

Review

Prescribing exercise and physical activity to treat and manage health conditions

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Introduction

The significant health benefits of physical activity (PA), which includes exercise, have long been recognised.¹ As well as reducing non-communicable diseases (NCDs) such as heart disease, diabetes and specific cancers, regular physical activity leads to improvements in mental health and cognitive function. Shockingly, around 5 million deaths per year are attributable to physical inactivity.² Within the UK, this accounts for 1 in 6 deaths, which is on par with smoking. Of equal importance, it is estimated that 40% of long-term conditions could be prevented if the population successfully met the UK Chief Medical Officer's physical activity recommendations.³ Furthermore, once a chronic illness is diagnosed, treatment is better managed with physical activity as part of the disease medical management plan, leading to the idea that "exercise is medicine" and should be part of every treatment plan. Indeed there is objective evidence that exercise can be used as an effective first-line treatment for an array of cardiovascular, metabolic, musculoskeletal, psychiatric and neurological conditions.⁴

The social benefits of PA are also apparent. Within children, PA has been shown to play a key role in brain development and long-term educational attainment.⁵ Within society, it also boosts workplace productivity and can potentially reduce levels of crime.^{6,7}

Despite the importance of physical activity, there has been no improvement in global levels of physical activity since 2001. Indeed we are currently faced with an epidemic of physical inactivity, with the 2012 and 2016 Lancet series on physical activity revealing that over 25% (1.4 billion) of the world's adult population were physically inactive in 2016.⁸ So why are we so keen to manage modifiable risk factors such as hypertension and type 2 diabetes through pharmacological measures yet so averse to formulating a structured physical activity and exercise plan for our patients, with no consultant physicians in sport and exercise medicine employed within Northern Ireland to help manage this prescription? The main reason behind this is probably due to a perceived lack of knowledge on how to do this safely and effectively. Doctors should be morally obliged to address this apparent lack of understanding. Doctors not only have a duty of beneficence so that the best interest of the patient is always encouraged but also non-maleficence, that is, the duty to avoid unreasonable harm to patients. Indeed,

a lack of understanding of how to safely prescribe exercise might lead to an exercise intervention with a higher degree of relative risk.⁹

Therefore this article aims to outline the key considerations when making an exercise prescription, so that it can be tailored individually for each patient with the ultimate goal of increasing accessibility of PA for all. To do this, we will use examples to demonstrate what an exercise prescription may consist of in patients with a range of chronic conditions.

What is physical activity and exercise and how much should we recommend?

Physical activity (PA) can be defined as any bodily movement produced by skeletal muscles that requires energy expenditure. Already, this definition is important when considering how best to prescribe PA to patients. It should be emphasised that PA includes all movement, whether this involves structured exercise, occupational activity, housing and gardening, or even transport. Exercise is a subcategory of physical activity and it can be defined as any planned, structured, repetitive and intentional movement that is intended to improve or maintain physical fitness.

An effective exercise prescription aims to integrate physical activity back into the individual's daily life so that it becomes a daily habit, rather than a chore. This is especially true in communities where there are significant inequalities in health and a lack of access to resources such as gyms and leisure facilities.

At present, the World Health Organisation (WHO) recommends that all adults should undertake 150-300 min of moderate-intensity PA, or 75-150 min of vigorous-intensity PA, or some equivalent combination of moderate- and vigorous-intensity aerobic physical activity, per week.^{10,11} This recommendation is different for children, with the WHO recommending an average of 60 min/day of moderate-to-vigorous intensity aerobic PA across the week.¹⁰ Moderate PA refers to any activity that is performed at 3.0-5.9 times the

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intensity of rest, or around 60% of maximal effort. Examples include a brisk walk, mowing the lawn, heavy cleaning (e.g vacuuming or mopping), light cycling or recreational badminton. Vigorous PA refers to any activity that is performed at more than 6 times the intensity of rest, or >75% of maximal effort. Examples include jogging, cycling fast and playing football, basketball, or a tennis singles match. Patients may also find it difficult to gauge what is moderate or vigorous PA. It is therefore useful to use the “**talk-sing test**” as a relative measure of exertion.¹² Clinicians should explain that during moderate PA, they should be able to talk but not sing. Likewise, during vigorous PA, you should have difficulty talking more than a few single words in response to any questions.

It is also becoming increasingly common that individuals have access to smart watches that track their heart rate during activity and estimate maximum heart rate (HR_{max}). Moderate PA can be more objectively described as activity that results in a HR that is 60-75% of their HR_{max} , whilst vigorous activity is activity that results in a HR that 75-90% of their HR_{max} . To estimate maximum age-related heart rate, the patient's age should be subtracted from 220. For example, for a 40-year-old person, the estimated maximum age-related heart rate would be calculated as $220 - 40$ years = 180 beats per minute (bpm).¹³

Without full appreciation of the definition of physical activity, 150-300 minutes of physical activity may sound like a daunting task. However, when we explain to a patient that if almost all of this can be achieved within their daily routine, it becomes much more achievable. It is important to promote a biopsychosocial understanding of PA so that the individual views it as a measure to improve not only their physical health but also their psychological and social health. This way, patients are more likely to view PA as enjoyable and therefore sustainable.

Taking a physical activity history

This skill is as important as taking an effective cardiovascular history if the clinician is to formulate a successful management plan. Firstly, it is vital that we gauge how much PA the individual undertakes every week. This can be summarised by two questions:

- i) “How many days per week do you engage in moderate or vigorous PA?” and
- ii) “During these days, how many minutes of moderate or vigorous PA do you do?”.

Within primary care, clinicians may use the General Practice Physical Activity Questionnaire (GPPAQ), which provides a simple, 4-level Physical Activity Index (PAI) categorising patients as: Active, Moderately Active, Moderately Inactive, and Inactive.

The FITT (Frequency, Intensity, Time, Type) principle is a useful tool for providing a more detailed insight into the

individual's current level of physical activity, whilst also forming the basis for future prescriptions. This tool is vital as it gives the clinician a more objective insight into reported activity levels and allows us to differentiate those who overestimate their activity from those who underestimate it:

- Frequency: number of sessions per week;
- Intensity: perceived exertion e.g relative to walking, the ‘talk-sing’ test or heart rate data (if available);
- Timing: duration of sessions;
- Type: aerobic, resistance, lifestyle activity changes etc.

As well as this, it may be useful to identify the settings that the individual achieves most of their weekly PA and exercise sessions. This includes further exploration into structured exercise (e.g by using the FITT principle) but also occupational PA levels. This could include such questions as:

1. What is the individual's job?
2. How long do they spend sitting in work?
3. What activities are they required to do in work?

This will allow the clinician to identify what areas to target when formulating a physical activity and exercise prescription, for example, encouraging exercise when commuting to work.

Clinicians often worry about prescribing exercise in those who may be at increased risk of adverse health conditions as a direct consequence of exercise and PA. Lack of knowledge in this area may lead to a further barrier to increasing individual PA levels and unnecessary referrals to secondary care for medical clearance prior to commencing a new PA and/or exercise programme. Vigorous-intensity exercise does have a small but measurable acute risk of cardiovascular complications. Consequently, it is still vital that we minimise this risk in susceptible individuals.¹⁴ This paradox should not prevent the clinician from prescribing exercise as the long-term beneficial effects of exercise far outweigh the acute risks.¹⁵

Indeed a recent landmark study found that higher levels of leisure-time physical activity were associated with a lower risk of mortality at any given level of coronary artery calcification.¹⁶

Clinicians must ask relevant questions to ascertain those who may be at increased risk from certain types of exercise. Important medical issues to consider include history of cardiovascular disease, renal disease, pulmonary disease, anaemia, cancer, pregnancy, and musculoskeletal disorders. Like any other medical history, ascertain if there is any relevant family history, such as sudden cardiac death or congenital heart disease, which may require further investigation before a PA prescription is started. Medications



used may also impact your proposed prescription. For example, if someone was on anti-coagulant medications, you would be advising against any contact sports or indeed cycling with the risk of head trauma! The Physical Activity Readiness-Questionnaire (PAR-Q) or American College of Sports Medicine (ACSM) Pre-participation Screening Questionnaire can be used to identify individuals who are at higher risk of the adverse outcomes related to exercise. The ACSM guidelines seek to simplify this process by eliminating the need for medical clearance and/or exercise testing in many individuals, especially when low- to moderate-intensity exercise and PA is contemplated.¹⁷ If an individual is thought to be at increased risk of adverse outcomes due to positive responses within the PAR-Q, the Physical Activity Readiness Medical Examination (PARmed-X) tool can be used to convey clearance for PA participation or prompt referral to a medically-supervised exercise programme.

In essence, if individuals understand their exercise tolerance, self-monitoring procedures and relevant prodromal symptoms, clinicians can safely prescribe exercise with confidence that the benefits far outweigh any potential risk. Within any exercise programme, patient safety can be achieved by a gradual progression of intensity, during which the individual remains within the limits of their exercise tolerance. This further promotes the importance of the FITT principle when prescribing exercise and the need for a tailored exercise programme for the individual based on their co-morbidities and personal preference.

How do I effectively prescribe exercise?

For an exercise prescription to work, it must be tailored to the individual. There are a number of key factors that the clinician must take into consideration when formulating an exercise prescription. These are listed below.

1. Take an exercise history – as above

Gauge how much PA an individual does per week with reference to the FITT principle.

Ask questions to determine a person's motivation and barriers to PA.

It is important that the clinician asks the individual about their reasons for being active and the unique barriers that have prevented them from being active in the past. For instance, someone may want to become more active to improve weight management, reduce risk of ill-health, reduce stress, promote enjoyment or a combination of the above. Common barriers include perceived lack of time or resources, lack of motivation or a fear regarding their physical health. It is important to discuss these common barriers with the patient and think of simple solutions to overcome them. For example, if time is an issue, can the person walk or cycle to and from work rather than always driving or walk/cycle with friends in the evening after work? This would also have the added benefit of combining socialisation with their PA and

exercise regimens.

It is also useful to determine the individual's preferences. How does the individual want to increase their levels of PA? For example, would they like to do this via group activities, outdoor versus indoor, general lifestyle changes or in relation to work? What type of exercise do they prefer – aerobic, resistance or a combination?

2. Identify any contraindications using PAR-Q/ PAEmed-X and refer on those who require medical clearance or a medically supervised exercise programme to a sport and exercise medicine consultant.

3. Use the FITT principle to formulate an effective yet realistic PA programme.

In this way, an exercise prescription should be the same as any other pharmacological medicine; it should be of the right class, the benefits should outweigh the drawbacks, and it should be prescribed at the correct dose and frequency to optimise compliance. Different exercise types (such as aerobic activities, resistance training and balance/proprioceptive exercises) serve different purposes and can all be effective. What is more important is that the type of exercise prescribed is perceived as enjoyable to the individual, increasing the likelihood that they will continue with it long-term. One difficulty some clinicians may have is a lack of knowledge of specific resistance exercises to prescribe and this can be overcome by seeking advice from, e.g. local gyms and recognised instructors in the area. Indeed, within the Belfast Trust, patients can access a local gym for 12 weeks 'free' of charge through the 'Healthwise' scheme if they have certain health conditions, such as high blood pressure, mental health issues or being overweight.¹⁸ This may be one way of introducing patients to formal exercise and gym routines through a supervised programme. It has proven to be hugely successful in the formulation of individual goals and encouragement of long-term physical activity in a safe and professional environment. Additionally, there are a variety of online resources available that utilise body weight and elastic bands that could be shown to patients if they wish to use this format of resistance exercise. Example workouts are available on YouTube or alternatively the NHS website.¹⁹ Individuals can also use housework as a form of resistance exercise, such as lifting boxes or shovelling. If desired, this can be incorporated directly into the individual's exercise prescription.

4. Give advice to reduce sedentary behaviour

When it comes to increasing activity levels, the premise that "every little helps" should be actively encouraged. Simple lifestyle measures, such as walking up the stairs instead of using the lift or standing whilst undertaking meetings at home, help to reduce sedentary behaviour, which has been proven to be associated with increased all-cause mortality, independent of PA levels.²⁰

Worked examples

1. Type 2 diabetes mellitus (T2DM)

A 48 year old man, Eugene, presents to your morning clinic for a diabetic review. His recent HbA1c values have all been >70mmol/m despite dual therapy of metformin and sitagliptin. When you ask him about his physical activity levels, he reports that he works in an office and finds it difficult to find time for exercise when he gets home from work due to family commitments. He wants to become more active to help control his diabetes whilst also setting a good example for his children. You reassure him that type 2 diabetes mellitus can be better controlled with regular physical activity and exercise and indeed, even reversed with appropriate lifestyle management, including appropriate weight loss.²¹ You complete the GPPAQ and the PAI indicates that he is “inactive”. Despite living only half a mile away from his workplace, he drives to work. He states that he likes walking and resistance exercise but doesn’t have the time to join a gym. You decide to prescribe him an exercise programme.

The global prevalence of T2DM is predicted to increase from 171 million individuals (2.8%) in 2000 to 336 million (4.4%) in 2030.²² Exercise is one of the key management strategies of T2DM, however, unlike pharmacological therapies, it is often neglected within patient’s medical management plans. Acute exercise activates alternative molecular signals that can bypass defects in insulin signalling in skeletal muscle, resulting in an insulin-independent increase in glucose uptake.²³ Indeed a Cochrane review, including 377 patients with T2DM found that 8-10 months of exercise in the form of progressive aerobic training, strength training or a combination of the two led to a significant improvement in glycaemic control when compared to the control group, even if no weight loss was achieved.²⁴ **More specifically, the exercise group saw a reduction of HbA1c of 0.6% which was the same as metformin if used over the same period.**²⁵

The first step is to ensure you have taken an accurate exercise history and rule out any medical contraindications so that he can commence an unsupervised exercise programme. The ACSM risk stratification tool recommends that metabolic disorders such as diabetes should have a thorough medical examination and graded exercise testing before moderate or vigorous PA. As previously stated, using the PARmed-X tool provides a safe foundation for allowing commencement of exercise. If you feel that this individual is at higher risk, you should recommend a gradual increase in PA levels and educate him regarding self-monitoring procedures and relevant prodromal symptoms when he should seek medical review. Important symptoms to inform the patient to be aware of are chest pain, palpitations, a feeling of faintness/dizziness, nausea, or dyspnoea in excess of what would be expected from that level of PA.

In the case of diabetes, it is also important to warn the patient of symptoms related to hypoglycaemia when exercising, such as dizziness, shakiness, visual changes, confusion or a difficulty concentrating. This is particularly important in patients who are prescribed medication that increase their risk of experiencing hypoglycaemia, for example insulin, SGLT-2 inhibitors and sulfonylureas.

Looking at this case, Eugene’s main motivation for increasing his physical activity levels is to improve his glycaemic control and set a positive example for his children. Simple education that exercise can be as effective as the medication he is currently using may further motivate Eugene to persist with PA longer term. It is also important to prescribe exercise that he enjoys and in a way that overcomes his current barriers; time and family commitments.

In this gentleman, there is a preference for low-moderate intensity aerobic exercise and resistance exercise. Evidence has shown that a combination of aerobic and resistance exercise is most beneficial for glycaemic control.²⁶ Interestingly, more recent research has revealed a significant benefit of high-intensity exercise.²⁷ However, in someone who is previously inactive, it is more useful to start an exercise regime that he is likely to continue long-term as well as starting low, building up his physical activity and conditioning before initiating more vigorous activity. Once regular exercise is established into his life, it might be worth discussing the additional benefits of high intensity exercise.

With all this in mind, here is an example of an exercise prescription for him using the FITT principle:

Frequency: On 3 days per week Monday to Friday - Walk to and back from work; perhaps also walk children to school if time permits.

On 1-2 days per week: Resistance-type training with family. Provide Eugene with several resistance-band workouts or links to YouTube videos. Encourage him to do this with his children after school or at the weekends. He can also build this resistance work into his walks, for example with walking lunges for periods of the walk. Eugene would also qualify for the ‘Healthwise’ gym referral scheme and this could help him initiate the resistance exercises.

Intensity: Walk at moderate pace; using the talk test, he should be able to talk but not sing when walking and doing his resistance workouts. It is best to recommend a graded approach. Past research has shown that an initial increase of 2,500 steps per day is achievable for inactive patients²⁸ and this could be monitored through the use of a pedometer, which counts steps taken each day by the patient and the daily step counts then recorded in a diary. Work with the patient and make self-set targets, with a target of 10,000 steps per day being an achievable target longer term.



Timing: Walking should take 30 mins per day if done when commuting to work. He should aim to walk between 90-120 mins per week.

Resistance workouts should take 30 mins at moderate intensity. To meet his PA guidelines, he should aim for 150 mins per week of either walking or moderate intensity resistance training.

Type: As above – combination of moderate aerobic and resistance exercise

Most importantly, this exercise prescription is tailored for Eugene. It includes the exercise type and intensity that he enjoys and aims to fit this into his daily routine so that it becomes a habit. A pedometer device has been utilised to allow him to track his progress and a diary should be kept of his daily step counts, which can then be objectively reviewed by health and fitness professionals. One of his motivations for exercising was to set a good example for his children. By walking to school and engaging in resistance-type workouts with them, he is setting a good example whilst also using exercise as a tool to increase family-time.

You may also recommend strategies for Eugene to minimise his sedentary time, such as standing in work, for example using a standing desk rather than the traditional sitting desks, or taking the stairs instead of the lift. It is vital that you arrange a follow-up appointment to monitor Eugene's progress and then agree future goals and targets as appropriate progress is made.

2. Osteoarthritis (OA)

A 63-year-old female, Niamh, presents with worsening pain in her right knee which she attributes to her 'wear and tear' arthritis. She enjoys running and used to run marathons but states that she has avoided exercise recently as she doesn't want to make her arthritis worse. She doesn't enjoy resistance training as much but is willing to try this. As a result, she has put on weight and now has a BMI of 31. She has had no reduction in pain with simple analgesics but wants to exercise to help improve her knee joint stiffness. You arrange a consultation to educate her about the role of PA in OA and prescribe an exercise regime.

OA affects around 8.5 million people in the UK and can significantly affect patients' quality of life.²⁹ A common misconception in osteoarthritis patients is that physical activity and exercise will aggravate their symptoms and accelerate the disease process. Recent research has shown that knee joint loading exercise is not harmful to articular cartilage health in people at increased risk of, or with, knee OA.³⁰ As well as the benefits exercise has for general health, a Cochrane review shows that the benefits of exercise in OA outweigh those of simple analgesics.³¹ Clinicians should take time to educate their patients as it is a common misconception that exercise will exacerbate symptoms and reassure them that exercise/PA will be a key part of their osteoarthritis management plan. It is also important to recognise that pain is

a modifiable symptom influenced by many biopsychosocial factors of which many can be managed non-surgically. Nevertheless, it is important to get the right prescription for the individual patient and programs must be personalized and adjusted to the patient's phenotype.³²

With OA, a combination of both aerobic and resistance exercise would also be useful as well as general stretching to reduce stiffness. Aerobic exercise is an effective way to achieve weight loss, which would offload any excess strain on her knee, with weight loss being shown to reduce pain in knee OA.^{33,34} Resistance exercise would maximise joint stability by increasing strength of surrounding muscles. In turn, this will improve function and reduce pain. Patients with OA are very much heterogeneous and will respond to exercise types differently. This supports the case for early follow-up to monitor pain and make recommendations based on early trials of various exercise types. For example, in OA affecting the knee, it is acceptable to have a discomfort in the knee which is self-graded as 3 or 4 out of 10 when walking or running but if above 7 out of 10, you should consider changing to an alternative activity such as cycling, Nordic skiing or swimming. It is important to stress that pain during therapeutic exercise for chronic musculoskeletal pain need not be a barrier to successful outcomes, with a systematic review showing that exercises where pain is allowed/encouraged have a small but significant benefit for pain and function over pain-free exercises in the short term.³⁵ In Niamh's case, you should also encourage that she engages in flexibility work, such as regular stretching at work or at home, as this will help maintain joint range of motion and minimise stiffness.

Here is an example exercise prescription using the FITT principle for Niamh:

Frequency: 5 sessions per week; mixed aerobic and resistance training

Intensity: This should be tailored to Niamh's level of pain. If she can run at a moderate pace (talk but not sing) with minimal exacerbation of symptoms, recommend that she tries this, especially as she has enjoyed this in the past. She may need to decrease the intensity to walking pace 1-2 times per week initially to ensure her pain is well controlled. Alternatively, she could change her aerobic exercise to another form, such as cycling and swimming, based on patient preferences. Also encourage at least one session of moderate resistance training per week.

Timing: To meet the PA guidelines, Niamh should aim for 150 mins per week of either moderate intensity aerobic or resistance training. Talk to her about how best she might split this up during the week.

Type: As above – combination of moderate aerobic and resistance exercise. It would be useful if you recommend that Niamh makes a diary of her activities so that she can identify the activities that trigger pain, so that she can avoid them. If running aggravates her symptoms, recommend that

she tries cycling or swimming as a form of aerobic exercise.

Conclusion

In conclusion, the benefits of exercise and the power of prescribing exercise should not be underestimated. PA is a vital primary treatment for several chronic diseases and is a cost-effective way to reduce population morbidity and mortality. Indeed, physical activity and exercise prescription should be a part of every patient's treatment plan, but the prescription needs to be individualised to their needs. Despite this, clinicians often feel like they lack the knowledge or confidence to prescribe an effective exercise regime for their patients. It is time that we move away from simply asking if our patients are active and provide them with individualised and objective physical activity methods so that they can meet the recommended physical activity guidelines and optimise their overall health. One way to achieve this is for a consultant-led sport medicine service to host clinics that can prescribe physical activity and exercise for different health conditions as well as helping to educate colleagues around 'exercise is medicine'.

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