable to selected major risk. Geneva: World Health Organization; 2009.
2. World Health Organization. Global recommendations on physical activity for health. Geneva: World Health Organization; 2010.
3. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, et al. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. *Lancet*. 2012;380(9838):219-29.
4. McTiernan A, Friedenreich CM, Katzmarzyk PT, Powell KE, Macko R, Buchner D, et al. Physical activity in cancer prevention and survival: A systematic review. *Med Sci Sports Exerc*. 2019;51(6):1252-61.
5. Schuch FB, Vancampfort D, Richards J, Rosenbaum S, Ward PB, Stubbs B. Exercise as a treatment for depression: A meta-analysis adjusting for publication bias. *J Psychiatr Res*. 2016;77:42-51.
6. Livingston G, Sommerlad A, Orgeta V, Costafreda SG, Huntley J, Ames D, et al. Dementia prevention, intervention, and care. *Lancet*. 2017;390(10113):2673-734.
7. Das P, Horton R. Rethinking our approach to physical activity. *Lancet*. 2012;380(9838):189-90.
8. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology consensus project process and outcome. *Int J Behav Nutr Phys Act*. 2017;14(1):75.
9. Ekelund U, Brown WJ, Steene-Johannessen J, Fagerland MW, Owen N, Powell KE, et al. Do the associations of sedentary behaviour with cardiovascular disease mortality and cancer mortality differ by physical activity level? A systematic review and harmonised meta-analysis of data from 850 060 participants. *Br J Sports Med*. 2019;53:886-94.
10. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. *Lancet*. 2016;388:1302-10.
11. Owen N, Healy GN, Dempsey PC, Salmon J, Timperio A, Clark BK, et al. Sedentary behavior and public health: Integrating the evidence and identifying potential solutions. *Annu Rev Public Health*. 2020.
12. Guthold R, Stevens GA, Riley LM, Bull FC. Worldwide trends in insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-based surveys with 1.9 million participants. *Lancet Glob Health*. 2018;6(10):e1077-e86.
13. Guthold R, Stevens GA, Riley LM, Bull FC. Global trends in insufficient physical activity among adolescents: a pooled analysis of 298 population-based surveys with 1.6 million participants. *Lancet Child Adolesc Health*. 2020;4(1):23-35.
14. World Health Organization. Global action plan on physical activity 2018-2030: more active people for a healthier world. Geneva, Switzerland: World Health Organization; 2018.
15. World Health Organization. Guidelines on physical activity, sedentary behaviour and sleep for children under 5 years of age. Geneva: World Health Organization; 2019.
16. Commission on Ending Childhood Obesity. Report of the Commission on Ending Childhood Obesity. Geneva: World Health Organization; 2016.

17. World Health Organization. Implementation tools: package of essential noncommunicable (PEN) disease interventions for primary health care in low-resource settings. Geneva: World Health Organization; 2013.
18. World Health Organization. Risk reduction of cognitive decline and dementia: WHO guidelines. Geneva: World Health Organization; 2019.
19. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. Geneva: World Health Organization; 2016.
20. Canadian Society for Exercise Physiology (CSEP). Canadian 24-Hour Movement Guidelines for Children and Youth (ages 5-17 years): An Integration of Physical Activity, Sedentary Behaviour and Sleep. Ottawa, Ontario, CANADA. 2016.
21. Carson V, Hunter S, Kuzik N, Gray CE, Poitras VJ, Chaput JP, et al. Systematic review of sedentary behaviour and health indicators in school-aged children and youth: an update. *Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme*. 2016/06/17 ed2016. p. S240-65.
22. Poitras VJ, Gray CE, Borghese MM, Carson V, Chaput JP, Janssen I, et al. Systematic review of the relationships between objectively measured physical activity and health indicators in school-aged children and youth. *Applied physiology, nutrition, and metabolism = Physiologie appliquee, nutrition et metabolisme*. 2016/06/17 ed2016. p. S197-239.
23. Australia Co. Australian 24-Hour Movement Guidelines for Children (5-12 years) and Young People (13-17 years): An Integration of Physical Activity, Sedentary Behaviour, and Sleep. 2019. p. 148.
24. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans. 2nd edition ed. Washington, DC: U.S. Department of Health and Human Services; 2018.
25. World Health Organization. Global Recommendations on Physical Activity for Health. Geneva, Switzerland: World Health Organization; 2010. 58 p.
26. Jakicic JM, Kraus WE, Powell KE, Campbell WW, Janz KF, Troiano RP, et al. Association between bout duration of physical activity and health: Systematic review. *Med Sci Sports Exerc*. 2019;51(6):1213-9.
27. Mottola MF, Davenport MH, Ruchat SM, Davies GA, Poitras VJ, Gray CE, et al. 2019 Canadian guideline for physical activity throughout pregnancy. *British journal of sports medicine*. 2018;52(21):1339-46.
28. Ding D, Lawson KD, Kolbe-Alexander TL, Finkelstein EA, Katzmarzyk PT, van Mechelen W, et al. The economic burden of physical inactivity: a global analysis of major non-communicable diseases. *The Lancet*. 2016;388(10051):1311-24.
29. Cecchini M, Bull F. Promoting Physical Inactivity. In: McDaid D SF, Merkur S,. editor. *The Economic Case for Public Health Action*. Copenhagen: World Health Organisation (acting as the host organization for, and secretariat of, the European Observatory on Health Systems and Policies); 2015.
30. World Health Organization, United Nations Development Program. NCD prevention and control: a guidance note for investment cases. Geneva: World Health Organization; 2019.
31. World Health Organization. Tackling NCDs: 'Best buys' and other recommended interventions for prevention and control of noncommunicable diseases. Geneva: World Health Organization; 2017.