

Expert Working Group Working Paper

Adults Working Group

UK physical activity guidelines: Draft review and recommendations for adults (aged 19-64 years)

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Background

UK physical activity guidelines

The first UK physical activity guidelines were produced in 1996 following the 1994 Ascot Meeting of UK and international experts, who agreed recommendations for adults (1, 2). These recommendations were then extended to include new recommendations for children and young people in 1998 (3). These recommendations included suggestions about the frequency, intensity and time of aerobic physical activity needed for each age group but also included the first recommendation for muscle strengthening, flexibility and bone health for children and young people only. In 2004 the English Chief Medical Officer formally endorsed these recommendations and thus began a continuing relationship with their production and dissemination that has continued to today. At the same time Scotland and Wales had adopted similar guidelines and following the publication of the 2008 USA physical activity guidelines (4), the UK CMOs harmonised and produced the current physical activity guidelines, published in 2011 (5). These included, for the first time, recommendations for Under 5s and for all age groups, sedentary behaviour (6).

Benefits of physical activity for adults

Regular physical activity (PA) is associated with decreased mortality and lower morbidity from a number of non-communicable diseases (7). Adults who are physically active report more positive mental and physical health (8). Despite this, a large proportion of the adult population in the UK are insufficiently active to meet the 2011 UK Physical Activity Guidelines (9). The scientific evidence on the relationships between PA and health continues to accumulate. The working group was tasked with examining the latest evidence with a view to updating the Physical Activity Guidelines for adults.

The key aim of this working paper is to present potential recommendations for any changes to the existing 2011 UK CMO Physical activity guidelines for adults. This working paper presents the findings of the Adults Expert Working Group (EWG). The document answers a set of questions set by the Chair of the CMOs Expert Committee for physical activity about potential changes to current physical activity guidelines, by expert scrutiny of the most up to date scientific reviews, and other national guidelines.

Outline of CMO Process

This work was conducted in three phases (summarised in Figure 1). Phase One saw the construction of each EWG, selection of international experts, formal purposive systematic reviews of the existing and new evidence, a website for a national consultation on the current UK CMO Physical Activity Guidelines and their implementation, and production of working group papers. All Chairs and Expert Panel members completed a statement of their declarations of interest.

In Phase Two, draft working papers were developed (this being one of the six papers). The draft papers were circulated to participants attending two Scientific Consensus Meetings (SCM) in Edinburgh and London, during June and July of 2018, respectively. This document has been revised in two ways: i) to reflect the feedback received from both consensus meetings; ii) in response to the updated evidence base.

Phase Three will include a second national consultation on the draft physical activity recommendations, and a final round of review and revision. EWGs will then produce a final technical report for the UK CMOs with final recommendations for new physical activity guidelines. If the CMOs sign off the suggested recommendations, then the CMO Guidelines Writing Group will support the production of a final CMO Physical Activity Guidelines Report.

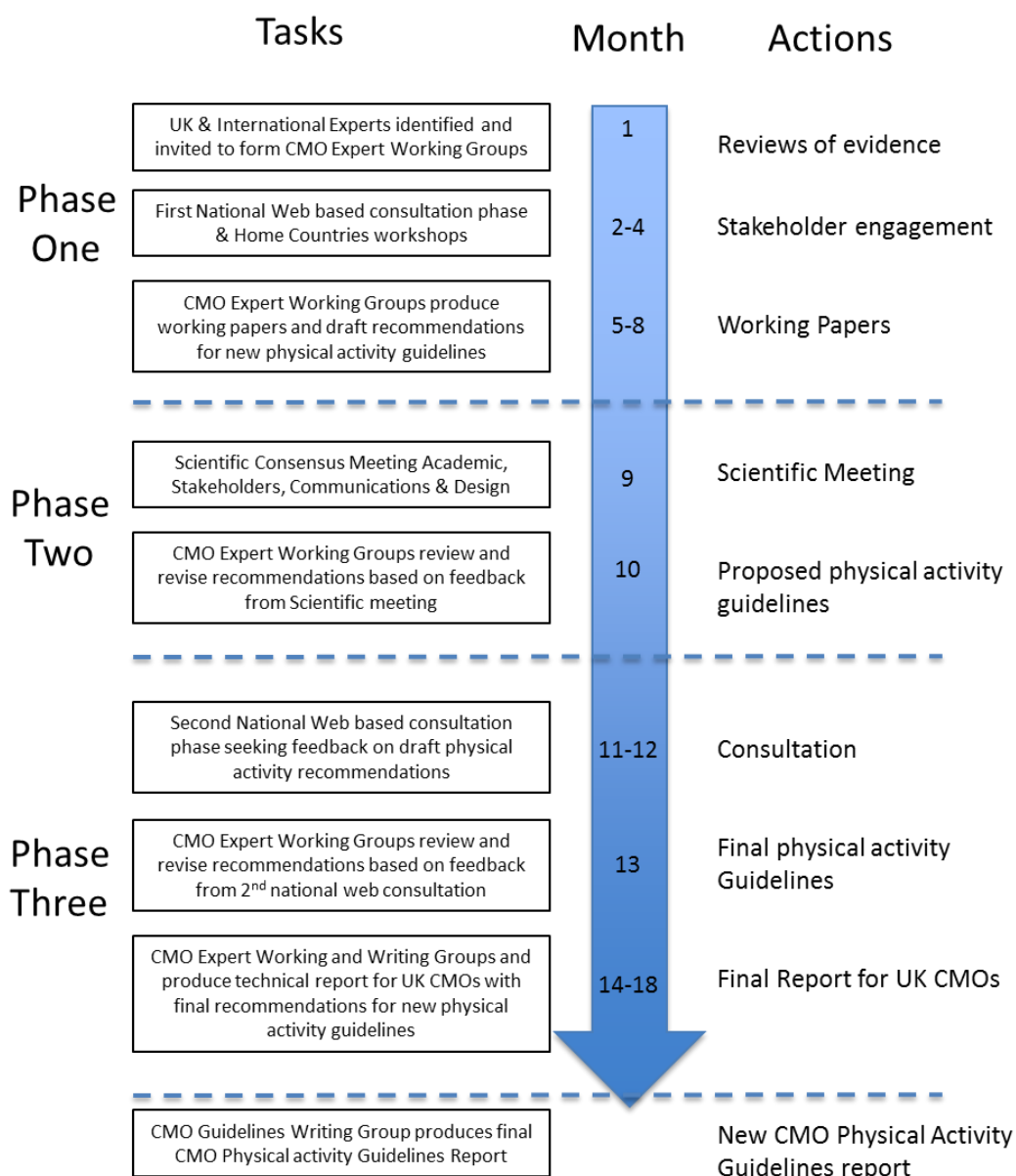


Figure 1. 2018 UK Physical activity guidelines review process

Methods for CMO Physical Activity Guidelines Update

Based on the experience of updating guidelines in 2011, as well as resources and time it was deemed impractical to undertake a full review of the primary literature. It was agreed by the EWG Chairs that to identify a set of key review documents to be the primary sources of evidence underpinning the UK review work.

The process to update the 2011 CMO physical activity guidelines drew upon three types of evidence: (A) recent published evidence reviews used to construct or update international physical activity guidelines; (B) the most recent pooled analyses, meta-analyses and systematic reviews from prospective and randomised controlled trials (RCT) research published since the most recent reviews used to update international guidelines; and (C) any additional relevant papers identified by each EWG. In addition, comments and suggestions about the current 2011 CMO physical activity recommendations were identified for each EWG from our first round of National Consultation.

Each EWG adopted the same principle, namely, to identify if there was any new evidence that justified a change to the existing 2011 guidelines. Where insufficient additional evidence was available then the 2011 guideline was retained. The current 2011 UK physical activity guidelines were constructed to advise the general population about the recommended frequency, intensity, time and types of physical activity required to prevent major chronic disease and to maintain health. In the UK, disease refer specifically to premature and all-cause mortality, years of life lost and disease burden (coronary heart disease, stroke, heart failure, diabetes mellitus type 2, chronic obstructive pulmonary disease (COPD), breast cancer, colorectal cancer, lung cancer, osteoarthritis, dementia and cognitive decline, and depression and depressive symptoms). The guidelines also focus on preventing premature (or all-cause) mortality and fractures, disabilities in the elderly, injuries and, in children, attention deficit hyperactivity disorder (ADHD) symptoms. We also included key risk factors which have a causal relationship with these chronic diseases i.e. systolic blood pressure, low density lipoprotein (LDL) cholesterol, body weight, adiposity, insulin sensitivity and cardiorespiratory fitness.

The specific steps that were followed to address items A-C that were highlighted above are described in detail below.

A. Identifying recent national evidence reviews used to construct or update physical activity guidelines

We searched for published international evidence reviews of physical activity, used to construct national physical activity guidelines and recommendations (published since 2010) using Google and targeting public health bodies (i.e. National Centre for Health and Clinical Excellence, Centre for Disease Control). We also contacted international experts to identify further examples of relevant reviews from the United States, Australia, Canada and The

Netherlands. We identified the most relevant and up to date high quality reviews from these sources and made summations of the effectiveness of the evidence across their health outcomes.

B. Identifying the most recent pooled analyses, meta-analyses and systematic reviews from prospective and RCT research?

We undertook purposive searches to identify review level relevant literature on the relationship between physical activity and health outcomes. Our searches primarily focused on review-level evidence for longitudinal cohort studies examining the relationship between physical activity and health outcomes. Systematic reviews and meta-analyses were also examined for RCTs to identify what types and volume of physical activity were used in effectiveness studies. We searched PubMed using a tailored set of broad MeSH terms (Medical Subject Headings) to capture the most current studies published, relevant to the needs of each EWG. For example, “resistance training”, “muscle”, “bone”, “balance” AND “physical activity” AND “adults”. Full search terms are presented in Table 1.

Table 1. Search Terms for Adults

Mortality	Breast Cancer	Sedentary Behaviour
Morbidity	Lung Cancer	Sitting
Health Outcomes	Prostate Cancer	Screen Time
Coronary Heart Disease	Mental Health	
Cardiovascular Disease	Dementia	Adults
Stroke	Cognitive	Young Adults
Heart Failure	Depression	Older Adults
Diabetes	Quality Of Life	
Chronic Obstructive Pulmonary Disease	Happiness	English
Osteoarthritis	Sleep	Review
Sarcopenia	Attention Deficit Hyperactivity Disorder	Meta Analysis
Strength	Blood Pressure	Individual Patient Data
Function	Hypertension	
Anxiety	Cholesterol	
Brain	Obesity	
Behaviour	Insulin Sensitivity	
Academic Performance	Body Weight	
Fractures	Body Composition	
Accidents	Fat Mass	
Falls	Aerobic	
Disability	Resistance	
Injury	Balance	
Cancer	Strength	
Colorectal Cancer	Fitness	
	Muscle	
	Bone	

The terms of the searches and their dates reflected the searches used in the most recent international evidence review from the Netherlands and the USA. For example, the searches used for the Dutch guidelines were truncated at 1 October 2016 so searches for this report include all publications from January 1st 2016 (in case of delayed archiving) to 1st January 2018. A total of 44 papers were identified using this process (10-53). EWGs reviewed these papers and made summations of the effectiveness of the evidence across their health outcomes.

C. Identifying any additional relevant papers by each EWG.

In addition to the above search strategy, each EWG member was asked to identify any relevant outcomes and primary papers from their own sources and networks. This searching of personal libraries was designed to supplement the searches carried described in A and B above. EWG members identified the most relevant and up to date high quality reviews from these sources and made summations of the effectiveness of the evidence across their health outcomes and whether the evidence suggested that any element of the 2011 guidelines for adults should be altered. A further 77 papers were identified by expert working group members.

Each member of the EWG was assigned a number of papers to review. For each paper they completed a proforma summarising the evidence and the relevance for the guidelines and making recommendations on whether the evidence reviewed justified that any element of the 2011 guidelines for adults should be altered.

Key questions

Question 1: Does the scientific evidence continue to support the current Physical Activity Guidelines for adults?

Statement 1: Adults undertaking 150 minutes per week of moderate intensity physical activity (MPA) or 75 minutes of vigorous intensity physical activity (VPA) and resistance training two or more times per week are likely to gain a range of physical and mental health benefits and a reduction in the risk of suffering from many non-communicable diseases

However more recent evidence suggests that health benefits may be derived from lower volumes, intensities and frequencies of activity, particularly for individuals with low levels of physical fitness (see Question 2a and Question 4). There is also new evidence to suggest that lower volumes than 75 minutes per week of short duration, very vigorous exercise may bring equivalent health benefits to those derived from adherence to the 2011 guidelines (Question 2b)

Commentary 1: The 2011 guidelines are consistent with the recent guidelines from the Netherlands (54). Although there is no consistent new evidence to suggest that the 150 minutes MVPA per week threshold should be changed we recognise that the choice of 150 minutes of MVPA for guidelines is somewhat arbitrary. This threshold has been widely adopted internationally and therefore has good research evidence to support the benefit of accruing this volume of activity. Furthermore, 150 minutes of MVPA per week is likely to be achievable for many people. There is however some evidence that the 150 minutes could be accumulated in bouts of any length and/or achieved in one or two sessions per week and still retain its beneficial effects. As in 2011 there is limited evidence that 75 minutes of VPA will result in equivalent benefits to 150 minutes of MPA. The current recommendation for resistance training (activities to improve muscle strength undertaken at least twice per week) also continues to be supported, but there is emerging evidence that a lower frequency (just one session a week) may result in meaningful benefit for several health outcomes (see Question 4). When messaging around the 150 minute “threshold” it is worth noting the systematic review of reviews by Warburton and Bredin (55) supports the benefits of physical activity at levels substantially below current guidelines levels. They argue that presenting threshold recommendations (i.e. 150 minutes MVPA) may present a barrier to many, particularly those who have low levels of physical activity, discouraging them from increasing their physical activity or progressing at their own speed. A commentary for the inclusion of lower volumes than 75 minutes per week of short duration, very vigorous exercise is included in the response to 2b below.

Question 2: Based on the current evidence on volume, intensity, duration and frequency of activity and their impact on health and disease, what modifications to existing UK guidelines are warranted?

- a. Should a threshold or range of PA dose be considered?
- b. What is the evidence for High-Intensity Interval Training (HIIT) on clinical/health outcomes?
- c. What is the evidence for the associations between physical activity and sleep?

a. Threshold / Range of PA dose

Statement 2a: Evidence continues to support 150 minutes of MVPA per week spread across the week. There is now evidence that lower volumes (<150 minutes per week), lower intensities (light) and lower frequencies (one-to-two sessions per week) of physical activity may confer health benefits. Setting a minimum dose of physical activity is a challenge given the broad spectrum of health outcomes. Different volumes and intensities of physical activity are likely to induce different physiological changes and health benefits. The curvilinear dose response relationship between physical activity and health outcomes suggests that the greatest benefits come from moving from inactive to moderate levels of activity below the threshold of current guidelines. The ‘some is good, more is better’ recommendation from the 2011 guidelines for older adults should therefore be included for adults and indeed reinforced and perhaps expanded. The amount and intensity of physical activity required to achieve additional health benefits is likely to be determined by current levels of activity.

Commentary 2a: Dose response relationship varies by disease risk. For many types of cancer, 150 minutes (10 MET-h)/wk of moderate to vigorous intensity physical activity (MVPA) is associated with a 13% reduction in mortality while 225 minutes (15 MET-h/wk) is associated with a 27% reduction (26). For colorectal cancer, recent evidence suggests that each additional 20 MET-h/wk is associated with a 10% reduction (32). For blood pressure the evidence suggests a graded dose-response relationship between physical activity and hypertension. 150 minutes (10 MET-h) of ‘leisure time PA’ reduces risk of hypertension by 6%, with further reductions of a similar magnitude for every additional 150 minutes (30). For type 2 diabetes, dose-response analysis from a review of 23 cohort studies indicates risk reduction can be achieved at levels of PA below current guidelines but substantially greater benefits can be achieved by being more active (42). For CVD, a review of 33 cohort studies confirmed that achieving current guidelines is associated with reduced risk but that moving from inactive to moderately active (6 MET-h/wk or less than half the current guidelines) brings greatest benefit (45).

A narrative review by Rhodes et al. (41) based on evidence from previous systematic reviews and meta-analyses suggests that health benefits are achieved with any level of physical activity even less than current guidelines and that greater benefits occur at higher levels of PA. A review of 40 studies on the benefits of light intensity physical activity (LIPA) suggests that LIPA is associated with a range of health benefits including lower risk of obesity and all-cause mortality as well as improved markers of lipid and glucose metabolism (56). In terms

of frequency of physical activity, an analysis of self-reported leisure time PA suggests that distributing the recommended volume of physical activity across the week may be unnecessary for all-cause, CVD and cancer mortality benefits (37) and mental health effects (see Question 6).

With the exception of one review (56), the reviews cited draw upon studies which have used self-reported physical activity. Given the challenges of this method, it is even more difficult to recommend a threshold of either intensity or volume of physical activity because of the limitations of self-report. In terms of intensity, it may be useful to include a description which refers to effort to in order to help distinguish relative and absolute exercise intensity.

b. What is the evidence for HIIT on clinical/health outcomes?

Statement 2b: HIIT or High Intensity Interval Training is a that has been coined to describe very short bouts of very vigorous exercise (at or close to an all-out or maximal effort). There is evidence that HIIT has a clinically meaningful effect on cardiorespiratory fitness (CRF), body weight, adiposity, insulin resistance, glucose control, systolic blood pressure, and diastolic blood pressure. The effects of HIIT on CRF appear comparable to or greater than seen with aerobic exercise interventions and are greatest when baseline CRF is low. Moreover, this is a more time efficient method of achieving the health benefits of physical activity than 150 minutes of MVPA. There is no consensus on the use of the term HIIT and insufficient evidence to specify the volume (or pattern) of high intensity exercise to be included within any new recommendation. However, this issue is reflected in the proposed recommendation, e.g. a shorter time but greater intensity option. This reflects the evidence that *“Lower volumes than 75 minutes per week of short duration, very vigorous intensity exercise may bring equivalent health benefits to those derived from adherence to the 2011 guidelines”* (as per statement 1 above). We suggest that further explanations in the form of examples of physical activity at this intensity are provided in the recommendations.

Commentary 2b: Multiple meta-analyses and systematic reviews have demonstrated that HIIT has clinically meaningful effects on fitness (14, 46, 47, 57), adiposity (14, 33, 48), body weight (25), and insulin resistance (25). In people who are overweight, there is evidence that HIIT reduces systolic blood pressure and diastolic blood pressure (14). Although current guidelines are consistent with improvements in CRF, the evidence suggests that shorter duration, very vigorous intensity activity can be as or more effective for these outcomes than aerobic exercise in adults with good exercise tolerance (58).

The EWG support the principle that this new evidence is reflected in the new CMO guidelines. The challenge of incorporating this into a new recommendation for HIIT is that the exercise protocols that have been used are quite variable. Some protocols use one or two ‘all out’ sprints (often on a cycle ergometer) and others involve up to ten very vigorous intensity bouts per exercise session (cycling or running). Although the evidence in support of HIIT is robust, there is no single definitive HIIT regimen that can be recommended. We

suggest a range of HIIT-related recommendation examples be presented, referring to the notion that working at a very vigorous intensity for a shorter duration (shorter than the current recommendation of 75 mins of vigorous PA), will also contribute to overall levels of physical activity and lead to health benefits. This principle could be illustrated with practical every-day examples such as stair climbing (59), and some specific recreational sports which may involve the intensity of exercise and work rest ratios used in HIIT research studies.

c. What is the evidence for the associations between physical activity and sleep?

Statement 2c: There is evidence to suggest that in adults, regular physical activity enhances the quantity and quality of sleep by reducing the time it takes to get to sleep (sleep latency), decreasing the amount of time that an individual wakes after going to sleep (sleep efficiency), increasing deep sleep and reducing daytime sleepiness in people with and without sleep disorders. The evidence suggests that these benefits occur from a single bout of activity but become more pronounced with regular physical activity. These acute, last bout effects on sleep may underscore the importance of physical activity frequency and suggest a benefit to accumulating the recommended volume of physical activity across the course of a week (i.e. daily). This is in contrast to other outcomes where frequency appears to be less important (see Question 2a Threshold/Dose)

Commentary 2c: The evidence for sleep benefits comes particularly from the US PAGAC Scientific Report (8). This report assessed the evidence for sleep benefit for both acute and habitual MVPA as strong, and the evidence for the benefit in individuals with insomnia or sleep apnoea as moderate strength. The strength of evidence for a dose response whereby longer bouts of, and more regular, physical activity improves sleep outcomes was also assessed as moderate. These benefits appear to be independent of the intensity and are unaffected by the time of day that the activity is undertaken.

Question 3: Please comment specifically on the available evidence related to the accumulation of physical activity in multiple short periods. Please comment on 1) whether this is relevant for the optimal health message and 2) whether it is or is not appropriate for any specific health conditions?

Statement 3: The 2011 guidelines recommended that physical activity should be accumulated in bouts of 10 minutes or more. Recent evidence suggests that physical activity accumulated through bouts of any duration is likely to lead to health benefits. The recommendation for a minimum bout length (i.e. at least 10 mins) may therefore no longer be necessary for the optimal health message.

Commentary 3: Contemporary physical activity guidelines evolved from early recommendations on the quantity and quality of exercise required to increase cardiorespiratory fitness. Evidence for these early guidelines was derived largely from RCTs

where individuals undertook 20 minutes of vigorous exercise on three days per week and therefore a minimum bout length of 20 minutes was promoted. Changes from an 'exercise for fitness' paradigm to a 'physical activity for health' paradigm resulted in a more flexible recommendation on bout length based on RCTs comparing multiple 10 minute bouts to continuous bouts of the same total intensity and duration. For the 2011 guidelines, reviews of these RCTs provided continued support for this threshold of bout duration. More recent studies have explored even shorter bouts (one to five minutes) but this has been somewhat overtaken by evidence from very short bouts of very vigorous intensity exercise and cohort studies in which self-reported domain specific activity is likely to be accumulated in bouts of less than 10 minutes.

Question 4: Is the evidence sufficient to support a separate guideline for muscle-strengthening activity, and a separate guideline for flexibility activities? If so, what should be considered, and should these guidelines differ for adults and older adults?

Statement 4: The evidence suggests that at least twice a week, all adults should undertake activities which increase or maintain muscle strength. The activities chosen should use major muscle groups in the upper and lower body and be repeated to failure (i.e. until the muscles feel temporarily 'tired out' and unable to repeat the exercise until rested for a short period). The guidelines could include specific examples of activities such as using bodyweight, free weights, resistance machines or elastic bands etc as well as activities of daily living such as stairclimbing, carrying shopping bags, lifting and carrying children and gardening. New evidence suggest that such activities performed just once a week with higher volume of work can also provide similar health effects.

Commentary 4: The evidence for this statement comes from a rapid evidence review of muscle and bone strengthening and balance activities (MBSBA) for health and wellbeing and makes suggestions for implementation of key findings and practical action for key audiences of the public, practitioners, policy makers and population surveillance (60). Activities which maintain or increase muscle strength include a range of everyday activities including carrying shopping bags, digging, lifting and carrying children, or climbing stairs, as well as the use of exercise equipment, including weight machines, free weights, or elastic bands. The challenge of definition is critical in establishing what types of physical activity contribute to muscle and bone strength, and balance health, and their relative effectiveness to develop and maintain health.

The 2011 guidelines suggest that adults should undertake physical activity to improve muscle strength on at least two days a week. Although not intended, the resistance training guidelines appear to be secondary to the primary message of achieving the 150 minutes of MVPA. The emerging evidence suggests that activities to maintain or increase muscle strength should be given equal importance for adults (and perhaps greater importance for adults at the upper end of the 19-64 age range).

The EWG also reported that recent meta-analytic evidence suggests that, for strength and muscle mass, the two days per week frequency of resistance training might be reduced to one day per week or performed over more days (61-63), assuming a minimum volume is performed across the week (e.g. between one to five sets of repetitions to a high degree of effort for all the major muscles of the body; (64, 65)).

The evidence reviewed also suggests that isometric training should be included as an option in any description of resistance training. If the guidelines were to specify the type of exercises for resistance training the evidence suggests that multi-joint exercises are equally effective but more time efficient than single joint exercises, and resistance band training is an effective method for healthy adults. Reviews by Carlson et al. (66) and Inder et al. (67) suggest that isometric resistance exercise training may be beneficial for blood pressure reduction and management. The revised guidelines should provide specific examples of resistance activities, and two recent reviews not included in the recent Netherlands (54) or US (8) reviews provide some evidence which could be incorporated into these recommendations (63, 65). A review of 21 studies by Gentil et al. (68), suggest multi-joint exercises are as effective as single joint. Evidence from a small systematic review and meta-analysis of five studies suggests elastic/resistance band training might be a suitable form of resistance activity for healthy adults (69). In terms of strength benefits from other types of physical activity, some review level evidence exists for benefits of participation in circuit training, ball games, racquet sports and Nordic walking (70).

Since the previous guidelines, little new evidence has emerged regarding physical activity and flexibility. No change or addition to the 2011 guidelines is justified.

Question 5: Based on the current scientific evidence, how should the physical activity guidelines address physical activity and weight management?

Statement 5: Physical activity expends energy and therefore makes a valuable contribution to weight management by reducing adiposity. The 2011 guidelines indicate that for weight loss a higher volume (beyond 150 minutes per week) of physical activity and dietary changes **may** be necessary (page 32 and 37 of the Start Active, Stay Active report (5)). The evidence reviewed suggests that **greater than** 150 minutes of physical activity and dietary restriction may be required for weight loss. Given the inter-dependency of energy intake and expenditure for weight loss it is not possible to specify how much more physical activity is likely to result in weight loss. However, given the scale of the problem of overweight and obesity, the importance of physical activity and the need for restricting energy intake simultaneously should be emphasised. Moreover, the role of physical activity in maintaining weight after weight loss should be highlighted.

Commentary 5: The UK Scientific Advisory Committee on Nutrition Report (2011) on Dietary Reference Values for Energy describes the impact of physical activity on energy balance

supporting the statement that physical activity can contribute to the maintenance of healthy weight and the prevention of weight gain (71). The evidence for the role of physical activity in weight loss in individuals who are currently overweight and obese comes from the Look Ahead Study (72) which indicated that greater than 150 minutes of activity resulted in clinically meaningful weight loss in overweight and obese adults with type 2 diabetes. The Cochrane Review of 12 RCTs echoes this finding suggesting that physical activity needs to be accompanied by changes in diet for diabetes prevention/delay (73). The SIGN guidelines (74) suggest that 45-60 minutes per day are required to prevent the transition to overweight or obesity. The recent US evidence review (8) did not include an assessment of the literature addressing the association between physical activity and weight loss or the prevention of weight regain following initial weight loss. It instead reverted to the 2008 evidence review which concluded that when a sufficient dose of MVPA is attained, it will result in weight loss and the prevention of weight regain and that physical activity has an additive effect on weight loss when combined with moderate dietary restriction compared to moderate dietary restriction alone.

It is also worth emphasising that the health benefits associated with physical activity are experienced by adults irrespective of weight status. In addition, overweight and obese women may benefit from increased risk reduction from endometrial cancer and overweight and obese men and women may be more responsive to HIIT's effects on insulin sensitivity, blood pressure and body composition.

Question 6: Based on the current scientific evidence, how should the physical activity guidelines address physical activity preventive mental health benefits?

Statement 6: The 2011 guidelines do not mention cognitive function benefits for adults (only for older adults). The evidence reviewed suggests that 45-60 minutes of moderate intensity aerobic and/or resistance exercise performed on as many days of the week as possible may improve cognitive function. For mental health benefits, physical activity does not need to be distributed evenly across the week. Similar benefits can be gained from undertaking the same weekly volume of physical activity in one or two bouts.

Commentary 6: The evidence for improved cognitive function comes from a systematic review of 39 interventions by Northey et al. (75). Evidence for lack of dose-response effect for cognitive decline and dementia comes from a systematic review and meta-analysis of 57 studies by (22). There is a clear protective effect for older adults and some evidence of a protective effect in younger adults. Evidence for the protective effects of physical activity for Alzheimer's Disease are only observed in people over 65 years (c/f older adult group).

Recent evidence suggests that for mental health benefits, physical activity does not need to be distributed evenly across the week but that similar benefits can be gained from undertaking the same weekly volume of physical activity in one or two bouts (23). Evidence

for equivalent effects of aerobic and resistance training on anxiety (76) and new evidence for the role of resistance training for reducing depression (77) underscores the recommendation (in Question 4) that resistance training be given equal prominence in the revised guidelines. The evidence for lower volumes of physical activity and mental health benefits come from one cross-sectional study by Hamer et al. (23) which utilised self-report physical activity data from Scottish and English health surveys. This level of evidence would not justify a change in the recommendation.

Question 7: Does the scientific evidence on the health benefits of physical activity suggest that physical activity guidelines should vary for women and men or for different population groups based on race, ethnicity? How well do the studies represent the population and the population at risk?

Statement 7: Although the majority of the evidence underlying the association between physical activity and health has been derived from studies of men, more recent evidence has confirmed similar relationships in women. At this stage there is no reason to vary the guidelines according to sex. Data for non-white populations remain more limited but these do not suggest that the relationship between physical activity and health varies by ethnicity. Therefore, there is no reason to vary the guidelines according to ethnicity.

Commentary 7: The US evidence review suggests that for some cancers there may be differences in the effects of physical activity by sex but the data is insufficient to confirm this suggestion (8). One obvious exception where the guidelines for women might diverge is for physical activity during pregnancy and postpartum. This is beyond the scope of this report and has been the subject of recent reviews by the CMO Expert Group.

Although many studies include participants from a range of ethnic backgrounds they are often not of sufficient size to make comparisons based on ethnicity. One exception included in the US evidence review (8) was for blood pressure. A meta-analysis of 71 dynamic resistance interventions (78) noted greater reductions in systolic and diastolic blood pressure in non-white compared to white samples. It is possible that given the differences in cardio-metabolic risk profile, ethnically specific guidelines may be warranted in the future (79).

Question 8: How applicable are any proposed changes to the current UK physical activity guidelines for adults with disability?

Statement 8: It is recommended that for substantial health gains disabled adults should do 150 minutes of physical activity at a moderate to vigorous intensity. They should also do challenging strength and balance exercises twice per week. There is little evidence that physical activity is unsafe for disabled adults when it is performed at an appropriate dose for their current level of activity and health conditions.

Commentary 8: The evidence for physical activity and adults with a disability was not identified in the 2011 Guidelines and not reviewed by this EWG. Evidence for this statement comes from the new evidence review by Smith et al. (80) commissioned by Public Health England that examined the latest scientific evidence of the health benefits for physical activity specifically for adults with a disability. This review overviewed the evidence for a positive association between physical activity and cardiorespiratory fitness, muscle strength, disease risk prevention, cardiometabolic health, functional skills, and overall wellbeing.

Question 9: Is there sufficient evidence/knowledge of the risks associated with physical activity to inform a statement on the risks versus benefits of the physical activity guidelines?

Statement 9: The risk of adverse events from physical activity are relatively low and the health benefits accrued from such activity outweigh the risks.

Commentary 9: The US evidence review (8) states that musculoskeletal injury is more common in activities which involve impact and is inversely associated with total volume of physical activity but the relative contribution of frequency intensity and duration are unknown. Adverse cardiac events are rare, are inversely associated with volume of regularly performed vigorous activity. So, although greater exercise intensity also brings greater levels of cardiorespiratory fitness, it also carries greater risk of injury, especially in individuals who are unaccustomed to exercise. This should inform any guidelines aimed at individuals who have been inactive for many years and supports the recommendation for a tailored approach outlined in the consideration of duration/ threshold above (Questions 2a).

Question 10: Would adoption of the proposed modifications to current UK physical activity guidelines influence the difficulty of meeting physical activity guidelines compared to the current physical activity guidelines for insufficiently active adults?

Statement 10: The proposed modifications, including a recognition of the benefits of LIPA, a removal of the minimum bout length for aerobic exercise and a change the description of resistance training may have implications for the proportion of adults meeting the guidelines. The “some is good, more is better” and the “all physical activity counts” messages may have a significant impact on the numbers of people who self-report meeting the guidelines and there is a risk that this approach might persuade inactive or insufficiently active people that they are doing enough. Conversely, providing greater clarity on what constitutes resistance training may result in a decrease in the proportion self-reporting meeting this aspect of the guidelines as activities previously judged to be resistance activity may be discounted.

Commentary 10: A study by Strain et al. (81) indicates that fewer than 1/3 of adults in the UK meet the 2011 muscle strengthening guideline, approximately half that of published

figures for MVPA. However, since there is no specific evidence for how the changes proposed might influence the difficulty of meeting the guidelines, the suggestions in the statement are plausible but speculative.

Question 11: What are the data limitations and implications for surveillance for this age group?

Statement 11: Although an increasing number of studies include device measured physical activity, a large proportion of the evidence is derived from studies using self-reported physical activity, which is subject to recall, social desirability and other bias. Even when device measured physical activity is included within surveillance, differences in the devices used and the way in which data is transformed and interpreted make comparisons between sub-populations difficult. Effective surveillance requires standardised methodologies consistently applied over time.

Commentary 11: Physical activity surveillance is important for assessing the effectiveness of interventions designed to increase physical activity at a population level. Across the UK many studies have attempted to describe levels of physical activity in the population and population subgroups. The lack of consistency in the methodology for measuring physical activity prevalence has consistently prevented valid comparisons across sub-populations and regions and decreased the extent to which the effectiveness of population level interventions can be compared.

Limitations of findings.

- We have not reviewed original research and limited our search to papers published in English.
- Papers identified in the literature searches, were reviewed by a single working group member.
- The search of personal libraries of working group members to supplement the systematic searches may have resulted in missed additional relevant studies
- The nature of the evidence and in particular the reliance on self-reported PA assessed in specific domains and the heterogeneity in how physical activity is operationalized in the papers reviewed is likely to have influenced our conclusions.

Draft recommendations

Recommendation 1: The UK physical activity guidelines should continue to recommend 150 minutes of moderate intensity physical activity per week. Further statements should make it clear that this volume of activity can be accumulated in different ways and that higher intensity activity for shorter amounts of time or a mixture of these moderate, vigorous and very vigorous activities will provide similar health benefit.

Recommendation 2: The UK physical activity guidelines should remove the statement advising that adults should accumulate physical activity in bouts of at least 10 minutes of moderate intensity at a time.

Recommendation 3: The UK physical activity guidelines should indicate that while optimal health benefits are likely to be derived from meeting the guidelines, they should now also stress the value of physical activity below the moderate intensity and 150-minute thresholds

Proposed recommendation:

For good physical and mental health, adults aged 19-64 should aim to be physically active.

One way to be active is to do 150 minutes of moderate intensity activity, such as brisk walking or cycling, a week. Other ways are 75 minutes of vigorous intensity activity, such as running or playing tennis, even shorter durations of very vigorous intensity activity, such as sprinting or hard circuit training, or a combination of moderate, vigorous and very vigorous intensity activity. However, it is important to remember that any activity is better than none, and more is better still.

Recommendation 4: The UK physical activity guidelines should continue to recommend activity to maintain or increase muscle strength for all major muscle groups but should expand this recommendation to include very vigorous intensity activity, impact exercise and balance training. Further statements should include specific examples of resistance training and other relevant activities. These examples should reflect key principles of progression, intensity, frequency, multi joint, multi modal (e.g. bodyweight, free weights, resistance machines, elastic bands etc) and examples from everyday living to develop or maintain strength should also be presented.

Recommendation 5: The UK physical activity guidelines should indicate that regular physical activity can contribute to weight maintenance including weight loss, the prevention of weight gain, and reduction in body fat.

Proposed recommendation:

Adults should also do activities to develop or maintain strength in the major muscle groups. These activities could include heavy gardening, carrying heavy shopping, or resistance exercise. Muscle strengthening activities should be done twice a week, but any strengthening activity is better than none.

Research recommendations

- Further research is needed to define the 'equivalencies' of different combinations of type, duration and intensity (beyond energy expenditure) and explore possible difference in their health benefits.
- Further research is needed to determine the most appropriate methods for physical activity surveillance at population level.
- Further research is needed to explore the suggestion that the benefits of resistance training might be gained from a lower frequency (1 day per week).
- Further research is needed to determine whether recommendations for physical activity should differ according to sex and ethnicity.
- Further research is needed to further determine the dose response relationship between physical activity and different health conditions /disease outcomes.
- Further research is needed to ensure that people can make use of technology to self-assess their physical activity according to the guidelines (i.e., we need to make sure that the recommendations 'work' with technologies) [given the pervasiveness of such devices]
- Further research is needed to determine the dose response relationship between physical activity and health for different population groups including those with a disability and different ethnic groups.
- Research is needed to determine the effect of removing the minimum bout length (formerly 10 minutes) on the proportion of the population meeting the new physical activity guidelines

Next steps

A second national consultation on the draft physical activity recommendations will be undertaken. This report will then be reviewed and edited where appropriate. A final technical report will then be produced for the UK CMOs with final recommendations for new physical activity guidelines. If the CMOs sign off the suggested recommendations, then the CMO Guidelines Writing Group will support the production of a final CMO Physical Activity Guidelines Report.

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