

Evidence Base for Physical Activity and Health

Major chronic diseases

The World Health Organization has reported that physical inactivity is one of the 10 leading causes of death in developed countries, producing 1.9 million deaths worldwide per yearⁱ. It estimates that physical inactivity is responsible for the following proportions of 'disability-adjusted life years' in developed countries:

- 23% of cardiovascular disease for men and 22% for women
- 16% of colon cancer for men and 17% for women
- 15% of type 2 diabetes
- 12% of stroke for men and 13% for women
- 11% of breast cancer.

All Cause mortality:

- adults who are physically active have 20-30% reduced risk of premature deathⁱⁱ,
- It has been estimated that 37% of CHD deaths can be attributed to physical inactivityⁱⁱⁱ.
- Evidence predicts that 9% of deaths could be avoided if people raised their activity status from low to moderate – equating to 30 minutes of aerobic activity on 1 – 4 days of the week^{iv}

Chronic Disease development

- Adults who are physically active up to 50% reduced risk of developing the major chronic diseases such as coronary heart disease, stroke, diabetes and cancers^v.

Effects across the lifecourse

Evidence of a health benefit for physical activity is seen throughout the lifecourse. In children, effects are predominantly seen in amelioration of risk factors for disease, avoidance of weight gain, achieving a high peak bone mass, and mental wellbeing. In adults, protection is conferred against the diseases themselves – including cardiovascular disease, cancer, type 2 diabetes – and obesity^{vi}.

Chronic Condition	Prevention	Treatment	Comments
CVD	<ul style="list-style-type: none"> • A UK study has estimated that 37% of coronary heart disease is attributable to physical inactivity^{vii}. The study also estimated that, if people who now have inactive or marginally active lifestyles changed to a moderate level of activity, this could achieve a 10% reduction in coronary heart disease risk. ▪ Evidence for beneficial associations between childhood physical activity and blood lipids is equivocal,^{viii} ^{ix} but more recent studies suggest that increases in HDL cholesterol (the 'protective' cholesterol) are associated with regular physical activity in childhood: those who do regular physical activity are more likely to have a higher HDL cholesterol level. ▪ Individuals who are active are 1.9 times less likely to have a heart attack than their inactive contemporaries^x 	<ul style="list-style-type: none"> ▪ Regular physical activity has been shown to have a positive effect on the coronary circulation of people with coronary vascular disease through improved endothelial function^{xi} ▪ Exercise-based cardiac rehabilitation programmes for people with coronary heart disease are generally effective in reducing cardiac deaths, and lead to important reductions in all-cause mortality^{xii}. ▪ Short-term physical exercise training in selected patients with chronic heart failure may have physiological benefits and positive effects on quality of life^{xiii} ▪ In patients with chronic ischaemic heart disease, physical activity can reduce mortality as part of cardiac rehabilitation^{xiv} 	
Stroke	<ul style="list-style-type: none"> ▪ Evidence from case control and prospective studies suggests that physical activity can reduce the incidence of stroke^{xv}, ^{xvi}, ^{xvii}, ^{xviii}, ^{xix}. Lee <i>et al</i> demonstrated that people who were highly active had a 27% lower risk of stroke incidence or mortality than less active people ^{xvi}. 	<ul style="list-style-type: none"> ▪ Limited evidence suggests that exercise therapy may be effective in the rehabilitation of stroke patients^{xx}. 	
Hypertension	<ul style="list-style-type: none"> • Hypertension can be both prevented and treated by physical activityⁱⁱ. 	<ul style="list-style-type: none"> ▪ Moderate intensity aerobic exercise is associated with reductions in both 	

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		systolic (3.8mmHg) and diastolic (2.6mmHg) blood pressure ^{xxi} .	
Obesity	<ul style="list-style-type: none"> <li data-bbox="436 383 961 630">▪ Children who are obese are more likely to have certain cardiovascular risk factors^{xxii, xxiii} a higher incidence of premature atherosclerosis (particularly in males)^{xxiv} and insulin resistance (a precursor of type 2 diabetes)^{xxv}. Obese children are also more likely to have lower levels of physical fitness,^{xxvi, xxvii} <li data-bbox="436 662 961 909">▪ Inactive people are more likely to be obese than active people. There is an association between energy expenditure (measured by doubly-labelled water) and lower fat mass: those with higher levels of energy expenditure tend to have a lower fat mass^{xxviii} 	<ul style="list-style-type: none"> <li data-bbox="984 383 1493 565">▪ Physical activity by itself can result in modest weight loss of around 0.5kg-1kg per month but the most effective way to lose weight involves a combination of physical activity and diet^{xxix, xxx, xxxi} <li data-bbox="984 597 1493 1006">▪ People who use a combination of a low-calorie diet and physical activity in order to lose weight lose greater fat mass and conserve more lean tissue (mainly muscle mass) than people who use diet alone.^{xxxii, xxxiii} This is likely to be important in the long term, as fat-free mass largely determines resting metabolic rate (the degree of energy expended by the body while at rest), and this is the bulk of daily energy expenditure for most people. <li data-bbox="984 1068 1493 1351">▪ Aerobic physical activity has a consistent effect on achieving weight maintenance (less than 3% change in weight).Physical activity alone has no effect on achieving 5% weight loss, except for exceptionally large volumes of physical activity, or when an isocaloric diet is maintained throughout the physical activity 	<ul style="list-style-type: none"> <li data-bbox="1516 383 2005 500">▪ To prevent obesity 45 – 60 minutes of physical activity per day may be needed if dietary intake is not reduced. <li data-bbox="1516 532 2005 695">▪ People who have been obese and have managed to lose weight may need to do 60- 90 minutes' activity a day in order to avoid regaining weight.

Chronic Condition	Prevention	Treatment	Comments
		<p>intervention. Following weight loss, aerobic physical activity has a reasonably consistent effect on weight maintenance^{xxxiv}</p> <p>▪</p>	
Diabetes	<ul style="list-style-type: none"> • Active People have a 33-50% lower risk of developing Diabetes compared with inactive people^{xxxv} • High-risk individuals in particular can substantially reduce their risk of developing type 2 diabetes by becoming more active as it can reduce their risk of developing the disease by up to 64%^{xxxvi}. 	<ul style="list-style-type: none"> ▪ Both resistance exercise and aerobic exercise have been shown to prevent and modify insulin resistance^{xxvii}, ^{xxxviii} Improvements in glucose metabolism of between 11% and 36% can be expected. ▪ The role of physical activity and exercise in treating type 1 diabetes is less well established, although evidence suggests that benefits are likely, perhaps most of all in the area of reducing mortality, CVD risk factors, and microvascular complications. For both type one and type two, physical activity may prevent the development of diabetic neuropathy and diabetic nephropathy. Physical activity and exercise may help prevent and treat gestational diabetes^{xxxix}. 	<ul style="list-style-type: none"> • The risk of premature death is much lower in active and fit persons with type 2 diabetes than in patients who are inactive and unfitⁱⁱ. ▪ The United States Diabetes Prevention Programme studied the effects of an intensive programme of diet and exercise, a drug (metformin), or a placebo in people with impaired glucose tolerance. The lifestyle modification group received intensive education and support, with care managers delivering a personal 16-lesson curriculum and subsequent monthly follow-up sessions to reinforce behavioural change. Subjects were advised to make a 7% reduction in body weight by a low-fat, low calorie diet and to take moderate physical activity such as brisk walking for 150 minutes per week. The lifestyle changes in diet and physical activity were found to be more effective in reducing the incidence of type 2 diabetes than treatment with the

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			drug metformin (58% vs 31% reduction in risk). ^{xi}
Osteoporosis	<ul style="list-style-type: none"> Physical activity can slow down the rate at which bone mineral density is reduced from the late 20s onwards, but it cannot reverse advanced bone loss ⁱⁱ. 	<ul style="list-style-type: none"> Physical activity in later life may delay the progression of osteoporosis, as it slows down the rate at which bone mineral density is reduced ⁱⁱ. 	
Osteoarthritis	<ul style="list-style-type: none"> Moderate daily physical activity may be associated with lower risk of subsequent osteoarthritis, especially among women^{xii} 	<ul style="list-style-type: none"> Physical activity may also delay the progression of osteoarthritis ⁱⁱ, Beneficial effects seen for people with osteoarthritis ⁱⁱ Among people with osteoarthritis, walking has weak, beneficial effects on disability, weak to moderate beneficial effects on pain, and moderate to large effects on patients' assessment of outcomes^{xiii} A broad range of physical activities – either individual activities or a combination – reduce pain, stiffness and disability, and increase general mobility, gait, function, aerobic fitness and muscle strength. Three 40-minute walks a week may help to halt the progression of knee osteoarthritis^{xiii}. 	
Back Pain	<ul style="list-style-type: none"> Evidence indicates that physical activity may delay the onset of low back pain ⁱⁱ. 	<ul style="list-style-type: none"> Aerobics-type exercise programmes can help prevent recurrence of low back pain^{xiv}. Yoga-style exercise, and exercises to increase endurance of the abdominal and back muscles, may also be helpful^{xiv}. 	

Chronic Condition	Prevention	Treatment	Comments
Overall Mental Health Conditions	<ul style="list-style-type: none"> ▪ Higher levels of physical activity are associated with higher subjective well-being, mood and emotions, life satisfaction and quality of life. A large number of experimental studies, most of which use aerobic forms of exercise, indicate that a single bout of physical activity can result in improved mood and vigour ⁱⁱ. 	See below for specific conditions	
Depression	<ul style="list-style-type: none"> ▪ People who lead an active lifestyle over several years have a reduced risk of suffering symptoms of clinical depression ⁱⁱ. 	<ul style="list-style-type: none"> ▪ Physical activity has been shown to be effective in reducing clinical symptoms in those diagnosed as severely, moderately or mildly depressed^{xlvi, xlvii, xlviii}. ▪ Four studies have indicated that physical activity is at least as effective for treating depression as psychotherapy ^{xlix, i}. ▪ Two studies have shown that physical activity can be as successful at treating depression as medication. 	
Anxiety and Stress	<ul style="list-style-type: none"> ▪ Physical activity has also been found to have a weak effect on reducing stress, anxiety and depression in adolescents ⁱⁱ. 	<ul style="list-style-type: none"> ▪ Physical activity has modest beneficial effects for people with generalised anxiety disorder, phobias, panic attacks and stress disorders^{li}. ▪ 	
Schizophrenia	<ul style="list-style-type: none"> ▪ 	<ul style="list-style-type: none"> ▪ Physical Activity can have a positive effect on psychological well-being in some patients with schizophrenia^{lii}. 	
Cancer	<ul style="list-style-type: none"> • Physical activity is associated with a reduction in overall risk of cancer ⁱⁱ. • Physical activity can also have an 	Cancer related fatigue and supervised regular light exercise	

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	<p>indirect effect through its role in the prevention of obesity which, in the USA, has been estimated to result in 10% of all-cause cancerⁱⁱⁱ.</p> <ul style="list-style-type: none"> • Compared with sedentary people, the available epidemiologic data suggest that active people have approximate reductions in risk of lung, endometrial, and ovarian cancers of 20%, 30%, and 20%, respectively^{iv}. 	<ul style="list-style-type: none"> • 28 RCT and 2 meta analysis demonstrate that regular light exercise reduces the severity of Cancer Related Fatigue • Supervised aerobic exercise programmes were more effective in reducing CRF than home-based exercise advice.^{iv} <p>There is a growing evidence base for the role that physical activity can play in cancer survivorship programmes.</p>	
Colon Cancer	<ul style="list-style-type: none"> ▪ There is a marked protective effect on colon cancer: the most active individuals have, on average, a 40-50% lower risk than the least active^{vi, lvii} 		
Breast Cancer	<ul style="list-style-type: none"> ▪ Physical Activity is associated with a reduced risk of breast cancer among postmenopausal womenⁱⁱ ▪ Women with higher levels of physical activity have about a 30% lower risk of breast cancer than the least active^{lviii, lix} 		
Cognitive Functioning Impairments	<ul style="list-style-type: none"> ▪ Children with higher physical activity levels are more likely to have better cognitive functioning. A meta-analysis of 44 studies concluded that there is a significant positive relationship between physical activity and cognitive functioning in children, with a mean effect size of 0.32 (0.27)^{lx}. ▪ There is limited evidence that physical activity can improve at least some 		

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	<p>aspects of cognitive function among older peopleⁱⁱ.</p> <ul style="list-style-type: none"> ▪ Physical activity may offer some protection against problems of serious cognitive impairment in old age^{lxi, lxii}. Two prospective studies show that high levels of physical activity reduce the risk of cognitive impairment, Alzheimer's disease and dementia^{lxiii, lxiv}. ▪ Review level evidence shows that older adults who exercise regularly are less likely to experience cognitive decline^{lxv}. 		
Bone Health	<ul style="list-style-type: none"> ▪ Physical activity – particularly in the puberty years and adolescence, particularly activity that physically stresses the bone – is important for bone health. A consensus is now emerging^{lxvi, lxvii, lxviii} that, while exercise may enhance skeletal growth in pre-pubertal children,^{lxix, lxx} the greatest benefit from exercise in terms of bone health occurs in early puberty. ▪ Children who do weight bearing physical activity have 5-15% more bone mineral density than inactive children, sufficient to reduce substantially the risk of osteoporotic fracture if maintained into old age.^{lxxi} 		
Falls	<ul style="list-style-type: none"> ▪ Physical activity can help prevent falls and consequent fractures, which are particularly relevant for people with 	<ul style="list-style-type: none"> ▪ Exercise programmes – particularly strength training – have been shown to be highly effective in reducing 	

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	<p>osteoporosis. Muscle weakness is the strongest risk factor for falling – stronger even than a history of previous falls^{lxxii}. Doing more than 5 hours of physical activity a week reduces the risk of hip fracture^{lxxiii}.</p> <ul style="list-style-type: none"> ▪ Physical activity can slow down the loss of muscle mass, but cannot halt it or reverse it. ▪ In programmes combining strength, balance and endurance training, the risk of falls was reduced by 10%; programmes with balance training alone reduced the risk by 25%; and Tai Chi reduced the risk by 47%.^{lxxiv} 	<p>subsequent incidence of falls among older people^{lxxv, lxxvi}₄₂₁</p>	
COPD		<ul style="list-style-type: none"> ▪ Being physically active reduces the risk of a COPD patient being readmitted to hospital by 46%^{lxxvii}. ▪ current NICE clinical guidance and the national clinical strategy for COPD advocate:“pulmonary rehabilitation should be offered to all patients who consider themselves functionally disabled by COPD (usually MRC Grade 3 or above)”. Those with COPD who are not sufficiently disabled by their condition to warrant participation in formal pulmonary rehabilitation programmes (MRC Dyspnoea Grades 2 or 1) should receive the same physical activity message as the general 	

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		population. This message may need to be tailored to overcome negative expectations about physical activity, including getting out of breath.	

The total cost of inactivity in England – including both direct costs of treatment for the major lifestyle related diseases, and the indirect costs caused through sickness absence – has been estimated at £8.2 billion a year^{lxxviii}. This does not include the contribution of inactivity to obesity which in itself has been estimated to cost £2.5 billion annually: £0.5 billion in NHS costs and a further £2 billion across the economy as a whole.^{lxxix} (It is estimated that obesity accounts for 18 million days of sickness per year.) Best estimates are that in western nations approximately 2.5% of total national health care costs are incurred through inactivity^{lxxx}. This figure is in line with the figures for England given above. If the proportion of insufficiently active people were reduced by just 5%, theoretically a £300 million saving in costs per year could be achievedⁱⁱ.

Strength of the evidence

(taken from the Department of Health Chief Medical Officer's Report: (2004) At Least Five a Week: Evidence on the impact of physical activity and its relationship to health. London.)

Table 1 Level and strength of evidence for a relationship between physical activity and contemporary chronic conditions

Condition	Preventive effects			Therapeutic effects	
	Level of evidence ¹	Strength of effect	Evidence of a dose response relationship	Level of evidence ¹	Strength of effect
Cardiovascular disease					
Coronary heart disease	High	Strong	Yes	Medium	Moderate
Stroke – occlusive	High	Moderate	–	Low	Weak
– haemorrhagic	Medium	Weak	–	Low	Weak
Peripheral vascular disease	No data/ insufficient data	–	–	Medium	Moderate
Obesity and overweight	Medium	Moderate§	–	Medium	Moderate§
Type 2 diabetes	High	Strong	Yes	Medium	Weak
Musculoskeletal disorders					
Osteoporosis ²	High	Strong	–	Medium	Weak
Osteoarthritis	No data/ insufficient data	–	–	Medium	Moderate
Low back pain	Medium	Weak	–	High	Moderate
Psychological well-being and mental illness					
Clinical depression	Low	Weak	–	Medium	Moderate
Other mental illness	No data/ insufficient data	–	–	Low	Weak
Mental well-being	–	–	–	Medium	Moderate
Mental function	Low	Moderate	–	Low	Weak
Social well-being	No data/ insufficient data	–	–	Low	Weak
Cancer				No data/ insufficient data*	–
Oesoph	Medium	Moderate	Yes		
Colon	High	Strong	Yes		
Rectal	Medium	No effect	–		
Breast	High	Moderate	Yes		
Lung	Low	Moderate	–		
Prostate	Medium	Equivocal	–		
Endometrial	Low	Weak	Yes		
Others	Low	Equivocal	–		

1 = Volume and quality of data

2 = From bone mineral density data. Osteoporosis is defined in terms of bone mineral density.

§ = Includes the effect of activity on disease as well as weight status.

* = However, a low level of evidence indicates weak effects on physical function and fatigue during and following cancer treatment.

This table provides a simplified summary of the nature and volume of evidence and an estimate of the strength of effect of activity currently indicated by that evidence. The level of evidence is intended to be a general indication of the volume and quality of the available evidence. The 'strength of effect' is intended to indicate how partial, or otherwise, the findings are. Three broad categories (descriptors), agreed between the Review Panel and the Expert Reviewers, have been selected within both 'level of evidence' and 'strength of effect'.

There is considerable variability in both the volume and quality of studies found in different areas of research regarding activity and health. Cardiovascular disease is relatively well investigated compared with areas such as obesity and mental health that have only recently attracted interest. The full picture is further confounded by the fact that physical inactivity affects a wide range of diseases and risk factors, many of which may occur in the same individual. The multiple effects of increased activity across these many chronic conditions are rarely considered in study design, so the true value of physical activity in terms of public health may well be under-estimated.

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