J R Coll Physicians Edinb 2020; 50: 173–80 | doi: 10.4997/JRCPE.2020.223 **REVIEW**

Physical activity and moving more for health

Ranulf Crooke[1], Christine Haseler[2], Tobias Haseler[3], Jack Collins[4], Andrew Crockett[5]

Abstract

Non-communicable diseases are a leading cause of death and levels are rising. Lifestyle changes, including physical activity, have benefits in all-cause mortality, cardiovascular and metabolic disease, respiratory conditions and cognitive and mental health. In some cancers, particularly colon, prostate and breast, physical activity improves quality of life and outcomes before, during and after treatment. Sedentary time is an independent risk factor with adverse effects in hospitalised patients. Mechanisms include anti-inflammatory effects and augmentation of physiological and neuroendocrine responses to stressors. Engaging patients is affected by barriers: for clinicians, awareness of guidelines and personal physical activity levels are important factors; for patients, barriers are influenced by life events, socioeconomic and cultural factors. Interventions to increase activity levels are effective in the short- and medium-term, including brief interventions. Face-to-face is more effective than remote advice and behavioural interventions are more effective than cognitive. There are no published guidelines for physical activity in hospitalised patients.

Correspondence to:
R Crooke
Hilary Cottage Surgery
Fairford
UK

Email:
ranulf.crooke@nhs.net

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Benefits and risks of physical activity

Introduction

Non-communicable diseases are rising and account for an estimated 89% of all deaths in the UK.[1] Life expectancy in some areas of the UK is projected to fall due to an increase in conditions such as cardiovascular disease, stroke and cancer.[2] A significant proportion of non-communicable diseases are thought to be preventable through addressing four main risk factors, one being physical activity, the others: tobacco use, poor diet and excess alcohol.[3] Despite evidence of the benefits, physical activity levels remain low, especially in hospitalised patients.[4] Engaging patients to change behaviour is challenging.[5]

In this review article, we wish to provide a broad overview of the background evidence for the benefits of sufficient physical activity, mechanisms through which these are achieved and how barriers to increasing activity might be addressed. Papers were selected from PubMed and Web of Science using the following search terms: physical activity, exercise, inactivity, sedentary, mechanism, benefit, risk, barriers, intervention and motivation. Studies cited in previous relevant reviews and official government publications or guidance and the authors' collections were also included.

Guidelines and definitions of physical activity and sedentary time

UK guidelines for physical activity[6] recommend at least 150 minutes of moderate intensity (or 75min vigorous intensity) physical activity every week, strength building at least twice a week, minimising sedentary time and, for older adults, improving balance twice a week. Any amount of movement contributes to the total. Most benefit is gained by switching from minimal to any engagement in physical activity.[7]

Physical activity is bodily movement produced by skeletal muscles that results in energy expenditure.[8] Moderate and vigorous activity can be differentiated by the 'talk test': being able to talk but not sing indicates moderate intensity, while having difficulty talking without pausing suggests vigorous activity.[6] Moderate intensity is between 3–6 METs (1 MET is the metabolic rate while sitting at rest), light intensity 1.6–3 METs and vigorous intensity over 6 METs.[8]

Equivalent benefits of meeting the UK guidelines might be achieved at much lower volumes through high intensity interval training (very vigorous physical activities performed in short bursts interspersed with rest or lower intensity activity breaks).[6,8]

[1]General Practitioner, Hilary Cottage Surgery, Fairford, UK; [2]General Practitioner, Hucclecote Surgery, Gloucester, UK; [3]General Practitioner Specialty Trainee 3, The Bloomsbury Surgery, London, UK; [4]General Practitioner, Trafalgar Medical Group Practice, Portsmouth, UK; [5]General Practitioner Specialty Trainee 2, Ponteland Medical Group, Newcastle, UK

Sedentary time is an independent health risk, irrespective of level of activity, and is defined as any waking-time activity spent in seated or lying posture, expending low levels of energy.[9]

Major health benefits of physical activity

All-cause mortality

Physical activity is consistently associated with reduced all-cause mortality in a dose-response fashion.[10] Increases in physical activity over time, irrespective of baseline activity levels, are associated with reduced all-cause, cardiovascular and cancer mortality.[11] This relationship persists after accounting for other associations of increasing physical activity (improved diet, BMI, medical history, blood pressure and lipids). The benefits are comparable with medication in some conditions and surpasses medication in reducing mortality after stroke.[12]

Cancer

The leading cause of avoidable mortality in the UK is neoplasms.[13] Moderate to strong evidence has shown risk reduction in bladder, breast, colon, endometrial, oesophageal, gastric, renal and lung cancers through regular physical activity.[8] Sedentary time and increased risk of endometrial, colon and lung cancer also appear to be linked.[8] Following a cancer diagnosis, regular physical activity has been shown to reduce all-cause mortality, cancer-specific mortality and risk of recurrence or progression in breast cancer, prostate cancer and colorectal cancer.[14,15]

Cardiovascular disease

Prevention of cardiovascular disease, the second leading cause of death in the UK,[13] shows strong evidence of a dose-response effect of physical activity.[8] The effect of physical activity on reducing blood pressure is also significant and may be similar to hypertensive medication.[16] Cardiac rehabilitation through physical activity, in established cardiovascular disease, reduces cardiovascular mortality, hospital admissions and improves quality of life, but not myocardial infarction or subsequent cardiac interventions.[17]

Respiratory disease

Chronic obstructive pulmonary disease is currently in the top three leading causes of death worldwide.[18] Whilst brief advice appears to have limited success, pulmonary rehabilitation improves quality of life, breathlessness and exercise capacity.[19]

Diabetes

Diagnosis of diabetes in the UK has doubled in the last 20 years and represents a significant modifiable disease burden.[20] Strong evidence supports an inverse relationship between physical activity and progression of HbA1C, blood pressure, BMI and lipids.[8]

Brain health

Cognitive health is important not just for lifespan, but for maintaining a greater number of disability-free years.[21] Dementia is England's second leading cause of death.[22] Cognitive function is improved by regular physical activity, reducing age-associated decline by up to 33%, the risk of dementia, including Alzheimer's, by up to 40%, and improving cognition in dementia and stroke patients with established disease.[8]

Mental health

Low-level physical activity (walking <150min/week) has been associated with reduced risk of depression of up to 63%,[23] whilst sedentary time has been associated with an increased risk of depression (relative risk = 1.14; 95% CI: 1.06 to 1.21).[24] There is also evidence that the benefits of physical activity, cognitive behavioural therapy and medications may not be significantly different.[25]

Sleep

Sleep is an important determinant of both physical and mental health.[26] Physical activity has been found to improve sleep in a number of ways: total sleep duration, sleep onset latency, rapid-eye-movement sleep, sleep efficiency and sleep quality.[27]

Obesity

Weight loss or attenuating weight gain is associated with greater amounts of moderate to vigorous physical activity but not with light physical activity.[8]

Older adults and frailty

With the UK's ageing population, mitigating the effects of the rise in chronic health conditions is important.[28] Light intensity activity in older adults is associated with a reduced risk of obesity, cardiovascular disease, cancer and all-cause mortality,[29] as well as reduced unplanned hospital admissions and medication prescriptions.[30] Poor physical function has a linear relationship with all-cause mortality, even from mid-life.[31] Impaired balance predicts a higher rate of all-cause mortality and cognitive decline.[32] Reduced muscle strength is associated with reduced walking speed, increased risk of disability and falls.[33]

Risks of physical activity

Physical activity is safe and beneficial for almost all people, including those with disabilities.[6] A safeguard against doing too much too soon is to start at low durations and intensities, for example 5 to 15 minutes activity 2 to 3 times a week and build up over time as the body adjusts.[6,8]

High-intensity competitive sport, unlike leisure activity or sport where intensity and duration can be controlled, has defined cautions (such as known or suspected coronary artery disease) where increased haemodynamic load may cause myocardial ischaemia.[34] In pregnancy, impact activities causing trauma, prolonged supine lying, high altitude or underwater activities are not advised.[35] Activity moderation and psychological support is required for exercise addiction, characterised by obligatory and excessive exercise.[36]

There is a greater risk of musculoskeletal injury with greater volumes of physical activity and injuries are more common with impact activities.[6]

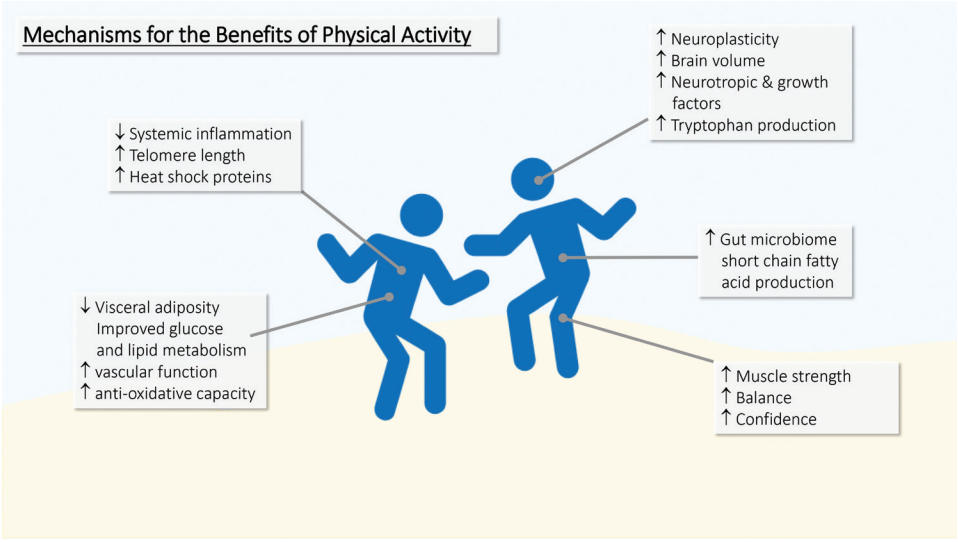


Figure 1 Mechanisms and benefits of physical activity. See text for references.

Adverse cardiovascular events are rare. Findings from studies of very high leisure-time physical activity levels are contradictory[8,37] but analysis suggests benefits against mortality risk continue at ≥10x the recommended guideline level of physical activity.[37] The evidence is insufficient to advocate lesser activity levels to avoid possible adverse effects. It is important to note that benefits at high volumes are much the same as guideline recommended lower volumes of physical activity.[8]

Physical activity

The mechanisms underlying the benefits of regular physical activity are diverse and not fully understood (Figure 1). Some of the possible pathways involve anti-inflammatory effects, augmenting physiological and neuroendocrine responses to biological and psychosocial stressors, creating resilience to stressors and optimising neurogenesis and growth factor production.[38] Potential mediators include: increased expression of heat-shock proteins (a group of proteins critically involved in cellular signalling and metabolism),[39] short-chain fatty acid production via the gut microbiome,[40] improved brain-derived neurotrophic factor, growth factors and tryptophan production, in addition to enhanced neuroplasticity,[41] improved anti-oxidative capacity[42] and reduced systemic inflammation.[43]

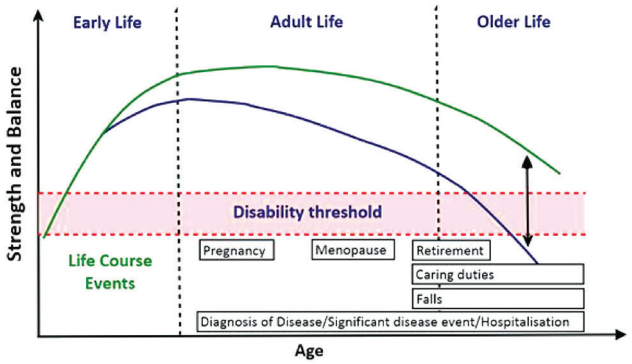
Key systems modulated by these changes are the sympathetic nervous system and the hypothalamic–pituitary–adrenal axis, which are activated in a dose-dependent manner by acute physical activity.[38] Adaptive response to the short-term, limited physical stress of activity develops increased resilience to physical and psychological stress. This results in protection from the maladaptive regulation of these systems that is observed with chronic exposure to stressors in conditions such as autoimmune, metabolic and cardiovascular diseases, and stress-related health problems, for example, depression.[38] The resultant physiological changes comprise reduced visceral adipose tissue inflammation, improved vascular function, glucose and lipid metabolism,[38] as well as greater brain volume and cognitive function.[44] Lower oxidative stress has been associated with longer telomeres (a biological marker of cellular ageing and senescence) which suggests that regular physical activity conserves telomere length and may mitigate the ageing process.[42]

Strength and balance training

Muscle and bone mass ordinarily peak before the age of 30, and muscle and bone strengthening activities are required to slow the decline in bone and muscle density to maintain capacity and function (Figure 2).[45] Multicomponent physical activity programmes including strength and balance training reduce the risk of fall-related injuries; walking alone does not reduce this risk,[46] but any physical activity reduces the risk of hip fracture by 20–40% compared to sedentary individuals.[47] A review of strength-training variables demonstrated that duration of training had a greater effect on muscle strength than any other variable such as type of exercise, number of repetitions or degree of resistance.[48] Muscles do adapt to training, even into old age.[33]

Evidence for balance training is less complete,[49] but showed some improvement from programmes which ran three times a week for three months, although these were not maintained after cessation. Exercises included gait,

Figure 2 Strength and balance ability over the life course and potential ages or events that may change the trajectory of decline with ageing (adapted from Skelton et al 2018).[51] The blue line depicts the decline attributed to life events versus the projected green line trajectory without these life events.



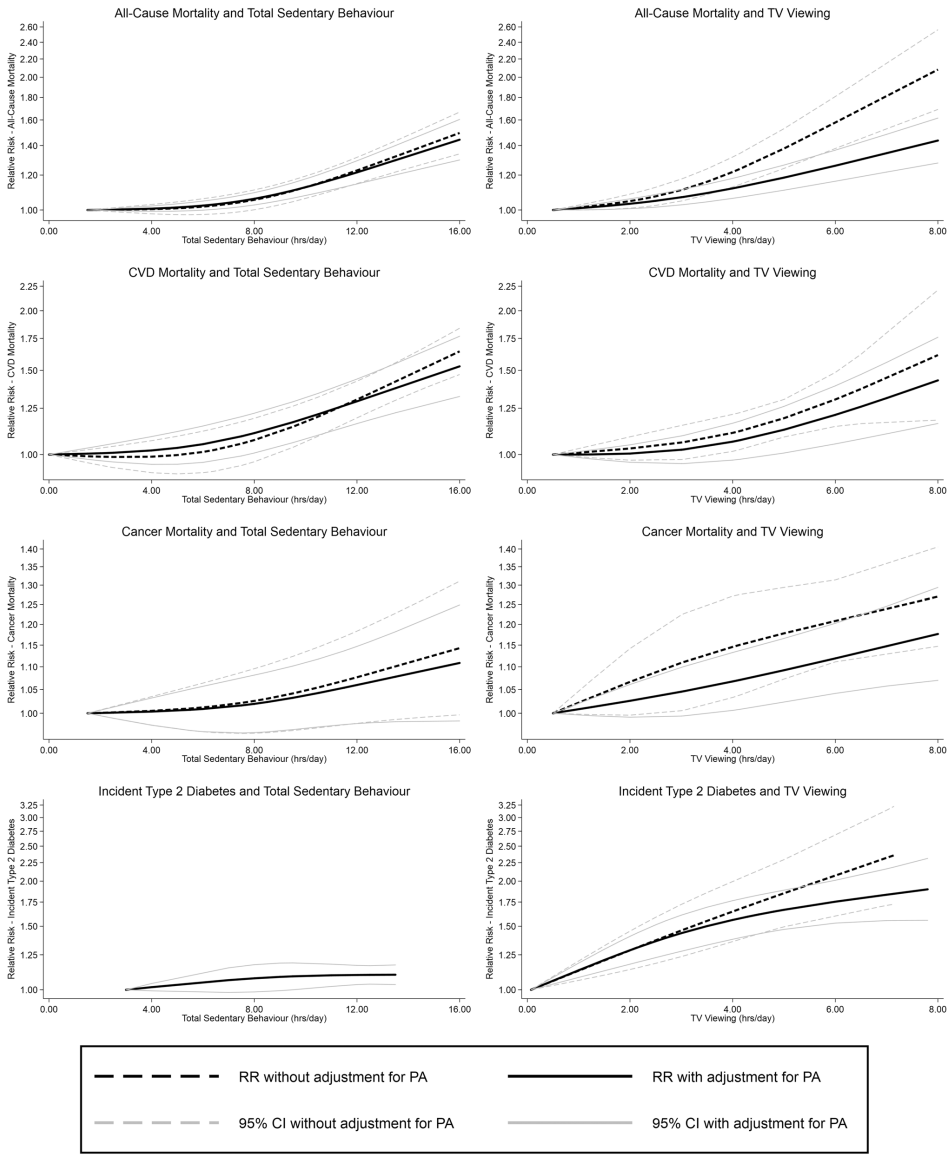


Figure 3 Non-linear associations between sedentary behaviour and health outcomes presented with and without physical activity adjustment (Patterson et al 2018).[9]

balance, 3D exercises, functional exercises and muscle strengthening; multiple exercise types improved indirect measures of balance such as timed get-up-and-go, single-leg stance and walking speed. Physical confidence is improved by training.[50]

Sedentary time

Adverse effects of sedentary time

Long-term health risks from sedentary behaviour are independent of the amount of time spent undertaking physical activity.[6,8] Being active regularly will only partially attenuate risks. Data from over 1.3 million individuals[9] showed that over 6–8 hours of daily sedentary time is associated with greater risk of all-cause, cancer and cardiovascular mortality, independently of levels of moderate to vigorous physical activity (Figure 3). Hospital bed rest, (patients may spend 87% of their time lying down)[4] is associated with muscle atrophy, insulin resistance, systemic inflammation and microvascular dysfunction amongst other complications.[52]

Benefits of interrupting sedentary time

One trial observed 19 overweight or obese participants while sedentary or with breaks of 2 minutes every 20 minutes to undertake light or moderate intensity walking on a treadmill. Results showed that glycaemic response to a test drink was 24.1% lower (5.2mmol/l [4.1–6.6], p<0.01) for light-intensity activity and 29.6% lower (4.9mmol/l [3.8–6.1), p<0.001) for moderate-intensity activity compared with uninterrupted sitting (6.9mmol/l [5.5–8.7]) and insulin levels were reduced.[53] In 17 overweight postmenopausal women with dysglycaemia, interrupting prolonged sitting with 5 minutes of standing or light intensity walking had similar reductions (34% and 28% respectively) in postprandial glycaemia.[54]

Barriers and ways to engage patients

Motivators and barriers to physical activity

Table 1 summarises the spectrum of patient and healthcare professionals' perceived barriers to engaging in physical

Middle age/elderly	Ethnicity and culture	Lower socioeconomic group	Inactive	Life events leading to decline in physical activity (Figure 2)	Healthcare professionals
Not enough time	Threat to cultural values	Lack of motivation	Lack of time	Stroke	Lack of time
No one to exercise with	Selfish activity	Lack of resources	Lack of enjoyment	Diagnosis of long-term condition e.g. osteoporosis (fear of falling and perceived pain)	Lack of incentive
Lack of facilities	Fear of racial discrimination	Too far to travel	Preferring other things	Retirement	Fear of increasing social inequality
Already active enough	Fear of religious discrimination	Lack of facilities		Becoming a carer	Insufficient training under or post graduate
Do not know how to	Belief it will harm	Fear of injury			Lack of knowledge of guidelines
Lack of motivation	No perceived benefit	Preferring medication			Lack of confidence giving advice
Too tired	'Western' culture not their culture	Lack of social support			

Table 1 Patients' and healthcare professionals' barriers to physical activity

activity and counselling. Barriers for patients vary according to age demographics,[55] ethnicity and culture,[56] socioeconomic group,[57,58] experience of life events[51] and current activity levels.[59] Healthcare professionals' own levels of physical activity are low; 48% of nursing and 38% of medical students do not meet the recommended guidelines.[60] Those who are not physically active are less likely to promote physical activity[61] and decisions on physical activity promotion tend to be linked to personal activity levels.[57] Lack of time, incentive, knowledge, confidence, training and fear of increasing social inequality are reported barriers to counselling patients on increasing physical activity levels.[57,62-65]

Motivators for active people include losing or maintaining weight, avoiding or managing a health condition, improving appearance or improving athletic performance and/or strength. There is a preference towards aerobic activity over resistance exercises.[6] Across all types of intervention, sufficient evidence for a consistent and statistically significant maintenance of increased physical activity levels over a long-term period (12 months) was achieved in 2011.[67]

Brief intervention

'Brief intervention' is poorly defined in the literature.[68] It is recommended that advice should be tailored to the individual's circumstances, abilities, goals and health[69] using a variety of techniques. There is moderate evidence from 15 studies of an increase in self-reported physical activity levels from those who received brief advice,[69] though the evidence is inconclusive as to whether there is a difference in effect between <5 minutes and >5 minutes interventions. There are some studies that show an initial 3–5 minutes consultation with follow-up is enough to bring about a short-term change in physical activity levels.[69] Number of contacts, length of contact or type of intervention show no significant difference.[70,71] Training physicians in delivering physical activity advice results in increased confidence and increased numbers providing information to patients (from 20% to 74%).[72] A practical model, 'ask-assess-advise', uses motivational interviewing (Figure 4).[73]

Face-to-face or remote interventions

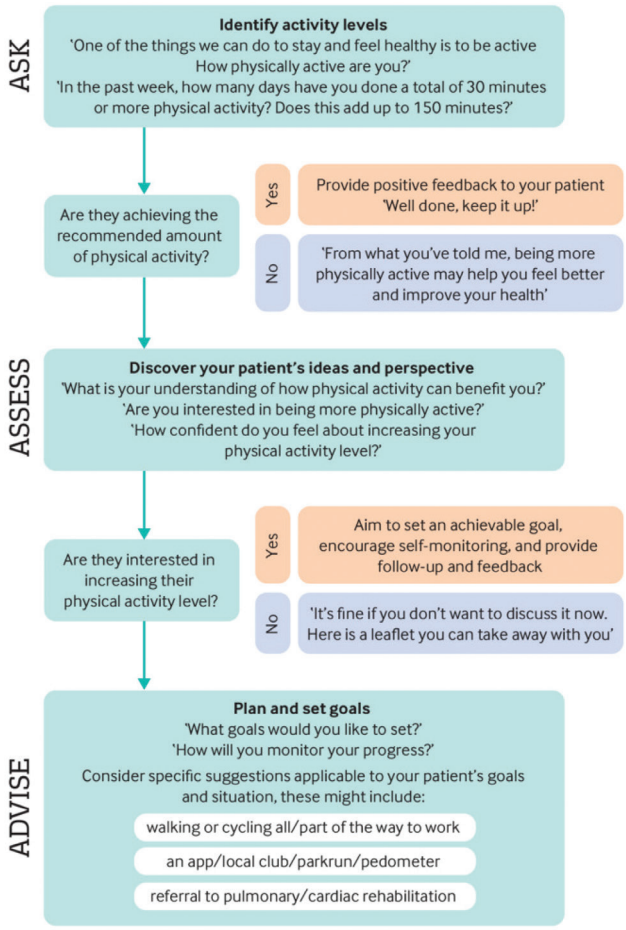
Good evidence from several systematic reviews and meta-analyses suggests both face-to-face and remote or web-based interventions have a positive impact on physical activity in targeted populations,[74] although the effect is greater face-to-face.[70] Communal physical activity, active goal-setting and self-tracking benefit from social interaction and may help sustain improvements in physical activity levels.[75]

Interventions targeting individuals are more effective than mass-media or targeting entire communities.[70] Despite being less effective, remote and web-based interventions have the potential to have an impact at a population level because of the overall efficiency (cost and time).

Information given to patients

How the information is delivered seems to have a significant effect. When education/advice/intervention is delivered as behavioural advice[70] (such as goal setting, contracting, self-monitoring, cues, rewards) or cognitive (decision making, health education, providing information), the behavioural advice is significantly more effective. A written exercise-prescription may be beneficial[70] but moderate evidence suggests that providing written information does not change the impact of brief advice.[69]

Figure 4 The Ask-Assess-Advise model (Haseler et al. 2019)[73]



Hospitalised patients

There are no consensus guidelines for physical activity in hospitalised patients. This is likely due to the heterogeneity of patients and a lack of robust evidence for interventions. Small sample sizes and a lack of standardisation of reporting measures hampers conclusions from current research into why patients spend the majority of their inpatient stay in bed.[4]

Healthcare professionals supervising 19 minutes of multimodal physical activity sessions daily throughout inpatient stays gave equivocal results.[76,77] Additional physical rehabilitation has been shown to improve activity levels and physical function but not length of stay.[78] Hospital stay in the previous 12 months is the biggest risk for functional decline in the elderly.[51] Changes to ward layout and hospital design are needed to promote 'recovery' rather than simply 'rest'.[79] Collective, team-based responsibility to challenge unnecessary sedentary behaviour and encourage activity through campaigns such as 'End PJ Paralysis', part of the recently launched 'Movement Movement' may also have a role.[80,81]

Conclusion

Increasing physical activity has definite benefits across a wide range of conditions, non-communicable disease, mental health and inpatient care. Physical activity guidelines emphasise that moving more is safe and indicate optimal levels for health benefits. The important factors in engaging patients are clinician awareness of guidance and personal physical activity levels. Barriers for patients are influenced by life events, socioeconomic and cultural factors. Interventions that help include a brief intervention included in a consultation, face-to-face or web-based interventions or community-based activities. Evidence supports a variety of interventions that achieve immediate post-intervention and long-term increases in physical activity, but this does not yet translate to a population level. More research is needed to facilitate patient engagement in physical activity as an essential dimension of health.

Resources

Moving Medicine provides a range of evidence-based condition-specific information to help professionals advise patients on physical activity: http://movingmedicine.ac.uk/prescribing-movement/

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