Physical Activity And Health

Last Updated : 23 July 2015

The contribution of physical activity to good health and quality of life has been known for centuries. The ancient philosopher Plato noted: “Lack of activity destroys the good condition of every human being while movement and methodical physical exercise save it and preserve it”. The current World Health Organization (WHO) guidelines show that Plato’s notion has not lost its importance, by encouraging everyone, regardless age or ability, to engage in regular physical activity, ensuring proper physical development and maintenance of physical and mental health throughout the lifespan.[1]

However, only relatively recently a lack of physical activity has become a public health concern. This is largely due to the reduced requirement to be active in daily life. Vehicles, machines and technology now complete the tasks that once required physical effort.[2,3] Research shows stark decline in overall physical activity levels in high income countries over the last 40 years, with medium income and even low income countries set to follow the trend.[2] The WHO estimates that 35% of Europeans do not meet the recommended minimum level of activity for good health,[2,4] and this is predicted to increase; not only in Europe, but in many countries worldwide.[2]

Our better understanding of the impact of inactivity to health,[5] has led to the recognition that physical inactivity is now the fourth leading risk factor for global mortality, after high blood pressure, tobacco use, and high blood glucose, and before overweight and obesity.[1] On top of that, the burden of disease caused by physical inactivity not only causes suffering for the victims, their families and friends, but also puts a huge strain on health care systems and leads to a loss of productivity due to sickness from work. In Europe, it has been estimated that physical inactivity costs between €150-300 per citizen per year.[6] Physical activity is therefore considered a health promotion priority.[7,8] In this light, this EUFIC review will define physical activity, address how it relates to health, present recommendations and current physical activity levels, and touch upon economic and other aspects of the global inactivity trend.

1. Physical activity

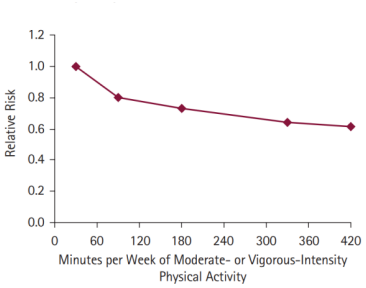
Physical activity is defined as any bodily movement, produced by skeletal muscles, that requires energy. This includes activities undertaken while working, playing, carrying out household chores, travelling and engaging in recreational pursuits. Examples of such activities are lifting, carrying, walking, cycling, climbing stairs, housework, shopping, dancing, and gardening[1]. The Compendium of Physical Activities is used to estimate the metabolic intensity of an activity compared to a resting state.[9] These metabolic equivalents (METs) are used to classify activities as sedentary behaviour (e.g. desk work, watching television), light intensity (e.g. food shopping, slow walking) moderate intensity (e.g. lawn mowing, slow cycling) and vigorous intensity activity (e.g. fast cycling, jogging). See Annex 1 and 2 on definitions and the classification of physical activities with further details and examples. Moreover, the human body is built to move, and major systems, including the skeletal, muscular, metabolic, circulatory, digestive and endocrine systems, do not develop and function properly unless stimulated by frequent physical activity. As such, physical activity has both a preventive and therapeutic effect across several diseases and conditions and contributes to quality of life in many ways.[1,10,11,12,13] See also section 5 on physical activity and health.

2. Physical activity recommendations

2.1 Background

The main focus of the WHO global action plan for the prevention and control of non-communicable diseases is on prevention and treatment of heart disease, cancer, respiratory disease and diabetes; the main causes of poor health and early death in Europe and worldwide.[7] Physical inactivity is identified as a common modifiable risk factor for these diseases alongside smoking, an unhealthy diet, and alcohol misuse. Recommendations (for physical activity) must be underpinned by science and much of the research effort in this field has focused on the amount and type of physical activity needed to remain healthy. This has been collated and thoroughly reviewed by a number of health authorities.[6,14,15] Overall, there is a clear dose response relationship between the amount of physical activity and its health benefits; the more active you are in terms of frequency, intensity or duration of activity, the greater the benefits to health. Those who are the most physically active are about 30% less likely to die prematurely compared to the least active,[16] as visualised in Figure 1. The risk of premature death decreases as the amount of physical activity per week rises. Importantly, the biggest reduction in risk is seen when very inactive people who do 30 minutes or less recreational activity per week start becoming a little more active,[16] suggesting that any increase in physical activity, no matter how small, leads to the improvement of health. The benefits of increasing regular physical activity have been observed in people irrespective of age, sex, ethnicity or weight status.[14]

Figure 1. The Risk of Dying Prematurely Declines as People Become Physically Active[11]



/>

Early research on cardiorespiratory health, which involves heart, lungs and blood vessels, suggested that only vigorous aerobic or endurance activity, such as running or fast swimming, was of benefit to these systems.[17] However, these beliefs changed when it was observed that as little as 150 minutes walking/week provides substantial benefits to heart and circulatory health, reducing the incidence of heart disease, lowering blood pressure and improving blood lipid profiles.[18,19] Later studies in men[20] and women[21] have supported this finding. Similarly, it was found that those who undertake regular, moderate physical activity of about 150 minutes per week have lower rates of type 2 diabetes or impaired blood glucose levels, compared to those who are less active.[14,22,23] Moreover, shorter sessions of exercise appear to be as effective as one longer episode of activity.[24] With regard to musculoskeletal health, weight bearing and weight resistance exercise, such as weight training, jumping, skipping and using playground equipment, are essential to increase and maintain bone density and muscular strength. Musculoskeletal fitness is positively associated with bone health, improved balance, functional independence, a reduced risk of falling and injuries in the elderly, improved mobility, psychological well-being and a better overall quality of life.[25] A dose-response pattern was also found here, with increasing health benefits observed with increasing musculoskeletal activity.[15]

2.2 The recommendations

The current WHO (2010)[1], European (2008)[10] and US (2008)[11] recommendations on levels of physical activity required for optimal health are similar. The WHO recommendations are summarised in Table 1 and presented in full in Annex 3. There are specific recommendations for different age groups.

Adults: The level of habitual physical activity recommended for adults, regardless of age, sex or ethnicity, has been shown to provide protection from heart disease and diabetes, and improve musculoskeletal and psychological health. The level chosen is also realistic and achievable for the majority of people and unlikely to lead to musculoskeletal injuries. It equates to being moderately active for 30 minutes, five days per week. It is also now recognised that it is not necessary to do the activity continuously for 30 minutes, as bouts of 10 minutes or more are beneficial. In other words, 3 sessions of 10 minutes per day would be equally suitable. It is better to be active on a regular basis (at least 3 days per week), as this conditions the body and provides regular stimulation to the body systems, rather than very active intermittently (e.g. once a week) which is more likely to lead to fatigue and injury.[1,10,11] Recommendations for older adults also include additional activities to support bone, joint and muscle health, and to improve balance. This is to reduce functional limitations, prevent falls and promote independent living.[25]

Children: In school-aged children and youth, physical activity is particularly important as it lays good foundations for an active life and a healthy adulthood. Active children have good cardiovascular fitness and strong muscles and bones. Weight bearing physical activity is especially important for children and young adolescents because this stimulates bone mass. The greatest gains in bone mass occur in the

years just before and during puberty with peak bone mass being achieved at the end of puberty. This helps to protect against osteoporosis and bone thinning in old age. The same positive dose response relationship between physical activity and health is observed in children, but the recommended level (both duration and intensity) is higher than in adults.[12]

Table 1. Summary of WHO Recommendations on minimum level of physical activity for health [1]

Age range	5 - 17 years	18 - 64 years	65+ years
Recommendations	60 minutes per day	150 minutes of moderate or 75 minutes of vigorous activity throughout the week.	Same as adults 18-64, or as physically active as their abilities and conditions allow.
	Vigorous intensity activity should be incorporated including those that strenthen muscle and bone at least 3 times/week	In bouts of 10 minutes or more, muscle strengthening activity included 2 or more days/week	Also to include activities which enhance balance and prevent falls 3 or more times/week

2.3 Sedentary people

There is no doubt that being inactive is unhealthy. Adults who do not achieve the recommended 150 minutes of physical activity per week should work gradually towards this goal. The good news is that even small amounts of physical activity have profound benefits to health, particularly for those who go from being completely sedentary to doing as little as 30 minutes of activity per week.[16] To reduce injury it is important to increase the amount of activity gradually over a period of weeks or even months. For example starting with slow walking for 5 minutes each day, then increasing to 10 minutes and gradually increasing the speed.[11]

2.4 Country differences

Most country specific guidelines recommend the same basic amounts and types of activity. However there are some differences in the scope of the guidance. For example UK and Swiss guidelines include advice to limit time spent being sedentary such as sitting in front of TV or other screens.[26,27]The UK guidelines include also specific advice for children under the age of five encouraging energetic play.[26] The Swiss guidelines encourage children and adolescents to maintain their flexibility and improve agility and co-ordination.[27] The US guidelines include advice for pregnant women (150 minutes moderate exercise/week with vigorous activity if highly trained) and adults with disabilities (as per adults or according to their ability).[11]

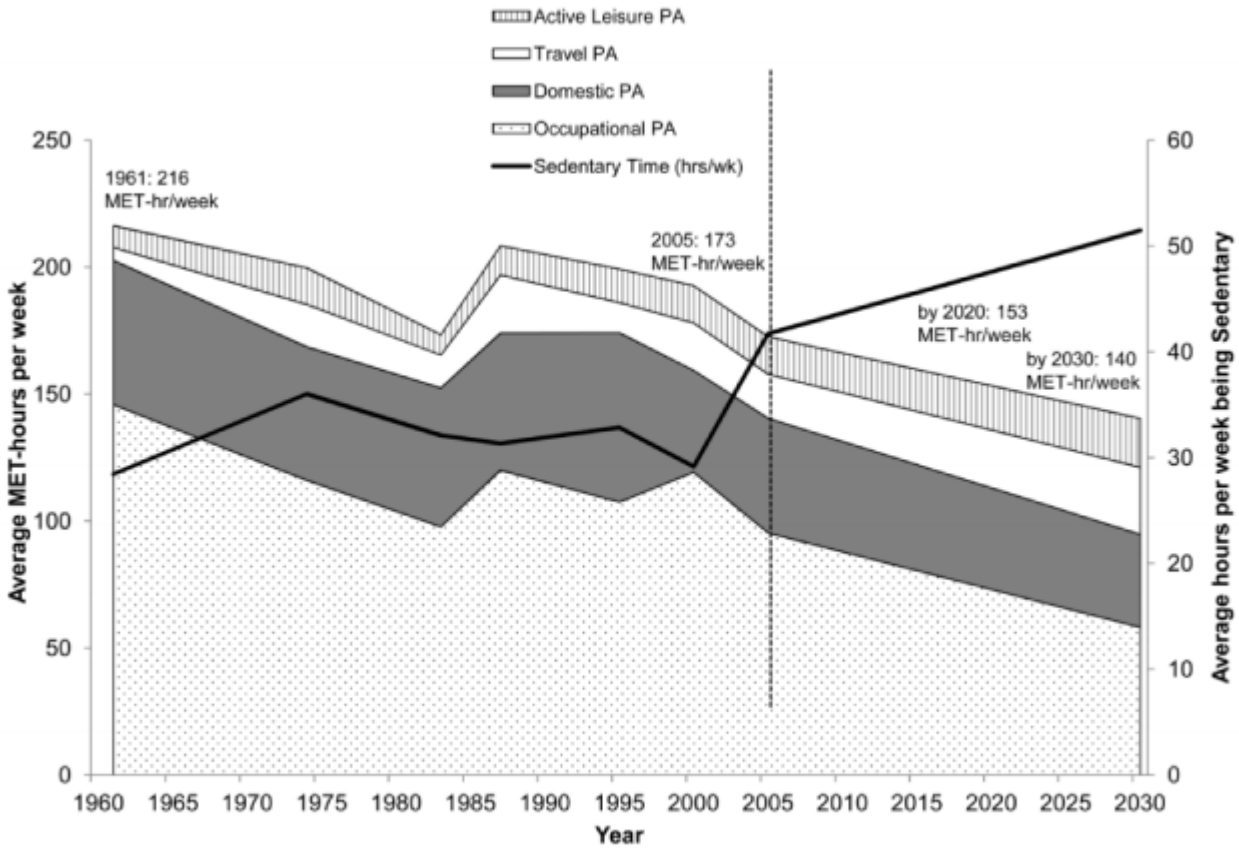
3. Current physical activity levels

New technologies have enabled people to reduce the amount of physical labour needed to accomplish many everyday tasks at work and at home. Private car ownership reduces the need for active transportation such as walking or cycling, and television, computers, and electronic entertainment have made it increasingly attractive to engage in sedentary leisure pursuits, particularly in the young. However, the extent of the impact of these changes on our physical activity levels has only been understood relatively recently, due to introduction of standardised ways of measuring physical activity

(such as with accelerometers) and the inclusion of all types of activities to assess how active people really are, including occupational, household, transport and recreational physical activity. This more complete set of data has revealed that low income countries are the most active due to greater occupational (manual jobs) and transport related activity (walking or cycling), followed by middle income countries, with high income countries being the least active. Despite promising increases in voluntary, recreational physical activity (such as sport and exercise) in high income countries, this does not compensate for the overall drop in incidental, activity in other areas of everyday life.[2,3,28] As middle and low income countries undergo technological transitions, it is predicted that they will also reduce their levels of physical activity.[28]

Using historical data on time spent on occupational and domestic work, travel, and leisure activities with MET hours (METs multiplied by the hours spent performing the activity) is a way of estimating the energy costs of the activity. Using this method, a recent study estimated that between 1961 and 2005 (44 years) physical activity levels dropped by around 20% in the UK.[28] The majority falls within occupational and domestic activity, and, although voluntary, active leisure or recreational activities have increased slightly, this did not make up much of the shortfall (Figure 2). A similar pattern was observed in the US, and more rapid drops in activity levels over a shorter period of time were seen in China and Brazil, probably linked to large scale urbanisation and technological advancement.[28]

Figure 2. UK adults' weekly time spent on physical activity and sedentary behaviour. MET stands for metabolic equivalents, estimating the energy costs of the activity[28]



PA = Physical activity

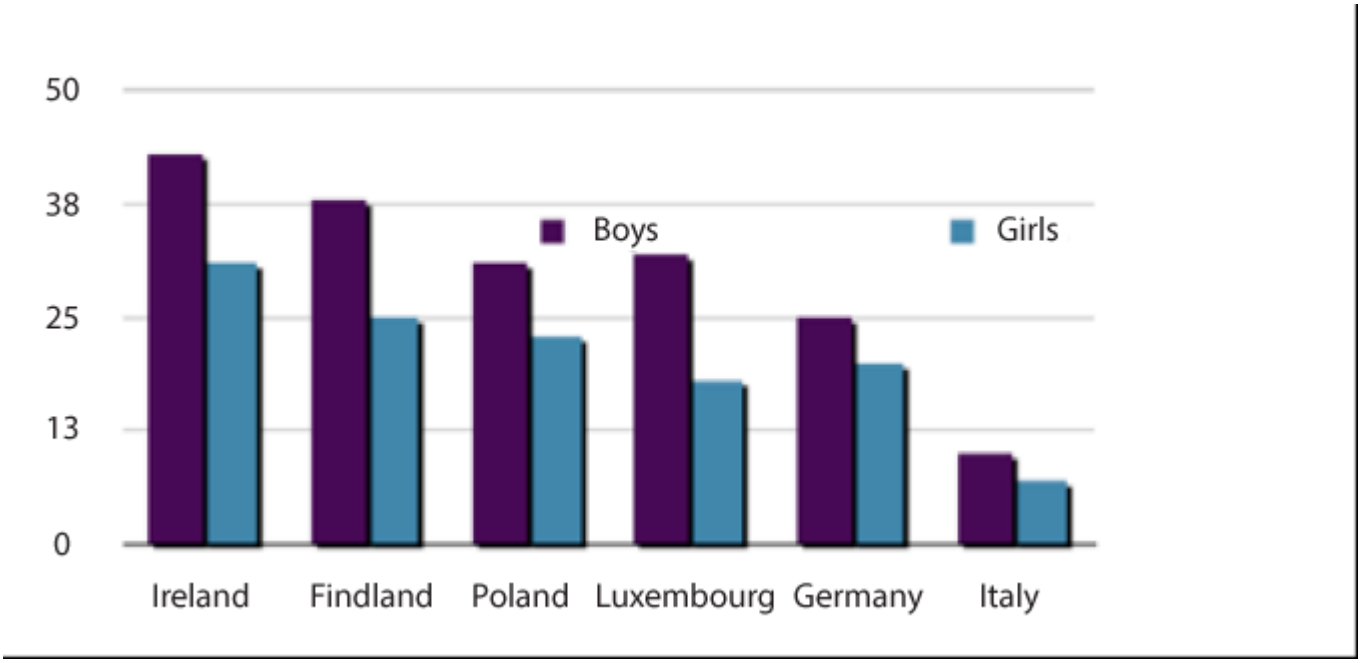
Levels of sport and physical activity have been monitored by Eurobarometer surveys. They show that within Europe, physical activity declines with age, males are more active than females, and the highly educated are more active that the less educated. The most recent survey shows that people in the Northern part of the EU are more likely to play sport or exercise, whilst those in the Southern member states are less likely to.[29] Those in the Netherlands and Nordic countries are also most likely to engage in physical activity like cycling, dancing or gardening. By contrast, walking was more prevalent in Southern and Eastern Europe. Overall, there appears to be an enthusiastic minority of Europeans who participate in formal physical activity such as sport, and who are also more likely to engage in other activities like cycling to work. Equally, about 1 in 10 Europeans are extremely inactive and do not even manage to walk for 10 minutes a day.[29]

Comparing physical activity levels in Europe over time is difficult due to differences in definitions and methods used. Few surveys have been carried out across the region with sufficiently consistent data. For example, earlier Eurobarometer surveys[30] asked different questions leading to incomparable data. The most recent versions have focused on both sport and the wider concept of physical activity.[29]

Physical activity levels versus the recommendations

Country estimates reveal that around a third of adults in Europe do not meet current WHO public health guidelines for physical activity.[2,4] The 'Health Behaviour in School-aged Children' (HBSC) study (2009-2010), which assessed the social determinants of health and well-being among young people, found that overall around four fifths of girls and two thirds of boys in the European Union do not meet current targets of 60 minutes/day of moderate to vigorous activity.[31] There was some variation between countries (see Figure 3), but girls were consistently less active than boys, and 11 year olds were consistently more physically active than 15 year olds. However these estimates are based on self-reported questionnaires rather than direct measurements (such as by accelerometer), and may be prone to either under or over-reporting. Even so this does give us a picture of the relative situation between countries.

Fig 3. Percentage of 11 year olds who report at least one hour of moderate to vigorous activity daily (selected countries)



Source: WHO HBSC survey 2009/1031

4.Physical activity and health

Since a landmark study in 1953[32] found that London Transport Authority bus drivers were more likely to develop heart disease than their more active bus conductor colleagues, the link between physical activity and disease has been explored extensively. There is now a large body of evidence on the importance of physical activity in disease prevention. [1,7,10,11,12,25] Inactivity contributes to premature death, the development of heart disease and stroke, obesity, type 2 diabetes, colon cancer, breast cancer, poor skeletal health and depression.[1,10,11,12] A large-scale study[5], estimated that, worldwide, physical inactivity causes 6% of the burden of disease from heart disease, 7% of type 2 diabetes and 10% of breast and colon cancers. Overall it was calculated that inactivity caused 5.3 million premature deaths worldwide. The authors stated that 121,000 deaths from heart disease, 14,000 deaths from breast cancer and 24,000 deaths from colon cancer could have been avoided in Europe in 2008 if everyone had been active enough to meet the current WHO recommendations.[5] The effects of inactivity on the different health conditions have been observed independently from the impact on weight status, and are discussed separately within this section.

4.1 Coronary heart disease and stroke

Current evidence indicates that the greatest benefit of physical activity is to heart health and the circulation.[1,14,15,16] For example, men maintaining an active lifestyle halve their risk of dying from, or contracting, serious heart disease.[33] For women, the reduction in risk is between 30-40%.[21] There is a clear dose response relationship, with the change from being sedentary to moderately active producing the greatest health benefits.[16] The benefits of physical activity and fitness also extend to those with established heart disease, and studies demonstrate the importance of regular exercise to attenuate or reverse the disease process.[34]

The direct benefits of regular physically activity to the cardiovascular system include: improvement in the ability of the heart to contract and relax fully increasing the effectiveness of pumping the blood;

improved blood circulation; increased lung capacity and with that an increased ability to take in and use oxygen; improved response of blood vessels (like arteries and veins) to dilate in response to activity and better blood vessel wall health including less inflammation. Metabolic adaptions include: alterations in blood lipid profiles, in particular an increase in the ratio of protective high density lipoprotein (HDL) to low density lipoprotein (LDL), and an increased use of fat as fuel. In this way physical activity reduces risk factors for heart disease and stroke, such as high blood pressure[35] and abnormal blood lipid profiles.[36]

4.2 Type 2 diabetes

Type 2 diabetes (T2D), often called 'adult onset diabetes' as it has been typically seen in adults over 40, is now being seen among children and young people, with the incidence of obesity and inactivity on the rise. There is good evidence that being physically active improves blood glucose control and prevents or delays the onset of T2D.[37] For example in a study of almost 6,000 men it was found that for every 500 calories expended weekly in leisure time physical activity the risk of developing T2D was reduced by 6%.[38] In a cohort of over 34,000 women it was found that any level of physical activity reduced the risk of T2D compared with being sedentary.[39] Data from 20 longitudinal studies demonstrated that in people at high risk of developing T2D, moderate activities were associated with a lower risk. High risk individuals include individuals with obesity, those with a positive family history of diabetes, or those with impaired glucose tolerance. However, the greatest gains were seen with vigorous intensity exercise, which may reduce the risk of developing T2D in at risk groups by up to a third.[40]

Most of the benefits of physical activity for reducing T2D are accomplished by short and long term improvements in insulin action, leading to better blood glucose control.[37] Physical activity improves the ability of the liver, skeletal muscle and fat cells to respond to insulin, known as insulin sensitivity. For example, exercise training for 16 weeks by older men resulted in a significant improvement of insulin sensitivity and fasting glycaemia.[41]

4.3 Cancer

After heart disease, cancer is the second major cause of death in Europe. Routine physical activity whether occupational or leisure is associated with reductions in the incidence of overall risk of cancer.[42] However, the evidence of a preventive effect is strongest for colon and breast cancer. Physically active men and women exhibited a 30-40% reduction in the relative risk of developing colon cancer, and physically active women a 20-30% reduction in the relative risk of developing breast cancer, compared to their inactive counterparts.[42]

Mechanisms by which physical activity may reduce cancer include: reducing inflammation (for example reducing long-term inflammation of the gut, which may help reduce colon cancer); an improvement in the function of the immune system, which enables the individual to fight the cancer; and improved hormone balance, which reduces the likelihood of cancers that use hormones to grow and spread, such as breast cancer.[15]

4.4 Overweight and Obesity

A study published in 2011 estimates that the worldwide prevalence of obesity nearly doubled between 1980 and 2008.[43] According to country estimates for the European Union, over half the adult population have overweight, and 23% of women and 20% of men had obesity in 2008. Childhood obesity in Europe

also rose steadily over the same time span.[4] In primary school children the combined prevalence of overweight and obesity range between 20-40 % with higher prevalence in the south of Europe compared to northern area.[44] However recent data on Swedish children shows no further increase suggesting the BMI in school children may be levelling off.[45]

Declines in physical activity levels in daily life are a significant factor in the dramatic increase in the prevalence of overweight and obesity in Europe. There is evidence that those who maintain a physically active lifestyle gain less weight with age than their inactive peers.[14] There is an inverse dose response relationship, and those with the highest levels of physical activity are the least likely to gain weight with age and vice versa. It has been suggested that levels of physical activity greater than currently recommended will be needed to prevent weight gain over the lifespan.[11, 46]

Physical activity alone does not necessarily lead to weight loss, however, when combined with calorie restricted diets, physical activity not only increases weight loss but also improves body composition, maintaining metabolically active muscle, while increasing fat loss.[1] There is good evidence that those who maintain regular physical activity are more likely to sustain their weight loss than those who rely on dietary methods alone.[1,11]

Importantly, apart from weight loss or weight loss maintenance, the benefit of physical activity for people living with obesity is the effect on their disease risk profile. Physical activity reduces their risk of heart disease and diabetes and metabolic predictors of these diseases like abnormal blood glucose and blood fat levels. This highlights the importance of physical activity independent to its impact on weight control and obesity.[1,11,15]

4.5 Musculoskeletal health

Physical activity produces strong muscles, tendons and ligaments, healthy joints and thicker more dense bones. The latter is particularly important during adolescence and childhood as during growth, substantial increases in bone mineral content occur, which reduces the likelihood of osteoporosis and hip fractures later in life.[12] Regular participation in physical activity throughout life ensures proper development during childhood and adolescence, and the maintenance of musculoskeletal health during adulthood and old age. Keeping active in old age reduces the risk of hip fractures and falls, and helps maintain functional ability such as lifting, carrying and climbing stairs, which are necessary for independent living.[15,25]

4.6 Psychological health

There is evidence that physical activity can reduce the symptoms of depression by boosting mood and feelings of well-being.[1,11] Even small amounts of physical activity can improve reactivity to stress and benefit sleep quality.

Regular physical activity can also improve mental acuity. It has been shown to improve academic performance in young people[12] and to contribute to the maintenance of thinking, learning and judgement skills in adults. In older adults, keeping active can improve mental functioning in areas such as planning, short term memory and decision making and delay the onset of dementia.[27]

In some individuals, being physically active may become an obsession related to excessive weight control issues, whereby exercising is viewed as a more acceptable alternative to disturbed

eating.[47] Strategies to cope with this behaviour are similar to those used for eating disorders.

4.7 Wider benefits of physical activity

There are other, possibly underestimated, benefits of physical activity.[13,48,49] This includes brain development, social benefits, emotional benefits, job performance and productivity. Bailey et al have explained how all the benefits of being active interrelate, support and enhance each other, making them stronger than the sum of their parts. For example, physical activity can improve life skills such as determination, self-discipline, time management, goal setting, emotional control and decision making, which in turn can have a powerful effect on success throughout life, influencing earning potential, social inclusion and feelings of self-worth.[49]

4.8 Potential risks of physical activity

The risks associated with physical activity are generally musculoskeletal, like pulling a muscle or twisting a joint. These problems are more likely to happen with excessive amounts of exercise, or by attempting an activity that the body is not yet prepared for, without proper warming-up or training. More serious incidents are heart attacks, which are more likely to occur amongst individuals that already have heart disease, and suddenly engage in strenuous activity. However, even people without existing heart disease, are not immune to heart attacks following sudden strenuous exertion.[1,10,6]

The risks related to being active can be minimised by properly warming-up before starting the more intense exercise, and by adjusting activities according to current ability. It is important to gradually build up the intensity and duration, so the body is able to cope with the increased demands on bones, muscles, heart and lungs. Muscle-strengthening activities should also be gradually increased over time. Initially, these activities should be done just 1 day a week starting at a light or moderate level of effort. Over time, the number of days a week and level of effort (intensity) can be increased slightly until it becomes moderate to high.[10] Overall, across all the age groups, the guidelines are clear about the benefits of being physically active outweighing the potential harms.[1,10,6]

5. Health Promotion Strategies

Much work is already underway to promote physical activity. For example The WHO Regional Office for Europe has created HEPA Europe, which is dedicated to the promotion of health enhancing physical activity (HEPA) within the European Union. In particular HEPA Europe will encourage the inclusion of physical activity promotion with local health policy and within transport policy as a healthy means for sustainable transport.[8]

In general, in high income countries, the approach tends to focus on individual behavioural change (for example by monitoring individual progress). By contrast, in moderate to low income countries like those in Latin America, the focus is on community based initiatives, where whole communities are encouraged to exercise together, e.g. by means of providing free classes.[50] It seems clear that population level approaches will be necessary to make a meaningful impact on overall physical activity levels. A good example is the promotion of the active transport in the Netherlands. It has combined the urban planning to make it easy and safe, with changes in public attitudes towards such methods of transport.[51] As mobile phones are widely owned amongst all social groups, it has also been suggested that employing mobile technologies in health promotion campaigns could be a useful tool to address inequalities in

health.[52]

6. Summary

Physical inactivity is a substantial and increasing burden on health, mental well-being and economies, making an increase in physical activity levels a global public health challenge. There is a dose-response relationship between the level of physical activity and reduction in the major non-communicable disease risk - the more physically active, the greater the benefits to health. Current guidelines have been set at the minimum amount of activity required to prevent the main non-communicable diseases, a level unlikely to have any adverse effects on musculoskeletal health. Further health gains can be expected above these minimum requirements. Although the recommendations are likely to be perceived as achievable by the majority of the people, they are not met by most, apart from a minority of the European population. There is a clear need for change, ranging from increased awareness, education, political support, a supportive social and urban environment, and multi-stakeholder interventions for sustained changes in physical activity behaviour.

The International Sport and Culture Association (ISCA) has provided feedback to this review.

Annex 1 – Definitions of terms related to physical activity

Table 2. Physical activity definitions WHO[1] US[11]

Physical activity	Any bodily movement produced by skeletal muscles that requires energy expenditure. This includes activities undertaken while working, playing, carrying out household chores, travelling and engaging in recreational pursuits. For example lifting, carrying, walking, cycling, climbing stairs, housework, shopping, dancing, and gardening.
Moderate intensity activity	On an absolute scale, moderate intensity refers to activity performed at 3-5.9 times the intensity of rest. On a scale relative to an individual's personal capacity this would be 5 or 6 on a scale of 10. It leaves the person feeling warm and slightly out of breath.
Vigorous intensity activity	On an absolute scale, vigorous intensity refers to activity performed at 6 or more times the intensity of rest for adults and typically 7 or more times for children and youth. On a scale relative to an individual's personal capacity this would be 7 or 8 on a scale of 10. The person would be sweating and out of breath.
Aerobic activity	Also called endurance activity, aerobic activity uses the body's large muscles in a rhythmical manner for a sustained period of time and improves cardiorespiratory fitness. For example walking, running, swimming and bicycling.

Muscle strengthening activities	Any activity that causes the body's muscles to work or hold against an applied force. This type of activity can be done using weights, elastic bands or body weight for resistance, for example doing push ups or climbing trees.
Bone strengthening activities	Also called weight bearing or weight loading activity, this type of activity produces a force which promotes bone growth and strength. For example running jumping skipping, brisk walking (these are also aerobic activities) and weight lifting or push ups (these are also muscle strengthening).
Excercise	Exercise is a sub-category of physical activity which is planned, structured, repetitive movement which aims to improve or maintain one or more components of physical fitness, such as strength, flexibility or stamina. For example weight training, yoga or running. Exercise is also frequently used to refer more generally to physical activity undertaken during leisure time with the primary purpose of maintaining fitness, performance or health.
Sport	Sport is another sub-category of physical activity which involves structured competitive situations governed by rules. For example athletics, field sports like football and racquet sports like tennis.
Balance training	Static and dynamic exercise that are designed to improve an individual's ability to withstand destabilising challenges from the environment.
Flexibility excercise	Exercises that enhance the ability of a joint to move through its full range of motion.

Annex 2 – Classification of physical activity levels

Table 3. Classification of physical activity levels[8]

Classification	METs*	Examples
Sedentary behaviour	1.0 - 1.5	Desk/computer work, watching TV, listening to music, meditating
Light-intensity activity	1.5 - 2.9	Light housework or gardening, food preparation, washing and dressing, playing an instrument, arts and crafts, slow walking, fishing, gentle yoga
Moderate-intensity activity	3.0 - 5.9	Scrubbing floors, mowing the lawn, home repair (e.g. painting) slow cycling < 10 mph, slow ballroom dancing, exercise class
Vigorous-intensity activity	>6	Lifting and carrying heavy loads (e.g. bricklaying), roofing, farming, fast dancing, running > 4 miles per hour, circuit training, fast cycling > 10mph

**METs = Metabolic equivalents which is the metabolic intensity of performing the activity compared to the resting state. NB This system is used for classification purposes only and does not estimate the energy cost of physical activity in individuals as this can vary widely depending on body mass index, age sex, efficiency of movement and environmental conditions. The full compendium is available here.*

Annex 3 – Current WHO guidelines on Physical Activity and Health[1]

5–17 years old: For this age group physical activity includes play, games, sports, transportation, recreation, physical education or planned exercise, in the context of family, school, and community activities.
In order to improve cardiorespiratory and muscular fitness, bone health, cardiovascular and metabolic health biomarkers and reduced symptoms of anxiety and depression, the following are recommended:

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

18–64 years old: For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g. walking or cycling), occupational (i.e. work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.
In order to improve cardiorespiratory and muscular fitness, bone health and reduce the risk of non-communicable diseases (NCDs) and depression the following are recommended:

1. Adults aged 18–64 years should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults should increase their moderate-intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity.
4. Muscle-strengthening activities should be done involving major muscle groups on 2 or more days a week.

65 years old and above: For adults of this age group, physical activity includes recreational or leisure-time physical activity, transportation (e.g. walking or cycling), occupational (if the person is still engaged in work), household chores, play, games, sports or planned exercise, in the context of daily, family, and community activities.

In order to improve cardiorespiratory and muscular fitness, bone and functional health, and reduce the risk of NCDs, depression and cognitive decline, the following are recommended:

1. Adults aged 65 years and above should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-

intensity activity.
2. Aerobic activity should be performed in bouts of at least 10 minutes duration.
3. For additional health benefits, adults aged 65 years and above should increase their moderate intensity aerobic physical activity to 300 minutes per week, or engage in 150 minutes of vigorous intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous intensity activity.
4. Adults of this age group with poor mobility should perform physical activity to enhance balance and prevent falls on 3 or more days per week.
5. Muscle-strengthening activities should be done involving major muscle groups, on 2 or more days a week.
6. When adults of this age group cannot do the recommended amounts of physical activity due to health conditions, they should be as physically active as their abilities and conditions allow.

At the recommended level of 150 minutes per week of moderate intensity activity, musculoskeletal injury rates appear to be uncommon. In a population-based approach, in order to decrease the risks of musculoskeletal injuries, it would be appropriate to encourage a moderate start with gradual progress to higher levels of physical activity.

References

1. World Health Organization (WHO) (2010). Global recommendations on physical activity for health. Geneva, Switzerland: WHO.
2. Hallal PC et al. (2012). Global physical activity levels: surveillance progress, pitfalls and prospects. Lancet 380:247-257.
3. Designed to Move, A Physical Activity Action Agenda. (last accessed in December 2014)
4. World Health Organization (WHO) Regional Office for Europe. The challenge of obesity - quick statistics. (last accessed in December 2014)
5. Lee I-M et al (2012). Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet 380:219-229.
6. World Health Organization (WHO) Europe (2006). Physical activity and health in Europe - Evidence for action. Copenhagen, Denmark: WHO.
7. World Health Organization (WHO) (2013). Global Action plan for the prevention and control of non-communicable disease 2013-2020. Geneva, Switzerland: WHO.
8. World Health Organization (WHO) Regional Office for Europe. HEPA Europe (European network for the promotion of health-enhancing physical activity).
9. Ainsworth BE et al. (2011). 2011 Compendium of Physical Activities: A second update of codes and MET values. Medicine and Science in Sports and Exercise 43(8):1575-1581.
10. EU Physical Activity Guidelines, recommended policy actions in support of health-enhancing physical activity. (2008) EU Brussels 7) WHO Europe (2006) Physical activity and health in Europe - Evidence for action. WHO Copenhagen
11. US Department of Health and Human Services (2008). 2008 Physical Activity Guidelines for Americans.
12. Janssen I & LeBlanc AG (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. International Journal of Behavioural Nutrition and Physical Activity 7:40.
13. Gill DJ et al. (2013). Physical activity and quality of life. Journal of Preventive Medicine and Public Health 46 (Suppl 1): S28-34.

14. Physical Activity Guidelines Advisory Committee (PAGAC) (2008). Physical Activity Guidelines Advisory Committee report, 2008. Washington, DC, US: Department of Health and Human Services.
15. Warburton DER et al. (2010). A systematic review of the evidence for Canada's Physical Activity Guidelines for Adults. International Journal of behavioural Nutrition and Physical Activity 7:39.
16. Nocon M et al. (2008). Association of physical activity with all-cause and cardiovascular mortality: a systematic review of hand meta-analysis. European Journal of Cardiovascular Prevention and Rehabilitation 15:239-246.
17. American College of Sports Medicine (1985). Guidelines for Graded Exercise Testing and Exercise Prescription. 3rd edition. Philadelphia, US: Lea & Febiger.
18. Hakim AA, et al. (1999). Effects of walking on coronary heart disease in elderly men, Honolulu Heart Program. Circulation. 100:9-13.
19. Manson JE et al. (1999). A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. New England Journal of Medicine 341:650–658.
20. Tanasescu M et al. (2002). Exercise type and intensity in relation to coronary heart disease in men. Journal of the American Medical Association 288(16):1994-2000.
21. Manson JEP et al. (2002). Walking compared with vigorous physical activity in the prevention of coronary heart disease in women. New England Journal of Medicine 347:716-725.
22. Hu FB et al. (1999). Walking compared with vigorous physical activity and risk of type 2 diabetes in women: a prospective study. The Journal of the American Medical Association 282(15):1433-1439.
23. Jeon CY et al. (2007). Physical activity of moderate intensity and risk of type 2 diabetes: a systematic review. Diabetes Care 3:744-752.
24. Lee IM, Sesso HD & Paffenbarger RS (2000). Physical activity and coronary heart disease risk in men: does the duration of exercise episodes predict risk? Circulation 102:981-986.
25. The Cochrane Library. Physical activity and exercise for health and well being of older people. (last accessed in December 2014)
26. UK Department of Health (2011). UK physical activity guidelines.
27. Swiss Federal Office of Sport and Federal Office of Public Health (2013). Health-Enhancing Physical Activity - Core document for Switzerland.
28. Ng SW & Popkin BM (2012). Time use and physical activity: a shift away from movement across the globe. Obesity Reviews 13(8):659-680.
29. European Commission (2014). Sport and Physical Activity, Special Eurobarometer 412.
30. Sjostrom M et al. (2006). Health-enhancing physical activity across European Union Countries: The Eurobarometer study. Journal of Public Health. 14(1):1-10.
31. World Health Organization (WHO) Regional Office for Europe (2012). Health Policy for Children and Adolescents No.6, Health behaviour in school-aged children, International report from the 2009/2010 survey. Copenhagen, Denmark: WHO.
32. Morris JN et al. (1953). Coronary Health disease and physical activity at work. Lancet 262:1111-1120.
33. Myers J et al. (2004). Fitness versus physical activity patterns in predicting mortality in men. American Journal of Medicine 117:912-918.
34. Taylor RS et al. (2004). Exercise-based rehabilitation for patients with coronary heart disease: systematic review and meta-analysis of randomized controlled trials. American Journal of Medicine 116:682-692.
35. Cornelissen VA & Fagard RH (2005). Effects of endurance training on blood pressure, blood pressure-regulating mechanisms, and cardiovascular risk factors. Hypertension 46(4):667-675.
36. Kodama et al. (2007). Effect of aerobic exercise training on serum levels of high-density

lipoprotein cholesterol: a meta-analysis. Archives of Internal Medicine 167(10):999-1008.
37. Colberg SR et al. (2010). Exercise and Type 2 Diabetes. The American College of Sports Medicine and the American Diabetes Association: joint position statement. Diabetes Care 33(12):e147-e167.
38. Helmrich SP et al. (1991). Physical activity and reduced occurrence of non-insulin-dependent diabetes mellitus. New England Journal of Medicine 1991 325(3):147-152.
39. Folsom AR, Kushi LH & Hong CP (2000). Physical activity and incident diabetes mellitus in postmenopausal women. American Journal of Public Health 90(1):134-138.
40. Gill JM & Cooper AR (2008). Physical activity and prevention of type 2 diabetes. Sports Medicine 38(10):807-824.
41. Ibanez J et al. (2005). Twice-weekly progressive resistance training decreases abdominal fat and improves insulin sensitivity in older men with type 2 diabetes. Diabetes Care 28(3):662–667.
42. Lee IM (2003). Physical activity and cancer prevention - data from epidemiologic studies. Medical Science and Sports Exercise 35:1823-1827.
43. Finucane MM et al. (2011). National, regional, and global trends in body-mass index since 1980: systematic analysis of health examination surveys and epidemiological studies with 960 country-years and 9.1 million participants. The Lancet 377:557-567.
44. Ahrens W et al. (2014). Prevalence of overweight and obesity in European children below the age of 10. International Journal of Obesity 38(2):S99-S107.
45. Moraeus L, Lissner L & Sjoberg A (2014). Stable prevalence of obesity in Swedish schoolchildren from 2008 to 20013 but widening socio-economic gap in girls. Acta Paediatrica 103(12):1277-1284.
46. Moholdt T et al. (2014). Current physical activity guidelines for health are insufficient to mitigate long-term weight gain: more data in the fitness versus fatness debate (The HUNT study, Norway). British Journal of Sports Medicine 48:1489–1496.
47. Johnston O, Reilly J & Kremer J (2011). Excessive exercise: From quantitative categorisation to a qualitative continuum approach. European Eating Disorders Review 19(3):237-248.
48. Bize R et al. (2007). Physical activity and health-related quality of life in the general adult population: a systematic review. Preventive Medicine 6:401-415.
49. Bailey R et al. (2013). Physical Activity: An underestimated investment in human capital. Journal of Physical Activity and Health 10:289-308.
50. Heath et al. (2012). Evidence-based intervention in physical activity: lessons from around the world. Lancet 380:272-281.
51. Kohl HW et al. (2012). The pandemic of physical inactivity: global action for public health. Lancet 380:294-305.
52. Pratt M et al. (2012). The implications for megatrends in information and communication technology and transportation for changes in global physical activity. Lancet 380:282-293.