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Article in *Clinical journal of sport medicine: official journal of the Canadian Academy of Sport Medicine* · July 2016

DOI: 10.1097/JSM.0000000000000363

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Physical Activity Prescription: A Critical Opportunity to Address a Modifiable Risk Factor for the Prevention and Management of Chronic Disease: A Position Statement by the Canadian Academy of Sport and Exercise Medicine

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(*Clin J Sport Med* 2016;26:259–265)

INTRODUCTION

Noncommunicable disease is a leading threat to global health. Physical inactivity is a large contributor to this problem; in fact, the World Health Organization ranks it as the fourth leading risk factor for overall morbidity and mortality worldwide.¹ In Canada, at least 4 out of 5 adults do not meet the Canadian Physical Activity Guidelines of 150 minutes of moderate-to-vigorous physical activity (MVPA) per week.^{2,3}

Prescription of physical activity (PA) is a key element of the multifaceted societal approach needed to address inactivity.^{4,5} Substantial evidence exists to support the benefits of exercise on at least 30 chronic diseases^{6–10} and the cost-effectiveness of exercise prescription in primary care,^{11,12} even for cardiovascular (CV) disease alone.¹³

Physicians play an important role in the dissemination of PA recommendations to a broad segment of the population. Over 80% of Canadians visit their doctors every year and prefer to get health information directly from their family physician.^{14,15} Unfortunately, most physicians do not regularly assess or prescribe PA as part of routine care,^{16–18} and even when discussed, few provide specific recommendations.¹⁹

Physical activity prescription has the potential to be an important therapeutic agent for all ages in primary, secondary,

and tertiary prevention of chronic disease. Sport and exercise medicine (SEM) physicians are particularly well suited for this role and should collaborate with their primary care colleagues for optimal patient care. We must act now to correct the general lack of knowledge and training in our medical schools and residency programs surrounding PA guidelines and prescription^{20–23} as well. The purpose of this Canadian Academy and Sport and Exercise Medicine (CASEM) position statement is therefore to provide an evidence-based best practices summary to better equip SEM and primary care physicians to prescribe PA and exercise, specifically for the prevention and management of noncommunicable disease. This will be achieved by addressing common questions and perceived barriers in the field.

DEFINITIONS

Both PA, defined as “any bodily movement produced by skeletal muscle,” and exercise, which generally involves structured activity to improve a certain aspect of fitness,²⁴ confer benefits with respect to chronic disease. Physical activity is further categorized as light, moderate, and vigorous (Table). Sport is one form of delivery of both PA and exercise but is not the focus of this statement.

How Effective Is Exercise Prescription by Primary Care Physicians?

Exercise prescription is effective at increasing PA levels^{26–28} and can generate positive clinical outcomes, such as reduced blood pressure and glycosylated hemoglobin,^{29–31} and also important positive effects on mental health,^{32–34} reducing risk of depression,³⁵ and improving cognitive function in older adults with dementia and Alzheimer disease (AD).³⁶ From an effectiveness standpoint, the number needed to treat (NNT) for one person to achieve the recommended adult PA guidelines of 150 minutes of MVPA per week through brief physician counseling is 12.³⁷ This is at least 4-fold lower than the clinical effort to achieve a comparable health benefit of a smoker to quit smoking, which has an NNT of 50 to 120.²⁷

Challenges exist, such as time constraints, complex comorbidities, perceived lack of patient engagement, and a lack of physician training or education on particulars of PA

Submitted for publication April 26, 2016; accepted April 28, 2016.

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This Position Statement will be co-published in the *British Journal of Sport Medicine*.

This Position Statement has been endorsed by the following sport medicine societies: ACSEP, AMSSM, BASEM, CASEM, ECOSEP, NIMF, SASMA, SDrA, SFAIM, SGSM/SSMS.

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TABLE. Descriptors of Physical Activity

Intensity	Objective Measures	What Patient Feels*	Typical Examples
Sedentary	<1.6 METs <40% HRmax <20% $\dot{V}O_{2max}$	At rest with limited added movement	Sitting and reading Watching TV Driving a car
Light	1.6-3.0 METs 40%-55% HRmax	Active No noticeable change in breathing/sweating	Slow walking (eg, around the house) Light work while standing (eg, cooking, washing dishes)
Moderate	20%-40% $\dot{V}O_{2max}$ 3-6 METs 55%-70% HRmax 40%-60% $\dot{V}O_{2max}$	Can be sustained for 1 h or more Increased breathing and sweating Still able to maintain a conversation. Can sustain activity for 30-60 min	Playing an instrument Brisk walk Low movement racquet games (eg, doubles tennis, recreational badminton) Water aerobics Resistance exercise Mowing the lawn
Vigorous	6-9 METs 70%-90% HRmax 60%-85% $\dot{V}O_{2max}$	Feeling "out of breath" Increased sweating Can be difficult to maintain a conversation Can sustain activity for up to 30 min	Jogging Hiking Swimming with effort Higher movement racquet games (eg, singles tennis, squash) Field/ball games (eg, soccer, basketball) Cross-country skiing Shoveling
High	≥9 METs ≥90% HRmax ≥85% $\dot{V}O_{2max}$	Feels like giving 100% All-out bursts between 1-2 min Intensity cannot be sustained for more than 10 min	Training/competing in most competitive sports Racing or any all-out activity (eg, running, rowing, swimming, skiing, high-intensity intervals)

*These descriptions do not generally apply for symptomatic Chronic Obstructive Pulmonary Disease patients. MET values for high-intensity activity may not be achievable for many patients with chronic disease, in which case HRmax or $\dot{V}O_{2max}$ values are advised.

HRmax, theoretical maximal heart rate; MET, metabolic equivalent of task (1 MET = the energy to lie/sit quietly); usually estimated as $(220 - \text{age}) \times 0.9$; $\dot{V}O_{2max}$, maximal oxygen uptake. Adapted from Norton et al.⁵⁵ Adaptations are themselves works protected by copyright. So to publish this adaptation, authorization must be obtained both from the owner of the copyright in the original work and from the owner of copyright in the translation or adaptation.

counseling. Some promising examples exist however, such as the 2008 study by Courneya et al,³⁸ eliciting high rates of adherence to exercise prescription in cancer patients. Exercise prescription is cost effective and can increase PA by 10% in relatively inactive patients,^{13,37-39} a number which recent Canadian evaluations have estimated could save ~2.1 billion dollars per year in health care and other costs if adopted at the population level.^{41,42}

Such counseling becomes even more effective in a range of situations in which (1) there is an increased risk of chronic disease; (2) the encounter includes an individual assessment of needs, motivation, habits, preferences, and barriers; (3) the message and goals are clear, simple, and realistic; (4) valid behavioral change approaches are used; and (5) proper follow-up, self-monitoring, and social support are available.²⁷ Medical practitioners' own PA habits influence their practice of PA history taking and exercise prescription as well.¹⁸

What Are the Key Messages That Should Be Given Regarding the Effective Dose of Exercise for the Prevention and Treatment of Chronic Disease?

In a landmark *British Medical Journal* article examining the head-to-head effects of medication versus PA/exercise

in chronic disease, authors Naci and Ioannidis⁴³ from Stanford University made a strong case for equivalent or superior effect of the health benefits of PA (Box 1). In particular, PA interventions were more effective than drug treatment among patients with stroke and were as effective as medications for the prevention of diabetes and secondary treatment of CV disease. Physical activity can be as effective as medications for the treatment of depression⁴⁴ and has a potent effect on cognitive function in dementia in patients with AD and in patients with a diagnosis of AD or non-AD dementia.³⁶

Several high-level systematic reviews have also identified risk reductions of 25% to 50% or more in most major chronic diseases for individuals who achieve 150 minutes of MVPA per week.^{9,27,45,46} A systematic review of 9 cohort studies with a mean follow-up of 9.8 years⁴⁷ and 2 recent prospective studies on large population cohorts (661 137 adults in the United States and Europe and 204 542 adults in Australia, followed for 14 and 8 years, respectively) demonstrated clear dose-response effects of PA to overall mortality^{48,49}; each 10 minutes of MVPA accumulated per day led to an approximately 10% relative risk reduction in mortality, up to 32% to 44% relative risk reduction at 150 minutes MVPA per week, depending on the amount of vigorous activity as part of the MVPA. The dose-response effect seems to

BOX 1. Key Messages for Patients During the Discussion of the Health Benefits of PA

- Exercise is more effective than medication for the treatment of stroke and as effective for the secondary prevention of coronary heart disease and diabetes.
- One hundred fifty minutes of MVPA accumulated per week can reduce the risk of most major chronic diseases by 25% to 50%.
- Fifteen minutes of MVPA per day (or 75 min/wk) is associated with an ~15% relative mortality risk reduction, and benefits increase with the dose.

plateau at a 50% to 60% reduction at 3 to 5 times the Guidelines (ie, 750 min/wk), and there is no evidence of increased mortality at high levels of PA in generally healthy individuals.

Although this target of 150 minutes may seem out of reach for many who are sedentary, studies have shown significant benefits for those who complete even small amounts of PA. The biggest positive change in health risk is in going from inactive to somewhat active (ie, 75-90 min/wk), resulting in a 15% reduction in mortality risk.^{27,50} Simply reducing sedentary behavior confers short- and long-term health benefits,^{51,52} whereas prolonged sedentary time in adults leads to adverse health outcomes independent of physical activity.⁵³

Long-Term Efficacy

Adherence to PA (as with other lifestyle modifications) tends to decrease at 1 year, yet can be sustained when activity is repeated,⁵⁴ or combined with community supports.⁵⁵ The Diabetes Prevention Program (DPP) observed maintenance of adaptations and reduced diabetes incidence 10 years after intensive support for PA during the study,⁵⁶ as was the case with a similar DPP in China^{57,58} which elicited reduced CV and all-cause mortality and incidence of diabetes at 20 years. The most cost-effective and practical option is brief PA counseling through primary care, which is proven effective at improving PA levels at 12 months after the intervention.²⁷ Multiple sessions may extend this time period even further,⁵⁴ as does exercise performed under supervision.⁵⁹

How Can Brief Exercise Assessment and Prescription Be Integrated in Primary Care?

There is evidence that a 2 to 4 minutes intervention in primary care effectively promotes PA.⁶⁰ Asking 2 simple questions regarding current PA (the exercise “vital sign” “EVS”) at each visit can further inform effective counseling: (1) “On average, how many days per week do you engage in moderate or greater physical activity (like a brisk walk)?” (2) “On those days, how many minutes do you engage in activity at this level?”⁶¹ Regular EVS monitoring can change physician behavior and improve patients’ risk of disease.⁶² If the physician has more time than that of a typical family practice appointment, motivational interviewing is an

effective method to raise the possibility of any behavioral intervention.^{10,63}

A written prescription (which comprises exercise and lifestyle goals) is a crucial element to signal that PA and exercise can be therapeutic.⁶⁴ For patients with stable conditions, general practitioners can provide customized exercise prescription. Incorporating discussions surrounding use of advanced technology⁶⁵ is discussed later in this article. Healthy patients are encouraged to join community-based programs and may exercise independently without supervision. Physical activity guidelines should also be prominent in the waiting room.

Physicians who do not have training in exercise prescription may refer to skilled allied health professionals and to appropriate community-based resources (Box 2). Follow-up is crucial, however, to signal the clinician’s conviction, determine the patient’s progress, solve problems, help identify social support, fine-tune the dose, and reset goals.

What Terminology and Examples Can Be Used to Describe Physical Activity Intensity to Patients?

Effective counseling requires physicians to clearly explain to their patients what is meant by terms like “MVPA” and advise on ways to limit sedentary behavior. Different PA intensities are described in Table.

Activities that correspond to any given level of intensity will change with the degree of an individual’s CV fitness; for example, once a previously untrained patient has been regularly active at a moderate intensity through walking for several weeks, what counts as brisk at first may become a lighter intensity exercise.

What Are the Safety Considerations Before Initiation of an Exercise Prescription?

For healthy patients, a gradual progression toward regular MVPA is safe and recommended. Participation in light to moderate exercise confers very little risk and can be “self-administered,” akin to an over-the-counter medication.⁶⁶ For those with stable asymptomatic CV, metabolic, or renal disease, medical clearance is not needed for patients already active but recommended for those who are inactive. Although

BOX 2. Practical Steps for Immediate Exercise Prescription

- Ask about PA at every consultation.
- A written prescription building toward accumulating 150 min/wk is crucial—it takes just 30 seconds to do this.
- Encourage the patient to measure (eg, pedometer, smart phone) and record their PA (paper, mobile app).
- Refer on as appropriate—consider appropriate physicians, physiotherapists, clinical exercise physiologists, kinesiologists, and certified fitness instructors.
- Follow-up with the patient to chart progress, set goals, solve problems, and identify and use social support.

these 2 categories represent the majority of patients in a typical primary care practice, physicians are often concerned with CV risk in patients with more serious conditions.

Self-screening instruments, such as the Physical Activity Readiness Questionnaire⁶⁷ or the American College of Sport Medicine health screening guidelines⁶⁸ direct people to a physician for further evaluation when current symptoms suggestive of CV, metabolic, or renal disease or complex comorbidities are present. In these cases, the physician should evaluate the clinical condition of the patient through a history and physical examination that will focus on contraindications to exercise. Patients with unstable angina, uncharacterized arrhythmias, or decompensated heart failure should not perform vigorous exercise before their conditions stabilize. Physical examination should focus on significant clinical signs, such as a heart murmur, pulmonary overload, or severe hypertension (resting blood pressure >200/110 mm Hg), which can indicate potential heightened risk.^{37,69}

The estimated prevalence of complications requiring hospitalization (including serious arrhythmias), acute myocardial infarction, or sudden cardiac death (SCD) during or immediately after a stress test are $\leq 0.2\%$, 0.04% , and 0.01% , respectively.⁷⁰ Vigorous intensity exercise acutely, albeit transiently, increases CV events.⁷¹ In a prospective study of sport-related SCD in the general population, however, the incidence of SCD was estimated to be 4.6 per million population per year or 0.00046% .⁷² Based on these numbers, it can be concluded that the gradual progression toward MVPA by a sedentary patient with stable chronic conditions and a normal history and physical is associated with such a low rate of CV events that further formal CV testing is not indicated.

High-Intensity Interval Training

Recently, high-intensity interval training has been promoted based on several systematic reviews^{73,74} showing greater benefits on CV fitness compared with lower intensity continuous training. High-intensity interval training involves alternate bursts of short intense PA interspersed with recovery periods and seems to be safe for rehabilitation of patients with coronary artery disease and heart failure,⁷⁵ although there are conflicting opinions in the literature as to its effectiveness and safety for population-level exercise.⁷⁶ For patients considered at higher CV risk, stress testing is advised (Box 3).

BOX 3. Key Messages Regarding CV Safety

- For generally healthy individuals, moderate exercise is safe. If inactive, begin with lower intensity and progress in duration and intensity over time.
- Progression toward recommended volumes of MVPA can be prescribed to patients with chronic disease. If inactive initially, a normal clinical evaluation is recommended. If already active, medical clearance is recommended before engaging in vigorous activities.
- Initiation of high-intensity physical activity, such as high-intensity interval training, should be preceded by establishing a “base fitness level” over several weeks through regular MVPA.⁷⁷

Is It Safe to Prescribe Exercise if My Patient Has Osteoarthritis (OA) or Other Comorbidities?

Several recent systematic reviews demonstrate that aerobic and resistance exercises will not result in increased pain or disability in patients with OA.^{78–81} In fact, both types of training generally reduce pain and increase function, further supporting the expert consensus recommendations that PA should be part of management.^{82–84}

Regarding individualized adaptation of exercise prescription to specific chronic disease, the reader is referred to the free online textbook provided by the Swedish Institute of Public Health¹⁰ and 2 recent review articles.^{9,85} In general, as mentioned earlier, if the patient has 1 or 2 stable chronic diseases and is otherwise healthy, PA can be self-administered, with a gradual progression toward the adult PA guidelines.

Which Tools Can Help Patients Adopt Active Behaviors?

Although the ubiquity of mobile phones and wearable technology may present a simpler method for clinicians to assess and promote active behaviors in primary care, the evidence in this area is still underdeveloped.⁸⁶ Meta-analysis of pedometer use demonstrates average increases of over 2000 steps in participants’ steps per day.⁸⁷ Step count targets for adults, using a guide of 100 steps per minute as “moderate intensity,” are in the range of approximately 7100 to 11 000 steps per day, with <5000 steps a day leading to adverse health outcomes⁸⁸; therefore, this can represent a significant improvement.

Data extraction may be time consuming for both patient and clinician, however, which may explain low levels of user adoption despite the benefits of many PA monitors. Individuals using wearable technology to improve their health exhibit the most consistent usage when tracking is simple and automatic.⁸⁹ Other technologies that may improve adherence to PA are text messaging⁹⁰ and “exergames.”^{91,92} Advances in the field of mobile apps for PA monitoring for health will inevitably continue and become more user friendly for both patients and doctors. Physicians are encouraged to be flexible and creative in their adoption of new devices to this end.

How Can Exercise Professionals Contribute to the Implementation of an Active Lifestyle?

The role of exercise professionals through physician referral of patients must be carefully considered so that an additional burden of treatment such as added costs for the patient or ease of access limitations do not raise barriers to integration of daily PA. Avoiding these and other potential obstacles is of particular concern for lower socioeconomic groups; medical professionals must be aware that those most at risk of disease are often the least able to afford the cure. In most cases, physicians should feel enabled to prescribe physical activity without referral, assuming appropriate safety considerations are made and gradual introduction of physical activity for the sedentary patient is advised. Nevertheless,

physicians are encouraged to identify potential partners within their communities (eg, local recreation centers, sports programs, walking/running groups) to build effective networks for patient referral and/or direction when desired.

Exercise professionals and other PA facilitators can be important members of an integrated approach to design and delivery of interventions, although experts point to the lack of evidence and sustainability for exercise referral schemes.^{93–96} Referral to a qualified exercise professional is most indicated for patients with conditions classified as high risk of morbidity and mortality associated with lack of PA (CV disease, type 2 diabetes) and special populations that would benefit from PA but have difficulty engaging because of low motivation or safety concerns (patients with cancer, epilepsy, or pulmonary disease). In many patients with chronic disease such as diabetes, exercise programs are most effective when supervised.⁹⁷ Therefore, the role of the exercise professional is to ensure not only safety and adaptation to ability level of the patient but also accountability for maximal treatment efficacy.

It is important to remember that patient empowerment is essential and the physician must communicate his or her belief that the patient is capable of change. Considerations should be made for the education and awareness building for the patient, family, and support network as part of the total program.

CONCLUSIONS

Primary care providers, and particularly SEM physicians, have an important opportunity to make PA an integral component of the prevention and treatment of chronic disease. It is the position of the CASEM that all SEM and primary care physicians should include PA assessment and prescription as part of routine health care for patients, and this should be a priority for training and education at every level of medicine.

Recommendations from physicians influence patient engagement and improve the likelihood of adoption. Canadian Academy and Sport and Exercise Medicine further recommends that clinicians lead by example and integrate physical activity into their own lives not only for their own health and well-being but also to provide further credibility and empathy for the challenges patients face.

Physical inactivity is and will remain one of the gravest threats to public health for this and future generations of Canadians unless a catalyst for change can be found. With a simple prescription for PA, front line physicians have one more tool to bring about real change in the lives of Canadians. With the evidence summarized in this review, the message is clear that PA prescription not only works but also costs less than relying on the alternatives alone. The time to act is now.

ACKNOWLEDGMENTS

The authors would like to thank Dr Amir Pakravan, Dr Jorge A. Ruivo, Dr Nikos Malliaropoulos, and Dr Hamish Osbourne for their thorough review of this manuscript before submission.

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