Supplementary file 1. Rapid evidence review

SUMMARY OF EVIDENCE REVIEW PROCESS

A rapid review of the literature was done to establish what is known about the risks of physical activity (PA) and exercise in people with long-term conditions (LTCs). This was presented to the steering group during the consultation phase. Once the symptom-based approach and clinical priorities for the consensus statement were established by the steering group, this review was used in the creation of the symptom-specific evidence statements.

AIMS OF EVIDENCE REVIEW

Provide an overview of existing guidelines and/or recommendations that address the risks of PA for people with long-term conditions, including:

- 1. What has previously been done to understand the associated risks?
- 2. What conclusions or consensus were reached?
- 3. How were conclusions or consensus reached?

Where possible, and using the findings from Aim 1, summarise the nature and incidence of recognised risks (morbidity and mortality) from physical activity by long-term conditions.

METHODS

The approach adopted for this review was a Rapid Evidence Review. This reflected both the nature of the question, and the time and resources available.

In terms of selecting relevant literature the following AGREE II criteria were used:

- Target population: adults (18-64 years) and older adults (65 years+), patients with one or more chronic condition undertaking physical activity;
- Study designs: position statements', 'consensus statements', 'guidelines' and 'recommendations';
- Comparisons: not applicable;
- Outcomes: quantified or qualified risks of physical activity;
- · Language: Available in English;
- Context: not applicable.

The online search was conducted in September-October 2019 using four major databases including PubMed, Google Scholar, Scopus and Web of Science. The chronic conditions listed on the Moving Medicine website were used as search terms, and included: 'cancer', 'COPD' ('chronic obstructive pulmonary disease'), 'dementia', 'depression', 'falls' and 'frailty', 'inflammatory rheumatic disease', 'ischaemic heart disease', 'musculoskeletal pain', 'type 2 diabetes mellitus'. Additional search terms including 'mental health', 'rheumatoid arthritis', 'heart disease' and 'cardiovascular disease' were used to ensure that publications were not excluded due to different nomenclature used in different countries.

Furthermore, the search also included conditions/symptoms that are typically associated with the chronic conditions listed on the Moving Medicine website; including 'Parkinson's disease', 'Alzheimer's disease', 'osteoarthritis', 'high blood pressure', 'hypertension', 'obesity', 'lower back pain'. The search terms 'adults' and 'older adults' were used to assess risk of physical activity under the heading of 'primary prevention'. Papers that reported on children and adolescents exclusively were excluded, as well as publications that exclusively covered conditions including fibromyalgia, HIV/AIDs and palliative care.

The search was targeted to 'position statements', 'consensus statements', 'guidelines' and 'recommendations' regarding PA and exercise prescription within each condition mentioned above. Search statements used (though not limited to) included: 'position statement on physical activity in (insert condition)', 'risks associated with being physically active', 'risks with physical activity prescription', 'risks with exercise prescription', 'practical considerations exercise prescription in (insert condition)' and 'consensus on the risks associated with physical activity'.

For publications where an academic body or organisation (such as the American Diabetes Association, ADA; or American College of Sports Medicine, ACSM) had more than one guideline or position statement, the most recent version was used.

In addition to the search for peer-reviewed publications and towards the end of the review process, an additional search for foundations, charities, and organisations that provide PA guidance for people with chronic conditions in the United Kingdom (UK) was conducted. Search statements for this component of the review process included, but were not limited to, statements such as '(insert condition) and physical activity UK', exercise and (insert condition) UK' and 'exercise prescription in (insert condition) UK'. It is important to note that the organisations and foundations identified in this component of the search process do not always give recommendations or discuss risk based on sound scientific evidence. For this reason, the results of this search are kept separate from the results generated from the primary search described above.

SUMMARY OF RESULTS

The findings of this rapid review suggest that there are condition-specific risks associated with the prescription of PA and/or exercise. However, these risks are outweighed by the benefits of PA for all conditions covered by this review. There is variability between conditions in terms of what has been done, and the specificity of recommendations or guidance.

The evidence is supportive of good prescription practice that involves a patient-centred approach, whereby PA and exercise prescription is tailored to the needs of the patient. A patient-centred approach can be demonstrated in several ways, such as:

- Knowing if and when supervised PA/exercise is required;
- Understanding the condition of the patient according to their symptoms, and not according to their diagnosis or disease exclusively;
- Considering the level of function of a patient according to their physical capabilities within their disease, and not according to their disease exclusively.

RESULTS IN RESPONSE TO AIMS

a) What has previously been done to understand the associated risks of physical activity in people with long-term conditions?

Seventy-nine relevant reports (reviews, consensus statements, position statements or guidelines) from around the globe were identified as relevant to this question. An overview of the work reviewed is shown in Table 1. It is worth noting that several references consider more than one condition. An overview of the search for foundations and/or organisations that provide PA guidance for people with chronic conditions is also shown in Table 1.

The majority of reports screened for this review primarily emphasise and report on the benefits of PA and/or exercise, and only some addressed the associated risks. When risks are addressed, (i) they are treated as secondary to the benefits; and (ii) they are not always specific to the condition in question.[1]

b) What conclusions or consensus were reached?

When risk is reported, it is discussed in one of three main ways:

- 1. The risks of PA are weighed against benefits, and the benefits of PA are usually stated to be greater than any potential risks;
- 2. Generic risks of PA or exercise-induced injury, that would also apply to a healthy population, are reported more often than condition specific risks;[2]
- 3. The risks of PA are addressed in a way that is not necessarily backed by empirical scientific evidence, but rather using a 'common sense' approach.

Specific risks and considerations as outlined in the various documents are summarised by condition in Table 1.

c) How were conclusions or consensus reached?

For the publications and documents included in this review, conclusions and consensus has been reached in the following ways:

- 1. For review papers (where recommendations are made following the either systematic or non-systematic review of evidence) the statements are "evidence based" though not always condition specific;
- For consensus statements, position statements or guidelines, the consensus has been reached following panel discussions. The panels are either made up of medical professionals/clinicians, researchers/academics or a combination. No statements based on Delphi methods have been identified in this review;
- 3. For some publications including guidelines and position statements, the conclusion has been drawn based on expert opinions. These experts are professionals/clinicians, researchers/academics or a combination

Table 1: Overview of literature reviewed and findings, shown by disease.

Condition and	Summary of findings	Additional PA considerations	Relevant UK Organisations
references			
Cancer [3–13]	There is no evidence to suggest that PA may worsen the condition of an individual with cancer or undergoing cancer treatment. The risks associated with cancer largely depend on the type and site of cancer (e.g., physical activity following a surgery close to the arms may need to be adjusted). Overall, individuals with cancer are encouraged to exercise as tolerated, and to pay attention to signs/symptoms and the state of their immune system. Specific signs/symptoms or considerations to be aware of include lymphoedema, pain, and chemotherapy-induced peripheral neuropathy. Exercising while supervised may be required.	-Presence of lymphoedema -History of surgery -Presence of pain -Presence of chemotherapy-induced peripheral neuropathy -Be aware of the area affected by the cancer – particularly for bone cancer (for risk of fracture) -Exercise as tolerated (presence of signs/symptoms and state of immune system is particularly important) -Supervision may be required	-Cancer Research UK Exercise Guidelines -The BASES Expert Statement on Exercise and Cancer Survivorship -MacMillan Cancer Support Guidance -NHS – Guys and Thomas -Pancreatic Cancer UK Information and Support -Prostate Cancer UK Guidance -Lymphoma Action UK Guidance -Breast Cancer Now Information
COPD [3,4,6,7,14-21]	An important consideration for patients with COPD is the severity of the condition. As the severity of the condition increases, the level of risk increases. For high-risk, symptomatic COPD patients, PA should be replaced with pulmonary rehabilitation, in which case supervision may be required. There is evidence that PA should be avoided due to increased risk in COPD patients during an infective episode or if the patient is in the immediate recovery phase of an exacerbation. If a COPD patient exercises as tolerated and in a manner that is tailored to their condition, and in an environment that is not polluted, there is no evidence to suggest that PA may worsen the condition of an individual with COPD.	-Timing of exacerbations -Risk of infections -Co-morbidities -Exercise as tolerated (presence of symptoms is particularly important) -Supervision may be required -Prescription of exercise should be tailored	-British Lung Foundation <u>Support</u> -NHS Inform <u>Living with COPD</u>
Dementia [3,4,6,7,22–24]	There is no evidence to suggest that PA may worsen the condition of an individual with dementia. However, exercise and/or PA should be made safer for individuals with dementia, as these individuals tend to have issues related to forgetfulness, balance, gait, and proprioception. Furthermore, these issues can worsen as the disease progresses and therefore the stage of the disease is an important consideration. Prescription of PA should be tailored to the needs of the individual and should be supervised when needed.	-Forgetfulness during activities -Safety related to balance, gait and proprioception -Stage of the disease is important -Tailored prescription as per the needs of an older adults (where applicable -Supervision may be required	-Alzeimer's Society United Against Dementia Guidance -Department of Health: 'Nothing Ventured, Nothing Gained': Risk guidance for people with dementia

Depression	There is evidence that a low risk of 'physical activity dependence'	-Source of depression (linked to self-	-Mind <u>Tips</u>
[6,7,25–29]	exists in the general population, and this risk may be somewhat	esteem and also eating disorders)	-Mental Health Foundation
	higher for people with depression. However, this is extremely rare	-Link timing of PA and exercise to	Guidance
	overall. There is also evidence that PA should not be prescribed to	depressive symptoms	
	an underweight depressed individual as there is a potential link	-Exercise dependence (and therefore a	
	with disordered eating. Provided that an individual with depression	negative motivation)	
	exercises or is physically active in an environment or setting that is		
	not related to the source or trigger of the depression (e.g.,		
	avoiding group activities for someone with social phobia) and is		
	not underweight due to an eating disorder, there is no evidence to		
	suggest that PA may worsen the depressive condition of an		
	individual with depression.		
Falls and Frailty	There is evidence that anyone who exercises or engages in PA	-Exercise (in general) increases acute risk	-Age UK guidance for older adults
[3,4,16,30–37]	incurs some risk for an adverse event (including a fall with	of falls (and potentially fractures)	and guidance for falls prevention
	fracture), but this is at any age. Exercise and PA prescription should	-Presence of other diseases (Multi-	-National Osteoporosis Society /
	be tailored according to the individual's physical condition, level of	morbidity)	Royal Osteoporosis Society and
	function and presence of other disease(s) or disability. Supervision	-Older adulthood is a special	British Geriatrics Society
	may be required for some individuals, and risk may be attenuated	consideration and level of function is	<u>Consensus statement</u>
	by making exercise and/or PA safe through changes to the home	important	
	environment, selecting appropriate exercise equipment and	-Supervision may be required	
	footwear.	-Safety (in terms of the home, exercise	
		equipment and footwear) should be	
		considered.	
Inflammatory	There is risk of harming a joint if improper technique is used when	-Supervision may be required	-National Rheumatoid Arthritis
Rheumatic	stretching, exercising and being physically active, especially if there	-Presence of joint pain	Society <u>Guidance</u>
Disease	is existing inflammation. In this regard, supervision may be	-Footwear is potentially important	-ARMA: Arthritis and
[3,4,6,16,38–	required. Exercise and/or PA should be tailored according to the	-Tailor exercise as per the needs and	Musculoskeletal Alliance
42]	individual's physical condition (including the weight status of the	preference of patient, as well as disease	<u>Guidance</u>
	patient), level of disability, the degree of pain and inflammation	activity (inflammation)	-Versus Arthritis, Arthritis
	present in the joints needing exercise, as well as the personal	-Be aware of medications and	Research UK <u>Policy Position</u>
	preference of the patient. Another potential consideration is that	interactions with PA	
	of drug therapy (and the interactions with PA). It is necessary for	-Discomfort and pain post-exercise is	
	post-exercise discomfort and pain to inform following exercise	important to inform following exercise	
	sessions. While some muscle soreness (or stiffness) is expected for	sessions	
	an individual who is untrained, prescription should change if	-Overweight or obesity may limit choice	
	symptoms of the disease worsen.	of PA/exercise	

Supplemental material

Ischaemic	Supervision during exercise and/or PA is recommended for	-Supervision is recommended	-Heart UK (Cholesterol Society)
Heart Disease	patients with heart disease, especially higher-risk patients, who	-Acute risk of adverse event	Guidance
[3,4,6,7,16,43-	may also require monitoring throughout their PA and/or exercise.	-Higher-risk patients need supervision	-Cardiomyopathy UK Guidance
49]	It is important to be aware of medications and the interactions	and monitoring	-British Heart Foundation
	with PA (e.g., beta-blockers attenuate heart rate response).	-Be aware of medications and	<u>Information</u>
	Hypertensive patients should avoid the Valsalva manoeuvre during	interactions with PA	
	resistance training, and exercise should be avoided in the case of	-Presence of other diseases and	
	systolic BP >180 mmHg and/or diastolic BP >105 mmHg. There is	conditions (particularly hypertension and	
	evidence that anyone who exercises or engages in PA incurs some	obesity)	
	risk for an adverse event. However, the evidence suggests that it is	-Hypertensive patients should avoid the	
	unlikely that a cardiac event that occurs during or soon after	Valsalva manoeuvre during resistance	
	exercise is because of the exercise. Rather, it is likely that the	training. Exercise to be avoided in the	
	individual had an underlying condition that was exacerbated by	case of systolic BP >180 mmHg or	
	exercise. Exceeding the recommended dose of exercise or PA may	diastolic BP >105 mmHg	
	increase the risk for recurrent cardiovascular events. Provided that		
	a heart disease patient exercises within their limitations and are		
	risk-stratified correctly, there is no evidence to suggest that PA		
	may worsen the condition of an individual with heart disease.		
Musculo-	For lower back pain specifically, it is important to determine	-Differences between pain that is acute	-ARMA: Arthritis and
skeletal pain	whether the pain is acute or chronic. Thus, obtaining an accurate	vs. chronic. Exercise not always indicated	Musculoskeletal Alliance
[3,4,6,7,16,50-	diagnosis is important before prescribing exercise or PA. Exercise	for acute back pain. Diagnosis is	<u>Guidance</u>
53]	should not be prescribed for individuals with acute lower back	important before prescribing exercise or	-Versus Arthritis, Arthritis
	pain. Abdominal bracing may cause further harm in some back	PA	Research UK Policy Position
	conditions and is therefore not recommended. Walking downhill	-Tailored prescription of exercise	
	may aggravate symptoms in individuals with spinal stenosis. For	-Abdominal bracing may cause further	
	individuals with other forms of musculoskeletal pain, the evidence	harm in some back conditions	
	suggests that appropriate PA (that is tailored to the individual) is	-Walking downhill may aggravate	
	unlikely to cause harm.	symptoms in individuals with spinal	
		stenosis.	
		-Risk of increasing damage	
		-Risk of increasing pain	
Type 2	For type 2 diabetic patients, supervision is recommended	-Supervision is recommended	-Diabetes UK <u>Guidance</u>
Diabetes	depending on symptom severity. Tailored PA and/or exercise	-Tailored prescription necessary	-My Diabetes, My Way Scotland
[3,4,6,16,44,54–	prescription is necessary. The evidence suggests that diabetic	-Presence of peripheral neuropathy	NHS <u>Guidance</u>
63]	individuals with neuropathy (autonomic and peripheral) and	(footwear is important in this regard)	
	retinopathy may be at an increased risk of injury during PA and/or	-Presence of autonomic neuropathy	

	exercise. For patients presenting with retinopathy, the Valsalva	-Presence of retinopathy (patients	
	manoeuvre during resistance training, and high-impact vigorous	should avoid the Valsalva manoeuvre	
	exercise, should be avoided. Footwear is important for diabetic	during resistance training, and high-	
	patients. Additionally, diabetic individuals with poorly controlled	impact vigorous exercise)	
	glycaemia may need to modify their PA and exercise, as well as	-Risk of hypo- and hyper-glycaemia	
	note their carbohydrate intake. Patients with diabetes are often	-Be aware of medications and	
	overweight or obese and so it is important to note the presence of	interactions with PA (also note	
	other diseases, and to also be aware of prescribed medications.	carbohydrate intake)	
	Provided that a patient with diabetes is examined effectively (to	-Presence of other diseases and	
	determine the optimal dose when weighing risks versus benefits,	conditions (particularly obesity)	
	e.g., running may be better for biological outcomes but may		
	increase risk of injury), there is no evidence to suggest that PA may		
	worsen the diabetic condition of an individual.		
Primary	For adults and older adults that are 'apparently healthy', there is	-Acute risk of adverse event during	-
Prevention	an acute risk of adverse event during vigorous exercise. There is	vigorous exercise	
[1-3,64-77]	also a general risk of (musculoskeletal) injury during vigorous	-General risk of injury (musculoskeletal	
	activity for all healthy people, and this is reduced by proper	injury) for all healthy people exists.	
	warming-up, stretching, strength training, and balance training. It	Reduced by warming-up, stretching,	
	is important to note that the risk of injury is relative to the size of	strength training, and balance training.	
	the increase in PA and that older age, as well as previous injury,	The risk of injury is related to the size of	
	increases risk of further injury. There is evidence that there is an	the increase in activity.	
	attenuation (and perhaps a reversal) of benefits in the case of too	-Previous injury increases risk of further	
	much PA is a risk. However, "too much" is defined as being at the	injury	
	extreme of the PA continuum (e.g., people who participate in ultra-	-In older adults, risk of injury is increased	
	endurance events and who reserve little time for adequate rest).	(by comparison to adults due to limited	
		functional ability, previous inactivity,	
		previous illness)	
		-Too much PA is a risk: there is an	
		attenuation (and perhaps a reversal) of	
		benefits at the extreme of the PA	
		continuum (people who participate in	
		ultra-endurance events and/or reserve	
		little time for adequate rest)	
Multi morbidity		-Tailored prescription necessary	-
[6,78]		-Be aware of any competing diseases.	

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