

IMPROVING PHYSICAL LITERACY FOR ADULTS WITH CHRONIC CONDITIONS

PhD Thesis – C. Petrusovski; McMaster University – School of Rehabilitation Science

**FRAMING PHYSICAL LITERACY THROUGH A REHABILITATION LENS: A
HEALTH PROMOTION ROLE FOR PHYSIOTHERAPISTS IN THE MANAGEMENT
OF CHRONIC CONDITIONS**

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for the Degree of Doctor of Philosophy in Rehabilitation Science

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TITLE: Framing Physical literacy through a Rehabilitation Lens: A Health Promotion Role for Physiotherapists in the Management of Chronic Conditions.

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LAY ABSTRACT

In Ontario, almost 80% of adults over the age of 45 are living with at least one chronic condition, such as diabetes, high blood pressure or arthritis. These conditions require on-going management and can cause challenges with one's function and mobility. Physical literacy is a term that is used commonly in schools and sports to describe the basic movement skills that children need to be active for life. It is unknown how physical literacy can help support adults with chronic conditions to improve their overall health. This thesis explored how physical literacy could improve function and mobility for adults and older adults with chronic conditions. The first study examined all the existing literature on adults and physical literacy. The second and third studies asked physiotherapy researchers and adults with chronic conditions what physical literacy means to them. The results of these studies found that there are different skills needed to become physically literate as an adult than what is needed to become a physically literate child. A new physical literacy model for adults was developed that guided an intervention study for adults with chronic conditions. Results of this intervention study found that a 5-week education program delivered virtually by a registered physiotherapist could improve adults' awareness of what physical literacy is, improve function and mobility outcomes and positively impact behaviours. The results of this thesis have provided a new way of thinking about physical literacy for adults and older adults. Physical literacy for adults involves self-monitoring movement, having knowledge of age-related changes, participating in meaningful, safe, and social movement activities, and understanding the benefits of physical activity for the management of chronic conditions.

ABSTRACT

Increasing access and improving knowledge of rehabilitation strategies is essential to address the adverse health outcomes related to the increased prevalence of multimorbidity with our aging population. Physical literacy is emerging as a strategy to increase lifelong participation in physical activity, however, there is limited research exploring how physical literacy can support optimal aging for adults with functional decline associated with chronic conditions. This thesis investigated how to frame physical literacy for adults through a rehabilitation lens and explored outcomes related to function, mobility, and health awareness as a result of a novel physical literacy intervention. The first study was an integrative review examining what is known about physical literacy for adults. Thirteen new physical literacy constructs emerged, that differed from the current physical literacy definition and addressed the needs of aging adults. Purposeful activities, knowledge of age-related changes and social interaction were identified as the top three. The objective of the second expert consensus study was to understand what components are required when acquiring physical literacy as an adult from the perspectives of healthcare professionals and researchers in optimal aging. The third qualitative study explored how adults with multimorbidity describe physical literacy for adults while considering barriers and facilitators associated with fluctuating health status. The findings from the preceding qualitative studies helped inform the program development of the fourth physical literacy intervention study and fostered a new rehabilitation focused Physical Literacy framework for Adults and adults with Chronic Conditions (PLACC). A pre-post study involving 20 adults with 2 or more conditions (95% female, 59 ± 6 years) participated in a 5-week multi-component, virtually delivered physical literacy group intervention. Post intervention significant improvements were

found for physical function ($p < 0.001$; Cohen's $D = 0.90$), as measured by the patient specific functional scale, mobility with the 4-meter walk test at self-selected speed ($p = 0.03$, Cohen's $D = 0.53$) and all 3 physical literacy awareness questions ($p = 0.001$, $p < 0.001$, $p = 0.001$). The results of this program of research can inform future public health interventions, involving rehabilitation focused physical literacy programs, designed by physiotherapists, and aimed at improving function and mobility for adults with chronic conditions.

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LIST OF DEFINITIONS

Health Behaviour: Any behaviour that impacts on people's physical and mental health and quality of life.

Functional Decline: An increased inability to perform basic activities of daily living (ADL) such as dressing and toileting and jeopardizes independence.

Health: A state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity.

Health literacy: The degree to which individuals have the capacity to obtain, process and understand basic health information and services needed to make appropriate health decisions.

Health Promotion: the process of enabling people to increase control over, and to improve their health.

Physical activity: Any voluntary movement produced by the body that requires energy expenditure

Physical function: participating in activities required essential to maintaining independence.

Physical Literacy: the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life.

Population health: an approach that (1) identifies systematic variations in interrelated conditions and factors that influence the health of populations over the life course; and (2) leverages the resulting knowledge to inform health promoting practices, programs, and policies

Preclinical disability: An intermediary stage between high and low functioning states where modifications to method or frequency of performing a task are implemented without any perceived difficulty performing the task.

Public health: the organized effort of society to keep people healthy and prevent injury, illness and premature death. It is a combination of programs, services and policies that protect and promote the health of all Canadians

Mobility: the ability to walk without assistance.

Multimorbidity: the coexistence of 2 or more chronic health conditions in an individual.

Rehabilitation: A set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment.

Self-management: having persons with chronic conditions engage in activities to protect their health, monitor and manage the symptoms of illness and manages the impact of illness on functioning along with the emotions and interpersonal relationships.

Self-management support: the systematic provision of education and supportive interventions by health care staff (and others) to increase patients' skills and confidence in managing their health problems, including regular assessment of progress and problems, goal setting and problem-solving support.

DECLARATION OF ACADEMIC ACHIEVEMENT

The following is a sandwich thesis that consists of 4 manuscripts (Chapters 2 through 5), each formatted and structured to meet the requirements of the individual journals to which they were submitted. I, Celeste Ann Petrusevski, contributed significantly to each of the included manuscripts, as such, I am the first author for all four included studies.

The candidate recognizes the contribution of Dr. Julie Richardson, Dr. Joy MacDermid and Dr. Mike Wilson in providing guidance, and key insights into the preparation of this thesis and the research process. Ashely Morgan contributed to the study selection, data selection and quality assessment process for the integrative review.

CHAPTER 1

THESIS INTRODUCTION

Thesis Introduction

Multimorbidity

The prevalence of multimorbidity, defined as the co-occurrence of two or more chronic conditions, continues to rise among individuals of all ages¹⁻³. Chronic conditions such as diabetes, heart disease, stroke and cancer are the leading cause of death in Canada⁴. Currently over 33% of adults (19-64 years) and 75% of older adults (≥ 65 years) report having one or more chronic condition⁵. As individuals age, the proportion of people with two or more chronic conditions increases steadily, indicating that older age is a risk factor for multimorbidity⁶. Health care utilization and costs associated with care of patients with multimorbidity are significant, due to the complexity of treatment required, and the coordination of care needed to manage multiple health concerns. People with multimorbidity experience various competing demands and are high users of the healthcare system, and are more likely to have frequent healthcare provider visits, homecare visits and hospital stays compared to individuals with no conditions^{6,7}. For example, a study by Broemeling et al, 2008 found that Canadians with two or more chronic conditions represented 12% of the population, however these individuals accounted for almost half (44%) of hospital days⁴. Multimorbidity is not characterized by any dominant combination of co-occurring conditions², however specific combinations of chronic conditions tend to cluster together, due to the common risk factors, such as poor nutrition, sedentary behaviour and smoking⁶. Individuals with arthritis or high blood pressure will commonly report heart disease or diabetes⁶. Certain clusters of conditions will have greater impacts on functional impairments, additionally, the greater number of chronic conditions is associated with an increased rate of functional impairments⁸.

Recent cross-sectional studies continue to demonstrate that the burden of multimorbidity is not experienced equally across the population^{3,9,10}. A study by Rosella et al, 2018 examining the association of multimorbidity with deaths in Ontario, found that chronic obstructive disease (COPD) and diabetes were the two conditions most prevalent in low-income areas⁹. These conditions are not associated with aging, but rather influenced by modifiable risk factors (smoking and obesity) that are rooted in social disadvantage. The majority of individuals in the health system are likely to struggle with multimorbidity at some point in their life. Upstream actions and population health approaches are needed to reduce the burden and disparities of multimorbidity and lessen the strains on the healthcare system.

The association of functional decline with multimorbidity and aging

It is well established that the prevalence of functional decline and mobility limitations are associated with multimorbidity¹¹⁻¹⁵. Functional decline, defined as a deterioration in self-care skills, with a loss of functional autonomy and an increase in mobility disability is associated with increased rates of depression, decreased life satisfaction and mortality rates^{16,17}. A systematic review examining multimorbidity and functional decline for community dwelling adults found that 77.8% of the included cohort studies reported that multimorbidity predicted functional decline over a period of one to six years¹¹. This review also noted a direct association between functional decline and the number of chronic conditions and the severity of health conditions¹¹. An increase in functional disability commonly occurs with multimorbidity because one's ability to compensate for a single condition is affected by competing comorbid conditions¹⁸. Additionally, the combination of the "big four" non-communicable conditions, (diabetes, cardiovascular disease, cancer and chronic lung disease) create confounding affects resulting in a higher risk of functional disability¹⁹.

Functional decline is a dynamic and progressive process, affected by the physiological aging process and resulting in changes to the physical, cognitive and social well-being of older adults²⁰. With age, muscle mass, muscle strength and physical performance tend to decline. Changes commonly begin to occur around middle age with an expected loss of 1.5% - 5% leg strength annually, starting at age 50²¹. Musculoskeletal changes that occur with aging, such as decreased lower extremity muscle strength, decreased endurance, impaired balance, decreased flexibility and pain can further contribute to functional and mobility limitations²².

Mobility limitations are defined as limitations in physical performance that precede more serious limitations of normal daily activity²³ and are commonly associated with one's walking ability, leading to an increased risk for social isolation²⁴. Several cohort studies have shown that walking speed predicts survival in older adults, independent of multimorbidity²⁵⁻²⁷. Additionally, walking speed is a reliable and valid rehabilitation outcome measure that can predict falls, fear of falling and the need for rehabilitation services for adults and older adults. A recent cohort study by Vetrano (2019) in Sweden, included 3241 participants (aged ≥ 60 years) and found that a slow walking speed ($<0.8\text{m/s}$) magnified the effect of cardiovascular and neuropsychiatric multimorbidity on mortality, independent of confounders over a short 3-to-5-year period²⁸. It is evident that functional and mobility status (i.e., walking speed) can mediate the association of multimorbidity and mortality, further demonstrating the need to assess functional status and provide interventions that target the mobility concerns of older adults and adults with chronic conditions²⁹.

Often times, adults are not aware of these functional changes until they drop below the functional performance threshold and they are unable to complete them anymore²⁰. There is increasing evidence demonstrating that function should be considered as a sixth vital sign and

assessed as a primary health outcome within primary care^{30,31}. It is important that rehabilitation professionals are involved in assisting with self-monitoring of functional changes and developing programs within the clinical, primary care and public health arenas that address the mobility changes that occur with aging and chronic conditions.

The management of chronic conditions

There is a wealth of evidence demonstrating that multimorbidity can be improved with prevention approaches to address risk factors such as inactivity and a sedentary lifestyle²²⁻³², however, only 11% of adults between 60 and 79 years meet the physical activity guidelines³³. New models of care have been developed which consider the complexities involved when managing multimorbidity³⁴ and collaborative efforts between the patient, healthcare providers, community and healthcare system are encouraged to optimize care. There is not a standardized treatment approach for multimorbidity, as healthcare strategies will differ to accommodate changes in impairment functions. It can be challenging for health professionals to determine where to target and focus the intervention. Understanding how to care for individuals with multimorbidity is an on-going challenge for our healthcare system. The Chronic Care Model (CCM), developed by Wagner (1996) is a framework including an organizational approach to caring for individuals with chronic conditions, specifically within primary care³⁵. Evidence has demonstrated that self-management support is the most frequently tested intervention within CCM framework and has demonstrated significant improvements for one or more outcome measure categories for most diseases³⁶.

Self-management (SM) can be defined as having persons with chronic conditions engage in activities to protect their health, monitor and manage the symptoms of illness and manages the impact of illness on functioning along with the emotions and interpersonal relationships³⁷.

Participants in SM programs acquire key skills, such as problem solving, action planning, overcoming barriers, accessing resources, self-monitoring and managing and developing relationships with healthcare providers³⁸. Rehabilitation experts, such as physiotherapists play an integral role in SM programs, specifically around removing barriers and increasing confidence with physical activity, fatigue management, posture, education and pain management³⁷.

However, further effort is needed to address the functional difficulties reported by persons with chronic conditions to improve health outcomes. The 2016 updated Cochrane review of interventions for multimorbidity in primary care found limited evidence for effectiveness³⁹.

Authors concluded there is a need to refine, refocus and improve the delivery of health services for adults with multimorbidity. For example, traditional self-management programs focus on the management of a single chronic condition (i.e., diabetes) which may undermine the coordination of care that is required for adults living with 2 or more conditions (i.e., diabetes, arthritis, and cardiovascular disease), specifically as this relates to functional and mobility challenges.

Programs designed for all individuals of all functional levels that maximize access and use of existing community, primary care, and public health resources and integrate physical activity with access to knowledge (i.e., optimal aging, rehabilitation strategies, self-monitoring, goal setting) and aim to improve one's physical literacy levels are required to address the public health crisis of multimorbidity.

Physical literacy for adults

Understanding the mobility and functional changes that occur with chronic conditions and encompassing the confidence and competence to self-address these changes require individuals to have physical literacy. There is not a clear consensus on the definition of physical literacy (PL), however the International Physical Literacy Association defines PL as “the

motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life”^{40,41}. The current PL definition has taken a health promotion approach through engagement in sports within the school curricula by engaging all children in purposeful sport activities to help create engagement with movement and activities. The PL constructs such as fundamental movement skills and physical competence are measured and compared along a continuum of child growth from kindergarten to high-school⁴².

The concept of PL has relevance to older adults, but the adaption of the concept to later in the lifespan is novel. Recent evidence indicates that PL applied to older adults involves developing knowledge, behavior and physical competency skills that optimize physical activity in the presence of aging, cumulative injury or comorbid health problems⁴³. It also requires a new set of skills aimed at self-monitoring of physical changes and the optimization of physical function as one experiences age-related physiological decline, or pain and loss of self-efficacy with movement, as a result of aging and chronic conditions. For example, a key component to becoming more physically literate for older adults living with osteoarthritis of the knee may be understanding the importance of correct knee alignment and learning to maintain the kinesthetic position while re-learning or learning new functional skills, such moving from sitting to standing⁴⁴. Other physical management might include the use of heat and ice in the management of inflammation and gait training to increase speed and efficiency with walking⁴⁵. Learning how to retain youth sports skills may not be as relevant to adults with knee OA as learning how to maintain leg power or manage inflammation with rehabilitation strategies and increasing awareness around new recreational sport activities that are safe for lower extremity limitations.

In addition, knowledge and understanding of physical literacy may go beyond learning the benefits of physical activity to also include learning and awareness of one's body and the changes that occur with aging and gaining knowledge on how to maintain participation in physical activity, despite health setbacks. Evidence suggests that maintaining PL becomes a critical component of healthy aging and maintaining independence^{43,46,47}. However, what is needed to become a physically literate adult will differ from what is needed to become a physically literate child. Further research is needed to understand how PL is defined for adults and older adults, including individuals with chronic conditions, mobility limitations and age-related changes.

Rehabilitation and physical literacy

Rehabilitation is defined as “a set of interventions designed to optimize functioning and reduce disability in individuals with health conditions in interaction with their environment”⁴⁸. Rehabilitation involves maintenance and restoration of function, which are key components to an increased quality of life for aging individuals⁴⁸. When people have timely access to rehabilitation services and/or the knowledge of rehabilitation strategies through PL programs, it can result in positive health outcomes and cost effectiveness, and extend the length of time that an individual can remain independent with a high quality of life⁴⁹.

The WHO Rehabilitation 2030: A Call to Action (2017) outlined the need for global action to upscale rehabilitation⁴⁸. This call to action includes integrating rehabilitation into all health systems (public health) and across all population groups. Within the context of health equity and infectious disease, rehabilitation and movement experts are being called upon, more than ever, “to transform society by optimizing movement to improve the human experience⁵⁰” (Jette, 2020 Physical Therapy Leadership Conference). Rehabilitation experts have the

opportunity to act as change agents for our healthcare field by promoting movement, rehabilitation knowledge and skills with a population health perspective to contribute to the global needs of our population^{51,52}. Building a physical literacy framework for adults and adults with multimorbidity that is framed through a rehabilitation lens and includes key evidence-based components that can optimize function and mobility, has potential to better address the needs of older people with complex conditions^{53,54}.

Physical Literacy as a health promotion strategy

Across the lifespan, PL is more critical for older adults and adults with chronic conditions than other age demographic^{43,46}. PL has been described as the gateway to physical activity for individuals of all ages^{43,46,55}. Therefore, building physically literate societies through health promotion initiatives can be considered a key opportunity in decreasing the prevalence and complications associated with multimorbidity^{56,57}. Cairney (2019) positions PL as a health and disease determinant, based on how public health promotes PL as a prevention model⁵⁶. Due to the low physical activity levels, specifically with older adults and adults with chronic conditions, as well as personal (motivation, attitude) and environmental factors, it is likely that the current adult and older adults population possess little knowledge of and engagement with PL⁴³.

The Ottawa Charter for Health Promotion defines health promotion as “the process of enabling people to increase control over, and to improve their health”⁵⁸. Health promotion is a prevention strategy that allows people to manage and positively affect their health. Physical literacy can be envisioned as a lifelong journey, in which individuals will experience changes in their physical competence, positive affect and motivation to participate in sustained movement activities. Physically literate adults and older adults will have the knowledge and awareness of how to increase control over their chronic conditions and the physiological aging process by

using movement, self-management, and rehabilitation strategies to improve their overall health. Future public health and physical activity promoting activities may benefit from changing the narrative to improving PL and building physically literate communities for adults and older adults. For example, the Canadian 24-Hour Movement Guidelines recommend that all adults (18 – 64 years and adults aged 65 years and older) accumulate at least 150 minutes of light, moderate or vigorous-intensity activity throughout the week, as well as strengthening, flexibility and balance exercises in order to obtain substantial health benefits^{59,60}. These new guidelines have expanded to also include recommendations for sedentary behaviour (limit sedentary activities to 8 hours/day) and sleep (accumulate 7-9 hours of sleep/night). The evidence-based guidelines are designed to provide a balanced approach to physical activity, sedentary behaviour and sleep across the whole 24-hour day⁵⁹. Results from the Canadian Health Surveys Data, including adults 18 – 79 years indicate that 43.9% of adults are meeting at least one of the recommendations, however less than 1 in 10 Canadians are meeting all 3 recommendations⁶¹. Future research is needed on how to effectively disseminate information to the public, such as behaviour change strategies, which can encourage the maintenance of recommended levels of physical activity over time, despite health challenges. Motivational strategies are also needed to encourage sedentary individuals to start exercising. For many, the word “exercise” has potentially negative perceptions, specifically for individuals experiencing pain and weakness. For the promotion of PL to be successful, it is the responsibility of all sectors (health services, education, sport, housing, and transportation) and stakeholders (policy makers, researchers, and educators) to be involved and support programs within various levels of prevention.

Population health approach to increasing physical literacy for adults

Upscaling rehabilitation principles and self-management skills to a population level for adults living with multimorbidity is essential to address the impact of mobility impairments secondary to aging and chronic conditions. Population health is defined as the “the health outcomes of a group of individuals, including the distribution of such outcomes with the group”⁶². According to Magnuson (2019), population health is a “strategy for understanding the health of populations” or an approach that “focuses on interrelated conditions and factors that influence the health of populations over the life course. It identifies systematic variations in their patterns of occurrence and applies resulting knowledge to develop and implement policies and actions to improve the health and well-being of populations”^{52,63}.

Before designing and delivering PL programs to disseminate across large population groups, it is important to recognize the social and environmental factors (i.e., education and safety) that are known to contribute substantially to a population’s health. Utilizing population health frameworks, such as the life course health development framework⁶⁴, which views health as a “dynamic, complex non-linear process” and the Ecological Model⁶⁵, which emphasize the environmental and policy settings, will add value in reaching individuals who are most in need. Socio-cultural norms and expectations should be considered in program planning. Policy developments that foster physically literate communities (designing neighborhoods that facilitate outdoor walking) are needed.

A public health role for physiotherapists

Even though the scope of practice for physiotherapy has traditionally focused within clinical practice and secondary and tertiary prevention, the physiotherapy profession continues to evolve to meet the needs of our aging population. In Ontario, physiotherapists have made an important contribution to primary health care as an integral member on family health teams and

carrying out health promotion programs, assessment and treatment triage, and screening activities⁶⁶. The physiotherapy profession is recognizing the limitations of condition-specific interventions for individuals when managing multimorbidity. Physiotherapists continue to be involved in health promotion activities within their practices (i.e., physical activity, fatigue management, stress management, pacing strategies., etc.) and take on both the provider and consultant role in specialized exercise and rehabilitation techniques, as well as education programs. Physiotherapists have the potential to encourage public health messages (i.e., physical literacy) and influence movement activities for adults who are experiencing functional and mobility limitations. A clearly defined public health role for physiotherapists is needed for the profession.

Physiotherapists have the potential to take on a leadership role in the public health sector by creating and executing evidence-based communication campaigns that share the benefit of PA in the management of chronic conditions and share key rehabilitation principles with the public. Physiotherapists can be more involved in top-down approaches by influencing policy makers and the physiotherapy curriculum, as well as lobbying and sharing a strong strategic vision for health promotion activities and building partnerships with community-based agencies and other healthcare organizations. Physical literacy programs for older adults and adults with multimorbidity, targeting mobility and functional limitations, and designed by physiotherapists within public health has potential to positively impact a large cohort of individuals who may be unaware of the rehabilitation and movement knowledge that can help them optimally self-manage their conditions throughout the lifespan.

Outline of Included manuscripts

To effectively design and deliver physical literacy programs it is important to first understand what critical components should be included when framing PL for adults and older adults. Therefore, a mixed methods program of research is presented that utilizes a sequential exploratory design. The first three chapters (integrative review, qualitative consensus study and qualitative interview study) are used to inform the fourth quantitative chapter (pre-post intervention study). **Chapter one** includes an integrative review and thematic synthesis of the current literature identifying what is known about PL for adults, in the context of addressing optimal physical function and mobility. **Chapter 2** includes an online-facilitated consensus study with identified rehabilitation and aging experts. The purpose of this expert consensus study is to use a nominal group technique to understand how PL is characterized from the perspectives of primary care physiotherapists, rehabilitation researchers and public health experts. **Chapter 3** includes a semi-structured interview study with working and retired adults who are living with 2 or more chronic conditions. The objective of this qualitative study is to explore how adults with multiple chronic conditions describe PL for adults and to understand the needs, preferences, barriers, and facilitators to acquiring and maintaining PL despite fluctuations in health status. **Chapter 4**, a pre-post intervention study was guided by the findings of the previous 3 chapters and the **Physical Literacy for Adults and adults with Chronic Conditions (PLACC)** framework, developed from the synthesis of the previous program of research. The purpose of this study is to investigate the effect of a novel, multi-modal knowledge translation PL intervention, among adults with multimorbidity. The objective of developing and delivering this innovative rehabilitation focused community intervention is to inform future public health interventions and demonstrate the benefit of improving PL as a health promotion approach.

Overall objective of thesis

The primary objectives of this project were:

1. To appraise, summarize and synthesize the current literature on physical literacy and adults to understand the key components required to acquiring physical literacy as an adult.
2. To understand how physical literacy is characterized and the barriers and facilitators to becoming a physically literate adult from the perspectives of rehabilitation and research experts, as well as adults and older adults living with multimorbidity.
3. To design a physical literacy intervention for adults with multimorbidity by integrating theory and evidence with knowledge users and provider perspectives and determine intervention effectiveness on key health and awareness outcomes.

References

1. Steffler M, Li Y, Weir S, et al. Trends in prevalence of chronic disease and multimorbidity in Ontario, Canada. *C Can Med Assoc J*. 2021;193(8):E270-E277. doi:10.1503/cmaj.201473
2. Koné Pefoyo AJ, Bronskill SE, Gruneir A, et al. The increasing burden and complexity of multimorbidity. *BMC Public Health*. 2015;15(1):415. doi:10.1186/s12889-015-1733-2
3. Ryan B, Bray Jenkyn K, Shariff S, et al. Beyond the grey tsunami: a cross-sectional population-based study of multimorbidity in Ontario. 109(5-6), 845–854. *Can J public Heal*. 2018;109(5-6):845-854. <https://doi.org/10.17269/s41997-018-0103-0>.
4. Branchard B, Deb-Rinker P, Dubois A, et al. At-a-glance - How Healthy are Canadians? A brief update TT - Aperçu - Quel est l'état de santé des Canadiens? Brève mise à jour. *Heal Promot chronic Dis Prev Canada Res policy Pract*. 2018;38(10):385-387. doi:10.24095/hpcdp.38.10.05
5. Statistics Canada. Aging and Chronic Diseases: A profile of Canadian Seniors. <https://www.canada.ca/en/public-health/services/publications/diseases-conditions/aging-chronic-diseases-profile-canadian-seniors-report.html>. Published 2021. Accessed June 15, 2022.
6. Broemeling A-M, Watson DE, Prebtani F. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: implications for policy and practice. *Healthc Q*. 2008;11(3):70-76. doi:10.12927/hcq.2008.19859
7. Barnett K, Mercer S, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37-43. doi:10.1016/S0140-6736(12)60240-2.

8. Dunlop DD, Lyons JS, Manheim LM, Song J. Arthritis and Heart Disease as Risk Factors for Major. 2004;42(6):502-511. doi:10.1097/01.mlr.0000127997.51128.81
9. Rosella L, Kornas K, Huang A, Bornbaum C, Henry D, Wodchis WP. Accumulation Of Chronic Conditions At The Time Of Death Increased In Ontario From 1994 To 2013. *Health Aff (Millwood)*. 2018;37(3):464-472. <https://doi.org/10.1377/hlthaff.2017.1150>.
10. Tetzlaff J, Epping J, Sperlich S, Eberhard S, Stahmeyer JT, Geyer S. Widening inequalities in multimorbidity? Time trends among the working population between 2005 and 2015 based on German health insurance data. *Int J Equity Health*. 2018;17(1):103. doi:10.1186/s12939-018-0815-z
11. Ryan A, Wallace E, O'Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes*. 2015;13(1):168. doi:10.1186/s12955-015-0355-9
12. Shumway-Cook A, Patla A, Stewart A, Ferrucci L, Ciol MA, Guralnik JM. Environmental Components of Mobility Disability in Community-Living Older Persons. *J Am Geriatr Soc*. 2003;51(3):393-398.
13. Melzer D, Gardener E, Guralnik JM. Mobility disability in the middle-aged: cross-sectional associations in the English Longitudinal Study of Ageing. *Age Ageing*. 2005;34(6):594-602. doi:10.1093/ageing/afi188
14. Guralnik JM, Ferrucci L, Simonsick EM, Salive ME, Wallace RB. Lower-Extremity Function in Persons over the Age of 70 Years as a Predictor of Subsequent Disability. *N Engl J Med*. 1995;332(9):556-562. doi:10.1056/NEJM199503023320902
15. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: A systematic review of the literature. *Ageing Res Rev*. 2011;10(4):430-439.

doi:<https://doi.org/10.1016/j.arr.2011.03.003>

16. Ní Mhaoláin AM, Gallagher D, O Connell H, et al. Subjective well-being amongst community-dwelling elders: what determines satisfaction with life? Findings from the Dublin Healthy Aging Study. *Int Psychogeriatrics*. 2012;24(2):316-323. doi:DOI: 10.1017/S1041610211001360
17. Koyano W, Shibata H, Haga H, Suyama Y. Prevalence and outcome of low ADL and incontinence among the elderly: Five years follow-up in a Japanese urban community. *Arch Gerontol Geriatr*. 1986;5(3):197-206. doi:[https://doi.org/10.1016/0167-4943\(86\)90022-1](https://doi.org/10.1016/0167-4943(86)90022-1)
18. Colón-Emeric C, Whitson H, Pavon J, Hoenig H. Functional decline in older adults. *Am Fam Physician*. 2013;88(6):388-394. pmid: 24134046; PMCID: PMC3955056.
19. Fong JH. Disability incidence and functional decline among older adults with major chronic diseases. *BMC Geriatr*. 2019;19(1):323. doi:10.1186/s12877-019-1348-z
20. Fried LP, Bandeen-Roche K, Chaves PH, Johnson B a. Preclinical mobility disability predicts incident mobility disability in older women. *J Gerontol A Biol Sci Med Sci*. 2000;55(1):M43-M52. doi:Research Support, Non-U.S. Gov't Research Support, U.S. Gov't, P.H.S.
21. Keller K, Engelhardt M. Strength and muscle mass loss with aging process. Age and strength loss. *Muscles Ligaments and Tendons J*. 2014;3(4):346-350. pmid: 24596700; PMCID: PMC3940510.
22. de Vries NM, van Ravensberg CD, Hobbelen JSM, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with

- impaired mobility, physical disability and/or multi-morbidity: A meta-analysis. *Ageing Res Rev.* 2012;11(1):136-149. doi:10.1016/j.arr.2011.11.002
23. World Health Organization ICF-The International classification of functioning, disability and health. Geneva: World Health Organization, 2005. [Google Scholar].
 24. Satariano W, Guralnik J, Jackson R, Marottoli R, Phelan E, Prohaska T. Mobility and aging: new directions for public health action. *Am J Public Health.* 2012;102(8):1508-1515. <https://doi.org/10.2105/AJPH.2011.300631>.
 25. Fritz S, Lusardi M. White Paper: “Walking Speed: the Sixth Vital Sign.” *J Geriatr Phys Ther.* 2009;32(2).
https://journals.lww.com/jgpt/Fulltext/2009/32020/White_Paper___Walking_Speed_the_Sixth_Vital_Sign_.2.aspx.
 26. Hardy S, Perera S, Roumani Y, Chandler J, Studenski S. Improvement in usual gait speed predicts better survival in older adults. *J Am Geriatr Soc.* 2007;55:1727-1734.
 27. Studenski S, Perera S, Patel K, Rosano C, Faulkner K, Inzitari M. Gait speed and survival in older adults. *JAMA J Am Med Assoc.* 2011;305(1):50-58.
 28. Vetrano D, Rizzuto D, Calderón-Larrañaga A, et al. Walking Speed Drives the Prognosis of Older Adults with Cardiovascular and Neuropsychiatric Multimorbidity. *Am J Med.* 2019;132(10):1207-1215.e6. <https://doi.org/10.1016/j.amjmed.2019.05.005>.
 29. Nunes BP, Flores TR, Mielke GI, Thumé E, Facchini LA. Multimorbidity and mortality in older adults: A systematic review and meta-analysis. *Arch Gerontol Geriatr.* 2016;67:130-138. doi:<https://doi.org/10.1016/j.archger.2016.07.008>
 30. Richardson J, Letts L, Chan D, et al. Monitoring physical functioning as the sixth vital sign : evaluating patient and practice engagement in chronic illness care in a primary care

- setting – a quasi-experimental design. *BMC Fam Pract.* 2012;13(1):29. doi:10.1186/1471-2296-13-29
31. Middleton A, Fritz SL, Lusardi M. Walking speed: the functional vital sign. *J Aging Phys Act.* 2015;23(2):314-322. doi:10.1123/japa.2013-0236
 32. Halbert CH, Bellamy S, Briggs V, et al. Effects of aerobic exercise training in community-based subjects aged 80 and older: a pilot study. *Prev Med (Baltim).* 2016;46(5):134 p-134 p. doi:10.1177/1090198115577378
 33. Statistics Canada. <https://www150.statcan.gc.ca/n1/pub/82-625-x/2015001/article/14189-eng.htm>. Published 2014.
 34. Wagner EH, Austin BT, Davis C. Improving Chronic Illness Care: Translating Evidence Into Action. 2001.
 35. Wagner EH, Austin BT, Von Korff M. Organizing Care for Patients with Chronic Illness. *Milbank Q.* 1996;74(4):511-544. doi:10.2307/3350391
 36. Reynolds R, Dennis S, I H. A systematic review of chronic disease management interventions in primary care. *BMC Fam Pract.* 2018;19(1):11. doi:10.1186/s12875-017-0692-3
 37. Richardson J, Loyola-Sanchez A, Sinclair S, et al. Self-management interventions for chronic disease: a systematic scoping review. *Clin Rehabil.* 2014;28(11):1067-1077. doi:10.1177/0269215514532478
 38. Lorig KR, Holman HR. Self-management education: history, definition, outcomes, and mechanisms. *Ann Behav Med.* 2003;26(1):1–7. doi:10.1207/S15324796ABM2601_01
 39. Smith S, Wallace E, O’Dowd T, Fortin M. Interventions for improving outcomes in patients with multimorbidity in primary care and community settings. *Cochrane database*

- Syst Rev.* 2016;3(3):CD006560. <https://doi.org/10.1002/14651858.CD006560.pub3>.
40. International Physical Literacy Association. <https://www.physical-literacy.org.uk/>.
Published 2014.
 41. Whitehead M. The concept of physical literacy. *Eur J Phys Educ.* 2001;6:127-138.
 42. Giblin S, Collins D, Button C. Physical Literacy: Importance, Assessment and Future Directions. *Sport Med.* 2014;44:117-1184. doi:10.1007/s40279-014-0205-7
 43. Jones GR, Stathokostas L, Young BW, et al. Development of a physical literacy model for older adults -- a consensus process by the collaborative working group on physical literacy for older Canadians. *BMC Geriatr.* 2018;18(1):13. doi:10.1186/s12877-017-0687-x
 44. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee: a Cochrane systematic review. *Br J Sports Med.* 2015;49(24):1554 LP - 1557. doi:10.1136/bjsports-2015-095424
 45. Uritani D, Koda H, Sugita S. Effects of self-management education programmes on self-efficacy for osteoarthritis of the knee: a systematic review of randomised controlled trials. *BMC Musculoskelet Disord.* 2021;22(1):515. doi:10.1186/s12891-021-04399-y
 46. Higgs C, Cairney J, Jurbala P, Dudley D, Way R, Mitchell D. *Developing Physical Literacy: Building a New Normal for All Canadians. Physical Literacy in the Adult and Older Years.*; 2019. https://sportforlife.ca/wp-content/uploads/2019/09/DPL-2_EN_web_November_2019-1.pdf.
 47. Dudley D, Cairney J, Wainwright N, Kriellaars D. Critical Considerations for Physical Literacy Policy in Public Health, Recreation, Sport and Education Agencies. *Quest.* 2017;69(4):436-452. doi:10.1080/00336297.2016.1268967
 48. Negrini S. The World Health Organization “Rehabilitation 2030: a call for action”. April

- 2017.
49. Oosman S, Weber G, Ogunson M, Bath B. Enhancing Access to Physical Therapy Services for People Experiencing Poverty and Homelessness: The Lighthouse Pilot Project. *Physiother Can.* 2019;71(2):176-186. doi:10.3138/ptc.2017-85.pc
 50. Jette A. Bringing a population health perspective to PT education. In: *Geneva R. Johnson Forum Keynote Address to the Educational Leadership Conference, American Physical Therapy Association/American Council for Academic Physical Therapy Education.* Seattle, WA, USA; 2019.
 51. Dunleavy K, Mejia-Downs A, Guerrero H, et al. Embedding Population Health in Physical Therapist Professional Education. *Phys Ther.* 2022;102(1):pzab238. doi:10.1093/ptj/pzab238.
 52. Magnusson D, Rethorn Z. Strengthening Population Health Perspectives in Physical Therapist Practice Using Epigenetics. *Phys Ther.* 2022;102(1):pzab244. <https://doi.org/10.1093/ptj/pzab244>.
 53. Beard JR, Bloom DE. Towards a comprehensive public health response to population ageing. *Lancet (London, England).* 2015;385(9968):658-661. doi:10.1016/S0140-6736(14)61461-6
 54. Meyer T, Gutenbrunner C, Bickenbach J, Cieza A, Melvin J, Stucki G. Towards a conceptual description of rehabilitation as a health strategy. *J Rehabil Med.* 2011;43(9):765-769. doi:10.2340/16501977-0865
 55. Edwards LC, Bryant AS, Keegan RJ, Morgan K, Jones AM. Definitions, Foundations and Associations of Physical Literacy: A Systematic Review. *Sports Med.* 2017;47(1):113-126. doi:10.1007/s40279-016-0560-7

56. Cairney J, Dudley D, Kwan M, Bulten R, Kriellaars D. Physical Literacy , Physical Activity and Health : Toward an Evidence - Informed Conceptual Model. *Sport Med.* 2019;49(3):371-383. doi:10.1007/s40279-019-01063-3
57. Roetert EP, Ortega C. Physical Literacy for the Older Adult. *Strength Cond J.* 2019;41(2):889-899. doi:10.1519/SSC.0000000000000430
58. *World Health Organization (1986) Ottawa Charter for Health Promotion. Geneva: WHO.* 23.
59. Ross R, Chaput JP, Giangregorio LM, et al. Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years and Adults aged 65 years or older: an integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metab.* 2020;45(10):S57-S102. <https://doi.org/10.1139/apnm-2020-0467>.
60. Tremblay MS, Warburton DER, Janssen I, et al. New Canadian Physical Activity Guidelines. *Appl Physiol Nutr Metab.* 2011;36(1):36-46. doi:10.1139/H11-009
61. Rollo S, Lang JJ, Roberts KC, et al. Health associations with meeting the Canadian 24-hour movement guidelines for adults: Results from the Canadian Health Measures Survey. *Heal reports.* 2022;33(1):16-26. <https://doi.org/10.25318/82-003-x202200100002-eng>.
62. Kindig D, Stoddart G. What is Population Health? *Am J Public Health.* 2003;93:380-383.
63. Magnusson DM, Eisenhart M, Gorman I, Kennedy VK, E. Davenport T. Adopting Population Health Frameworks in Physical Therapist Practice, Research, and Education: The Urgency of Now. *Phys Ther.* 2019;99(8):1039-1047. doi:10.1093/ptj/pzz048
64. Halfon N, Larson K, Lu M, Tullis E, Russ S. Lifecourse health development: past, present and future. *Matern Child Health J.* 2014;18(2):344-365. <https://doi.org/10.1007/s10995-013-1346-2>.

65. McLeroy K, Steckler A, Bibeau D. The social ecology of health promotion interventions. *Health Educ Q.* 1988;15(4):351-377.
http://tamhsc.academia.edu/KennethMcLeroy/Papers/81901/An_Ecological_Perspective_on_Health_Promotion_Programs.
66. Dufour SP, Lucy SD, Brown JB. Understanding Physiotherapists' Roles in Ontario Primary Health Care Teams. *Physiother Canada.* 2014;66(3):234-242.
doi:10.3138/ptc.2013-22

CHAPTER 2:
**FRAMING PHYSICAL LITERACY FOR AGING ADULTS: AN INTEGRATIVE
REVIEW**

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**FRAMING PHYSICAL LITERACY FOR AGING ADULTS:
AN INTEGRATIVE REVIEW**

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Abstract

Purpose:

Physical literacy is an important component for improving functional health for adults. However, little is known how physical literacy can be framed to support the rehabilitation needs of aging adults.

Methods:

An integrative review was conducted to understand what components are used to frame physical literacy for adults. Electronic databases were searched from 2000 - 2021 for eligibility criteria including: 1) adults \geq 45 years of age, 2) addressed physical literacy OR physical literacy components AND referred to outcomes assessing either mobility, physical function, rehabilitation, health promotion, health prevention, public health, or physical activity.

Results:

A total of 22 articles met the inclusion criteria. The varied methodological quality, including grey literature (50%) to systematic reviews (14%), indicates that physical literacy for adults is a novel topic. When defining physical literacy for adults, 13 new constructs emerged with purposeful activities, knowledge of age-related changes and social interaction as the top three. Physical literacy interventions demonstrated improvements in self-efficacy, physical function, and exercise behaviour.

Conclusion:

Findings from the current literature indicate that engagement in purposeful, social, and diverse activities, obtaining knowledge of age-related changes and being able to self-adapt to mobility fluctuations is the foundation to becoming a physically literate adult.

Key words: physical literacy, adults, older adults, chronic conditions, health promotion

Introduction

Older adults are a rapidly growing segment of our population, accounting for 6.5 million Canadians and 17% of the population (1). As adults age they are at an increased risk for chronic health conditions that commonly affect function and mobility (2). Chronic conditions such as diabetes, heart disease, stroke and cancer are the leading causes of death in Canada (3). Currently over 33% of adults (19-64 years) and 75% of older adults (≥ 65 years) report having one or more chronic condition (3). The proportion of people with multimorbidity, defined as the co-occurrence of two or more chronic conditions, continues to rise among individuals of all ages (3,4). Multimorbidity is a challenge for our healthcare system due to various competing demands, the complexity of treatment required, and the coordination of care needed to manage multiple health concerns. Musculoskeletal changes associated with aging such as decreased lower extremity muscle strength, impaired balance, decreased flexibility and pain can further contribute to functional impairments and mobility limitations for adults (5,6). There is a wealth of evidence demonstrating that chronic conditions can be better managed with health promotion approaches that address risk factors such as inactivity and a sedentary lifestyle (3,7,8), however, only 11% of Canadian adults between 60 and 79 years meet the recommended physical activity guidelines of 150 min of moderate to vigorous physical activity/week. (9)(10)(11)(12). Globally, sedentary behaviours and physical inactivity have been estimated to cost \$53.8 billion annually in direct health care costs(13). Additionally, individuals with multimorbid conditions represent a disproportionately high percentage of total healthcare costs (68%) for both older adults (>65 years) and younger adults (<65 years)(14). To date,

public health programs have demonstrated mixed outcomes with minimal uptake, usability and long-term adherence by individuals with chronic conditions (15,16). Similarly, health initiatives aimed at increasing physical activity levels for the healthy adults continue to report mixed findings (17)(18)(19). When designing and implementing public health programs to target important functional and mobility needs of aging adults, utilizing a more rehabilitation-focused approach throughout the program planning and including education and movement components, may add value by improving important physical health outcomes (20,21).

Health promotion has been defined as “activities directed toward increasing the level of well-being and actualizing the health potential of individuals, families, communities, and societies (22).” When considering the health needs of aging adults and adults with chronic conditions, there is an integral connection between the principles of health promotion and rehabilitation. The goal of rehabilitation is to provide strategies designed to optimize functioning and reduce disability in individuals with health conditions (23). As the underlying conditions and functional limitations will fluctuate with aging adults, health promoting behaviours can serve to optimize one’s overall health, resulting in improvement or maintenance of function. New models of healthcare involving collaborative efforts between the patient, community and healthcare system have been developed which consider the complexities involved when managing multimorbidity (24). These models commonly involve self-management interventions with a physical activity and education component and have demonstrated improvements in patient outcomes for target populations such as self-efficacy for exercise and quality of life, along with overall decreased healthcare costs (25). Even though there is considerable overlap between disease management interventions and health

promotion programs, it is important to distinguish the two. Self-management interventions are oriented toward managing the condition(s) and symptoms with consideration to one's overall wellness so there are fewer acute episodes. Health promotion initiatives primarily focus on overall wellness of a population with consideration to chronic condition(s) and illness (26). A health promotion approach with an ecological focus for aging adults and adults with chronic conditions that provides access to rehabilitation information and strategies is key to changing health behaviours and improved health outcomes. If aging adults and adults with chronic conditions are to successfully engage and adhere to the evidence-based healthy aging activities and behaviours, they will require a level of physical literacy. Information specific to health promotion within the context of living with age related changes and chronic conditions and delivered through population-based agencies, such as the YMCA and Heart and Stroke Foundation is a valuable resource that can allow adults to choose movement behaviours or strategies that are transferable to older age and support healthy aging. Sharing knowledge regarding the benefits of movement and exercise both in a rehabilitation and public health promotion context has potential to increase physical activity adherence for adults and older adults. Physical literacy has demonstrated positive associations with lifelong participation in movement activities, as well as self-esteem, injury reduction and social foundations(27)(28).

There are varying terms used in the literature to describe physical literacy, however the most widely accepted definition is supported by the International Physical Literacy Association and explains physical literacy as “the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life” (29). Over the last decade, physical literacy has gained popularity in industrialized countries

with youth sport development, as well as primary and secondary school physical education curriculum for children. In schools, children are taught the foundations of physical literacy, through motor competencies skills and an introduction to a wide variety of movement and sport activities, with the hope to increase engagement and appreciation for a wide variety of movement activities (30). The concept of physical literacy has relevance to adults, but the adaption of the concept to adults later in the lifespan is novel. Even though maintaining physical literacy has been identified as a critical component of healthy aging and maintaining independence (31) and researchers recognize the concept of physical literacy throughout the life-course (32), studies have predominantly focused on children and youth (33,34). Currently, little is known about how physical literacy can be framed to support aging adults. To understand the role of physical literacy in the management of multimorbidity, we must first identify how physical literacy is defined for adults and utilized to promote healthy aging for adults and older adults. To date, there remains minimal literature discussing the intersection of physical literacy and rehabilitation. Therefore, an integrative review and thematic synthesis of the literature was used to identify what is known about physical literacy for adults and how physical literacy is currently characterized for aging adults, in the context of addressing optimal physical function and mobility. Integrative reviews provide a rigorous framework for reviewing and amalgamating literature from a variety of methodologies, including quantitative, qualitative, mixed methods, and opinion papers (35). The aim of this paper is to address the following research questions: 1) What are the critical components included when framing physical literacy for adults and older adults? 2) What is the role of physical literacy in promoting successful aging for adults? 3) What components are important to include in a

physical literacy program when considering the functional rehabilitation needs of adults and older adults? 4) How do adults and older adults currently access and use physical literacy? A systematic integrative review was chosen for the study methodology, as there is a need to synthesize the existing literature on physical literacy to understand how this construct has evolved since its inception (21). This review has the potential to uncover constructs and principles from a variety of literature sources that can be used to evaluate if the current physical literacy definition accurately frames a physically literate adult. Currently, there are 2 systematic reviews, focusing on physical literacy constructs and definitions throughout the life-course (children and adults) and 1 scoping review examining older adult's physical competence under the physical literacy construct. However, there are no reviews to date examining the definition of physical literacy for adults and older adults.

Design and Methods

The following 5-step process proposed by Whitemore and Knafl was followed throughout the integrative review; problem identification, literature search, data evaluation, data analysis and presentation of findings (35).

Literature Search

An initial search in Google Scholar, PubMed and Embase was undertaken to identify relevant search terms. Analysis of the text words contained in the titles and abstracts was conducted to determine accurate search filters. A systematic search was then conducted using the following electronic databases; Medline Ovid, CINAHL, Cochrane Library, Embase, and AMED. Google scholar was used to cross reference findings. Keywords used for this review included (“physical literacy” OR “physical activity”) AND (“adults” OR “aging”) AND (“rehabilitation” OR “mobility”

OR “physical functioning” OR “mobility” OR “health promotion” OR “prevention” OR “public health”). Additional papers from reference lists of the studies reviewed were identified. See Table 1 for a full list of search terms utilized.

Inclusion and Exclusion Criteria

Articles were included in this review if they met the following criteria: Included adults ≥ 45 years AND addressed the term physical literacy OR referenced the physical literacy constructs (motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life), AND addressed one or more outcomes/results which assessed either mobility, physical function, rehabilitation, health promotion, health prevention, public health or physical activity. On the population level, prospective studies have found that changes in physical functioning (i.e. decline in muscle strength) begin to occur among middle aged persons (i.e. 45 years) (37)(38), therefore 45 years was chosen as the ideal cut off point for inclusion in the review. In addition, preclinical functional declines commonly precede mobility limitations, indicating middle age as the optimal time to intervene with physical literacy interventions. Physical literacy as a construct can be dated back to the 1800s, however only in the last 20 years has this construct re-emerged with researchers around the world. Therefore, the search dates were limited to the period of December 2000 – March 2021. Only those articles published in the English language were included. There were no restrictions based on study design. Unpublished papers, reports and documents were not excluded, as grey literature congruent with our research questions had the potential to fill the research gap, while complementing and conveying findings to a wider audience (39). In addition, lay views of physical literacy for adults are important for testing the

validity of existing models to determine whether they have relevance to the population to which they are applied (39).

Data Evaluation

Quality appraisal of the studies in this review was conducted with the Joanna Briggs Institute (JBI) Critical Appraisal Tools for Systematic Reviews, Randomized Controlled Studies, Quasi-experimental, Cross sectional, Qualitative Studies and Text and Opinion (40). Refer to Supplementary Tables 1– 7.

Data Analysis

Full text of all studies were independently reviewed by two investigators (CP, AM) and data extraction included documenting the following: 1) article design/methodology, 2) country of origin, 3) objective of article, 4) sample population, 5) physical literacy definition used, 6) physical literacy constructs associated with adults or older adults, 7) theoretical derivation, 8) professional association referenced 9) study results or main outcome of paper and 9) future research needed. Findings were extracted using the 4 research questions addressed by the review. Studies were then divided into quantitative, mixed methods, qualitative and opinion/literature review groupings (Supplementary Table 8). Data were organized by the principle investigator (CP) according to themes and relationships using constant comparison through qualitative inductive content analysis(41). The extracted findings were analyzed using a systematic approach, allowing identification and categorization of findings, followed by generation of explanatory synthesis across the categorized findings. All information from the data extraction was entered into the Covidence software program, an online abstraction tool (Covidence systematic review software) (42).

Results

A total of 1,742 articles were identified through the initial database search and 27 additional articles were included with hand searching the reference list. After removal of duplicates, 1682 articles were screened by reading title and abstract. Full-text screening was completed with 139 articles. Many articles were excluded because the paper focused on physical activity and not physical literacy. A total of 22 articles were included in this review that addressed physical literacy and adults. The PRISMA flow diagram (43) illustrates the study selection process (Figure 1). Even though papers were included in the review from 2000 – 2021, the majority of articles (77%) and all systematic/scoping reviews and quantitative studies (8/8) were published between 2016 and 2021.

Description of Evidence

The majority of papers included in the review (50%) were grey literature, including conceptual models, opinion papers and literature reviews. Five studies (23%) used quantitative methods, 2 articles (9%) included mixed methods design and 1 study (5%) used qualitative methods. There are three review papers (14%) included using a systematic methodology. Overall, with reference to the Joanna Briggs Institute Appraisal Tools (40), the methodological quality varied from low to high. Three opinion papers (44–46) were considered to have low methodological quality as they met only 3/6 of the checklist criteria. All other articles (18/22) were considered to have moderate to high methodological criteria, as they met a minimum of 5 of the assessment criteria (40). Refer to Supplementary Tables 1-7. Papers were published in six countries however, most articles were published in Canada (45%), followed by the United States (23%) and United Kingdom (18%). This review included 2 systematic reviews (33,47), 1

scoping review (48), 2 randomized controlled studies (49,50), 1 quasi experimental study (51), 1 pre-post study (52), 1 cross-sectional survey (53), 2 mixed methods studies (54,55), 1 qualitative focus group study (56), 3 conceptual model papers (27,57,58), 6 literature review/opinion paper (28,44,45,57,59,60) and 2 grey literature education guides (28,46). Refer to Table 2 for a description of the Literature.

Sample

Sample sizes for the 5 quantitative studies ranged from n= 30 to n= 725 with male and female participants included in all studies. The average age of the adults included in the quantitative studies is 65 years. All four intervention studies (49–52) included healthy community dwelling adults identified as physically inactive or sedentary. Qualitative and mixed methods study sample sizes ranged from n=15 to n=102 with an average age of 73 years.

Physical Literacy Definition

In total, 18/22 papers presented a definition of physical literacy. The majority of the articles (89%) refer to the current Whitehead (36) definition of physical literacy, as “the motivation, confidence, physical competence and knowledge to value and take responsibility for engagement in physical activity for life”. Both systematic reviews (33,47) and the scoping review (48) referred to the Whitehead definition when describing physical literacy for adults. The 2 randomized controlled trials (49,50) included in our review did not define physical literacy, however there was strong reference to the current physical literacy constructs, such as physical competence, motivation, knowledge, and confidence. Cairney et al (27) present a conceptual model that moves beyond the current Whitehead definition to position physical literacy as a determinant of health. Cairney purports that “physical literacy is a

multidimensional, experiential convergence of motor, affect, social and cognitive components that expand from early childhood to old age” (27). Dudley, et al (58) defines physical literacy as “the ability to move with confidence and competence using all the physical assets one has at their disposal at any given point in time across varying contexts”. Jones et al (54) utilize the current Whitehead definition to present an evidence-informed conceptual model, based on health experts that expands on the current physical literacy constructs to add relevance to older adults. Papers focusing on promoting physical literacy for adults and older adults discuss the need to develop beyond the Whitehead definition to provide an inclusive representation of a physically literate adult and/or older adult.

Physical Literacy Constructs

From the 22 articles, 65 constructs that related to physical literacy and adults were extracted. From there, 6 components were generated from the current Whitehead definition and 13 new physical literacy components related to adults were identified. The most commonly identified new components reported in the literature consisted of meaningful/purposeful activities (18), knowledge of age-related changes (12), social interaction (12), diverse activities (11), physical/age adaptation (10), and environmental awareness/understanding (9). Other reported new components include positive affect/attitude (6), self-regulation (6), adequate strength, flexibility and balance (4), regular periodic movement (3), safety awareness (3), cognitive activity (3) and resilience (2). Refer to Table 3: Physical Literacy Constructs. Following the Whitehead definition of Physical literacy, engagement in physical activity was identified in all papers (100%), followed by motivation (77%) and confidence (77%). Therefore, having the motivation and confidence to participate in physical activities, continue to be identified as key

attributes to attaining physical literacy for individuals of all ages. Meaningful person-centered activities and purposeful physical activities were identified as the most commonly reported new component (86%). Making purposeful movement activities that address older adult's pragmatic needs, such as maintaining physical and mental independence will likely increase one's motivation for sustained movement. Knowledge of body changes related to aging was also a commonly reported component (55%) indicating the need for differing education material that address the functional and mobility needs of aging adults. Health literacy defined by The Institute of Medicine, is "the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions (61)". Aging adults living with chronic conditions are required to make personal health decisions on a regular basis that address their fluctuating health status and manage their condition(s). The knowledge and understating required to attain physical literacy for adults will differ to that of younger individuals. Information related to the changes with strength, flexibility, balance, speed, endurance and maintaining function as individuals age is required to keep adults informed. For example, gaining an understanding of why one is having mobility challenges or experiencing fear of falling will reinforce the need to engage in movements, despite these physiological changes. Maintaining social interactions (55%), diversity of movement (50%), environmental awareness/understanding (41%), positive affect/attitude (27%) and self-regulation skills (27%) were also commonly reported, demonstrating how physical literacy for adults can differ to that of younger individuals. The aforementioned new constructs identified, validate the need to take an ecological approach when considering the promotion of physical literacy for adults and understand how physical function can be

improved, as opposed to simply promoting physical activity. Age-friendly communities with high walkability, good access to parks and recreation facilities, and sidewalk functionality should be included. Community elements such as socio-cultural norms and gender are also required to increase success.

Measuring physical literacy for adults

Of the 22 papers included, 4 articles evaluated physical literacy programs for adults and/or older adults (49–52). Additionally, 1 systematic review (47) evaluated the measurement and assessment attempts of physical literacy for children and adults and 1 scoping review (48) explored how the physical competence of older adults' would be measured under the concept of physical literacy. A variety of objective measures were reported such as number of steps/day, Short Physical Performance Battery Test (SPPB), 400-meter walk, and the Seniors Fitness Test. Subjective outcome measures were also reported, such as self-efficacy for exercise scale, International Physical Activity Questionnaire (IPAQ) and exercise knowledge open-ended questions. The scoping review by Huang, et al (48) included papers that assessed physical competence under the concept of physical literacy for older adults (≥ 65 years). This review found that the Medical Outcomes Study Short Form–36 Questionnaire was the most common self-report measure to assess physical function. Additionally, gait speed measures (62), the senior fitness test (63) and single leg stance (64) were the most commonly reported objective measures when assessing mobility, balance and/or strength under the umbrella of physical literacy. The pilot non-randomized controlled study by Holler, et al assessed the effects of a holistic physical exercise training on physical literacy among physically inactive adults (51). This study was the first to measure physical literacy for community-dwelling adults by designing

a questionnaire covering five identified physical literacy domains: physical activity behaviour, attitude towards a physically active lifestyle, exercise motivation, knowledge and self-efficacy. The 15-week physical literacy intervention consisted of tailored strength and endurance exercises, in addition to a multi-modal education component and as a result, significant improvements were found for the physical activity behaviour and exercise self-efficacy domains (51). This pilot study used diverse self-report measures to assess physical literacy outcomes. Interestingly, the randomized controlled trial by Matz Costa et al. (49), evaluated their Engaged4life program, an intervention to encourage inactive adults to embed physical activities that are personally meaningful, with a variety of outcomes, including # of steps/day, # of cognitive activities/day, #social interactions/day and # of personal meaning actions/day. This intervention utilized technology monitoring, goal setting and peer mentoring to encourage physical activity, cognitive activities, social interactions and personal meaningful activities into every-day life. Improvements were found for all 4 domains for the physical literacy intervention group; however, the study was not powered to detect significant differences between the self-monitoring control group. An 8-week pre-post Get Fit for Active Living (GFAL) physical literacy intervention for sedentary community dwelling older adults found significant improvements for task specific self-efficacy, lifestyle self-efficacy and physical function, as measured by SPPB (52). Interestingly, an RCT by Stathokostas et al. (50) looked at longer term adherence levels for GFAL intervention and found improvements in exercise adherence with a 66% retention at 12 months, in addition to maintenance of the physical function outcomes at the 6 month follow up.

Physical Literacy Interventions for Adults

Four interventions studies (49–52) were identified in the review, including 2 RCTs, 1 quasi-experimental and 1 pre-post study. Only one study measured outcomes under the concept of physical literacy and aimed to promote physical literacy for older adults (51). The main purpose of the other 3 intervention studies were to assess adaption and adherence to physical activity after participation in a multi-component exercise program, designed with physical literacy principles. All 4 interventions targeted inactive community dwelling adults and older adults and demonstrated improvement in physical literacy outcomes. Intervention components included a range of functional exercises, technology assisted self-monitoring, goal setting, education sessions and behaviour change techniques. Table 3 provides a summary of the 4 studies evaluating physical literacy interventions.

Social sectors promoting physical literacy

This review examined which social sectors are responsible for promoting physical literacy for adults. Recreational community programs designed for adults and older adults were most commonly referenced (n=16). Health and medicine fields discussing to role of physical literacy with successful aging (n=9), followed by education sectors supporting physical literacy for children and adults throughout the life-course (n=8) were also commonly referenced. Sport associations (n=5), and public health and policy fields (n=2) were also noted in this review. Refer to Table 2: Nature of the Literature.

Physical literacy and rehabilitation

There was no reference to the role of rehabilitation in the promotion of physical literacy for adults, when examining the articles included in this review. However, thematic analysis identified several constructs related to rehabilitation and physical literacy. Optimal function

and mobility were the most commonly reported constructs, followed by rehabilitation exercises (strength, flexibility, speed, endurance and balance), adherence to sustained physical activity, self-monitoring and self-management. Refer to Figure 2.

Accessing physical literacy for adults

All 22 papers focused on physical literacy for community dwelling adults and older adults. The following themes emerged when evaluating constructs related to how adults can successfully access experiences which build physical literacy in the community: daily access to recreational activities, accessible built environments, access to enjoyable physical activities, access to a variety of movement activities, social support, culturally relevant and financially viable options, education on safe/supportive movement, multiple formats, and tailored to community needs. A cross-sectional survey (53) of community dwelling Canadian older adults included in the review found that an “easy to use website”, and an email newsletter were the top 2 preferences when asked how older adults would like to receive information on physical literacy (53).

Discussion

This review demonstrates that literature generated to date has been largely theoretical and descriptive, exploring varying definitions and models to describe the promotion of a physically literate adult. Higher levels of physical literacy are theorized to provide benefits, to the individual and to societies, however research to support this is lacking. This review aimed to address 4 key objectives: 1) What are the critical components included when framing physical literacy for adults and older adults? 2) What is the role of physical literacy in promoting successful aging for adults? 3) What components are important to include in a physical literacy

program when considering the functional rehabilitation needs of adults and older adults? 4)

How do adults and older adults currently access and use physical literacy? When evaluating the critical components of physical literacy for adults, the literature presents debate questioning whether the current physical literacy definition (“the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life”) is accurate and inclusive to the needs of adults and older adults. For example, Cairney et al (27) argues that the current physical literacy definition should be expanded to position physical literacy as a health disease determinant. Cairney depicts physical literacy as a holistic concept that entails reciprocal, intertwining motor, social, affect and motivational factors that are reinforced with knowledge (27). Dudley et al (58) defines physical literacy as the “knowledge, skills, understandings and values related to taking responsibility for purposeful physical activity and human movement across the life course, regardless of physical or psychological constraint”. Dudley presents a new model of physical literacy including policy considerations for key decision makers in the fields of public health, recreation, sport and education to support children and adults as they age (58). Dudley argues that there is a need for “physically literate societies”, that encompass more than education and sport agencies and should address the public health needs of all individuals of all ages. Jones et al (54) provides an expansion of the current physical literacy definition to describe a new physical literacy model, informed by multi-disciplinary researchers and practitioners, with some consideration of the unique physical and social needs of older adults (≥ 65 years). The physical literacy model discussed by Jones et al (54) differs from the previous frameworks by focusing only on older adults and using an ecological approach to integrate physical literacy into the lifestyles of aging

adults. The traditional Whitehead model of physical literacy describes a pathway from birth to adulthood in which the individual develops physical literacy skills as a child that they can reflect on and grow with as they age. This model presents limitations for adults who may not have base functional movement skills, such as running, throwing, jumping or who have not engaged in these skills for many years. Additionally, the Whitehead model does not fully consider the new skills that adults are required to learn, as a result of age-related or health condition related function and mobility changes. For example, with chronic conditions, individuals will need to learn how to monitor their functional status and adjust as needed to maintain mobility. They will need to learn rehabilitation strategies, including strengthening, flexibility, endurance, and balance exercises that will promote maximum mobility. These findings highlight that the current physical literacy definition should be reconceptualized to include the following key components that encapsulate the characteristics central to physical literacy for adults and older adults; engagement in purposeful, social, and diverse physical activities, having the motivation and confidence for movement, knowledge of age-related changes and the role of physical activity and being able to self-adapt to physical changes.

Many articles addressed the intersection between successful aging and physical literacy for adults, however varying frameworks were used to demonstrate the association. Successful aging is commonly associated with “avoiding disease and disability, having high cognitive, mental and physical function, being actively engaged in life, and being psychologically well adapted in later life (65).” Higgs (28) describes physical literacy as the foundation to successful aging. Higgs argues that there are eight physical literacy components (appropriate physical activity, cognitive function, psychological well-being, social connection, embracing life

transitions, managing chronic conditions, mindful nutrition and designing movement opportunities for adults of all ages with all abilities) that will lead adults to successful aging (28). Increasing physical activity and decreasing the risks for illness and mobility impairments are at the center of both physical literacy and successful aging, demonstrating the clear relationship between the constructs. Interestingly, even though there was reference to functional exercises aimed at improving and managing mobility and the new physical literacy models acknowledged the role of chronic conditions when promoting physical literacy for adults, no articles discussed the intersection of rehabilitation with physical literacy and successful aging. For example, Cairney's physical literacy framework across the life course (27) includes a pathway linking chronic conditions to physical literacy by considering the impacts of conditions such as cardiovascular disease, Type 2 diabetes, obesity, high blood pressure, and osteoarthritis on function and mobility (27). This framework acknowledges that the onset of chronic conditions may restrict movement opportunities for aging adults, forcing adaptations to movement behaviours and creating challenges when acquiring new movement experiences (27). It can be applied that rehabilitation strategies are required to improve function and maintain participation in movement activities to ensure adults and older adults build capacity within their physical literacy as the requirements for movement and function change with age. Figure 2 illustrates the reciprocal association between physical literacy, successful aging, physical activity, and rehabilitation. This figure uses the thematic findings of the review and demonstrates the intersection between the complex role of the four components: rehabilitation, physical literacy, successful aging, and physical activity, in the promotion of physical literacy for adults. Function and mobility outcomes were commonly used in the

assessment of physical literacy, however rehabilitation professionals, such as physiotherapists were not involved in the design and delivery of the programs. This omission is surprising since rehabilitation professionals have the expertise and skills to support physical literacy initiatives by sharing knowledge regarding the prevention and management of movement impairments (66). Increased awareness about the intersection of rehabilitation and physical literacy by practitioners and policymakers is likely to increase the dissemination of these ideas.

When considering physical literacy interventions, this review demonstrates the dearth of research that has explored physical literacy in adults and older adults. The 4 physical literacy interventions in the review included both a physical activity component and an education component that addressed important behaviours such as motivation, self-efficacy with movement, and confidence. This demonstrates that the holistic nature of physical literacy for adults involves a multitude of constructs that go beyond physical competence. It is apparent that physical literacy is important for sustained participation in physical activity, but development of physical literacy for adults can occur through unstructured movement pursuits, such as recreational activities, daily routines, social interactions, and community involvement, in addition to structured movement pursuits such as sport, exercise, rehabilitation programs, healthcare visits and education programs. Two grey literature articles specifically described exercises designed to increase physical literacy for adults (46,67). A Canadian Sport for Life Physical Literacy Movement Guide, prepared by Kitchen et al. presents 30 dynamic and functional movements, such as grapevine, squats and ladder drills that aim to improve the way adults move, as well as enjoy recreational movement(46). Similarly, a conceptual paper by Roetert et al (67) presents the following 5 key functional resistance exercises, aimed to start

older adults on the path of physical literacy: scapular retraction, bridging, partial squat, grapevine and heel raises.

When examining how adults' access and use physical literacy, the current literature primarily focuses on programs for community-dwelling adults and older adults and the need to build communities that support adults with their physical literacy journey. A 2020 cross sectional survey of older adults by active aging Canada (53) found that "accessible environments" and "affordable opportunities" were the top two emerging themes when asked how to support older adults to be physically active. This survey also found that older adults would prefer to receive information on physical literacy with an easy-to-use website or an email newsletter, both highly accessible resources (53). For physical literacy to be embraced by the older adult community and adapted as a disposition, there is a need to articulate what physical literacy entails for adults and older adults from health and physical function lens.

Implications for practice and research

In the context of physical literacy for adults and older adults, individuals may have developmental skills that were established at an earlier age, which they retain to a greater or less extent from childhood. However, there are other physical literacy skills, to learn as individuals age that are related to maintaining function in adulthood and the management of chronic conditions. Physical activity is one component that can improve function, and physical literacy, however there are many other components, such as self-monitoring of age-related changes, including safe and diverse movements into every-day activities, the practice of core functional activities, such as rising from a chair and understanding and implementing rehabilitation strategies to address age related changes as a means to maintaining optimal

mobility. The traditional conceptualization of physical literacy does not fully account for aging and changes in function and mobility with aging. A key feature is that it is currently primarily based on a developmental model that is expanding one's physical activity, not a developmental model where movement and activity is becoming more constrained due to age related changes. This review adds value to the current literature on physical literacy frameworks and definitions, by highlighting the key components that are central to physical literacy for aging adults. Future physical literacy interventions should be designed with a focus on the identified key components, including having the motivation and confidence to engage in meaningful, social, and diverse activities and having knowledge of age-related changes and understanding how to adapt to these changes. A pilot physical literacy intervention for adults (45 – 65 years) with 2 or more chronic conditions and delivered with a population health approach is currently underway. This intervention was developed iteratively based on the results of expert consensus group using nominal group technique to reach consensus on the key components required for a physical literacy intervention for adults(68). In addition, semi-structured interviews were conducted with working adults (45 – 65 years) who are living with multiple chronic conditions to understand what physical literacy means to aging adults and how to effectively increase physical literacy awareness as a strategy to improving participation and adherence to physical activity, despite health challenges. Early findings indicate that physical literacy for adults and older adults involves increasing one's capacity to be able to choose diverse movement activities that are enjoyable, while monitoring one's own ability for movement, having the knowledge to identify early loss of movement components and knowledge to remediate restrictions. The development of physically literate adults and older

adults will require collective action among organizations and sectors, such as rehabilitation specialists, public health units and policy. Future research is needed to determine whether interventions delivered by rehabilitation professionals at a population level and aimed at improving physical literacy components important to optimal aging and the management of chronic conditions for adults and older adults will improve health outcomes, such as function and mobility. Additionally, future research is needed to effectively disseminate information and movement strategies at a population level to adults and older adults who will benefit the most from becoming physically literate.

Strengths and Limitations

This integrative review offers the first synthesis of a variety of literature sources and evidence types on how physical literacy is framed for adults and older adults. The inclusion criteria are broad, allowing for a compilation of current literature on a new and complex topic. However, the extracted findings are not homogenous in this aspect. Our findings are limited by the number and quality of articles identified. Quantitative and qualitative studies that matched the eligibility criteria were limited, however those included contributed substantially with identified physical literacy components for adults and older adults in addition to the current physical literacy measurements and community interventions. The majority of literature included were from grey literature, including opinions and conceptual frameworks, decreasing the validity of findings. The included literature sources were conducted in 6 different countries with reference to active and inactive community adults ≥ 45 years, strengthening the external validity.

Conclusion

This review advances an understanding about physical literacy for adults and older adults and adds value in the fields of public health and policy by reconceptualizing the physical literacy construct to include the *functional health* needs of aging individuals. A shift in public understanding of what components contribute to physically literate adults and older adults can positively influence important aging outcomes and help guide program development where rehabilitation has part to play, aimed at disseminating important physical literacy strategies. This review has highlighted that having an awareness of the safe and purposeful activities available, the benefits of movement and how to sustain movement, through fluctuations in health and abilities, such as episodic fluctuations in multimorbidity is the foundation to becoming a physical literate adult and older adult.

Implications for Rehabilitation

- Physical literacy is emerging as a promising health strategy to address the mobility needs of adults and older adults
- When defining physical literacy for aging adults, there remains a lack of effective conceptualization of this construct.
- The foundation to becoming a physically literate adult involves monitoring one's ability for movement and having the knowledge to identify and remediate changes in function while engaging in purposeful movements.
- Physical literacy programs designed to target the rehabilitation needs associated with aging and delivered at a population level have potential to positively impact important health outcomes equitably for all aging adults.

References

1. Statistics Canada. Government of Canada - Action for seniors report [Internet]. 2014. Available from: <https://www.canada.ca/en/employment-social-development/programs/seniors-action-report.html>
2. Ferrucci L, Cooper R, Shardell M, Simonsick EM, Schrack JA, Kuh D. Age-Related Change in Mobility: Perspectives From Life Course Epidemiology and Geroscience. *J Gerontol A Biol Sci Med Sci* [Internet]. 2016/03/14. 2016 Sep;71(9):1184–94. Available from: <https://pubmed.ncbi.nlm.nih.gov/26975983>
3. Roberts K, Rao D, Bennett T, Loukine L, Jayaraman G. Prevalence and patterns of chronic disease multimorbidity and associated determinants in Canada. *Heal Promot Chronic Dis Prev Canada*. 2015;35(6):87–94.
4. Broemeling A-M, Watson DE, Prebtani F. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: implications for policy and practice. *Healthc Q*. 2008;11(3):70–6.
5. Marko M, Neville C, Prince M, Ploutz-Snyder L. Lower extremity force decrements identify early mobility decline among community-dwelling older adults. *Phys Ther*. 2012;92(9):1148–59.
6. Ryan A, Wallace E, O’Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes* [Internet]. 2015 Oct;13(1):168. Available from: <https://doi.org/10.1186/s12955-015-0355-9>
7. Kastner M, Cardoso R, Lai Y, Treister V, Hamid JS, Hayden L, et al. Effectiveness of interventions for managing multiple high-burden chronic diseases in older adults: a

- systematic review and meta-analysis. *Can Med Assoc J* [Internet]. 2018 Aug 27;190(34):E1004–12. Available from:
<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC6110649/>
8. de Vries NM, van Ravensberg CD, Hobbelen JSM, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: A meta-analysis. *Vol. 11, Ageing Research Reviews*. 2012. p. 136–49.
 9. Statistics Canada. Tracking Physical Activity Levels of Canadians, 2016 - 2019. [Internet]. 2019. Available from: <https://www150.statcan.gc.ca/n1/daily-quotidien/190417/dq190417g-eng.htm>
 10. Bullard T, Ji M, An R, Trinh L, Mackenzie M, Mullen SP. A systematic review and meta-analysis of adherence to physical activity interventions among three chronic conditions: cancer, cardiovascular disease, and diabetes. *BMC Public Health* [Internet]. 2019;19(1):636. Available from: <https://doi.org/10.1186/s12889-019-6877-z>
 11. Colley R, Garriguet D, Janssen I, Craig C, Clarke J, Tremblay M. Physical activity of Canadian adults: accelerometer results from the 2007 to 2009 Canadian Health Measures Survey. *Heal reports*. 2011;1(7).
 12. Tremblay MS, Warburton DER, Janssen I, Paterson DH, Latimer AE, Rhodes RE, et al. New Canadian Physical Activity Guidelines. *Appl Physiol Nutr Metab* [Internet]. 2011 Jan 1;36(1):36–46. Available from: <https://doi.org/10.1139/H11-009>
 13. Ding D, Kolbe-Alexander T, Nguyen B, Katzmarzyk PT, Pratt M, Lawson KD. The economic

- burden of physical inactivity: a systematic review and critical appraisal. *Br J Sports Med* [Internet]. 2017 Oct 1;51(19):1392 LP – 1409. Available from:
<http://bjsm.bmj.com/content/51/19/1392.abstract>
14. Thavorn K, Maxwell CJ, Gruneir A, Bronskill SE, Bai Y, Koné Pefoyo AJ, et al. Effect of socio-demographic factors on the association between multimorbidity and healthcare costs: a population-based, retrospective cohort study. *BMJ Open* [Internet]. 2017 Oct 1;7(10):e017264. Available from:
<http://bmjopen.bmj.com/content/7/10/e017264.abstract>
 15. Kahn E, Ramsey L, Brownson R, Heath G, Howze E, Powell K, et al. The effectiveness of interventions to increase physical activity. A systematic review. *Am J Prev Med*. 2002;22(4 Suppl):73–107.
 16. Trost S, Owen N, Bauman A, Sallis J, Brown W. Correlates of adults' participation in physical activity: review and update. *Med Sci Sport Exerc*. 2002;34(12):1996–2001.
 17. Baker P, Francis D, Soares J, Weightman A, Foster C. Community wide interventions for increasing physical activity. *Cochrane Database Syst Rev*. 2015;5(1).
 18. Tseng E, Zhang A, Shogbesan O, Gudzone K, Wilson R, Kharrazi H, et al. Effectiveness of Policies and Programs to Combat Adult Obesity: a Systematic Review. *J Gen Intern Med Intern Med*. 2018;33(11):1990–2001.
 19. Mönninghoff A, Kramer J, Hess A, Ismailova K, Teepe G, Tudor Car L, et al. Long-term Effectiveness of mHealth Physical Activity Interventions: Systematic Review and Meta-analysis of Randomized Controlled Trials. *J Med Internet Res*. 2021;30(23):4.
 20. Parekh AK, Goodman RA, Gordon C, Koh HK, Conditions HHSIW on MC. Managing

- multiple chronic conditions: a strategic framework for improving health outcomes and quality of life. *Public Health Rep* [Internet]. 2011;126(4):460–71. Available from: <https://pubmed.ncbi.nlm.nih.gov/21800741>
21. Rimmer J, Riley B, Wang E, Rauworth A, Jurkowski J. Physical activity participation among persons with disabilities: barriers and facilitators. *Am J Prev Med*. 2004;36(5):419–25.
 22. Pender N, Murdaugh C, Parsons M. *Health Promotion in Nursing Practice*. 6th ed. Boston, MA: Pearson; 2010.
 23. World Health Organization (WHO) [Internet]. [cited 2020 Mar 16]. Available from: <https://www.who.int/news-room/fact-sheets/detail/rehabilitation>
 24. Grembowski L, Schaefer J, Johnson K, Fischer H, Moore S, Tai-Seale M, et al. AHRQ MCC Research Network. A conceptual model of the role of complexity in the care of patients with multiple chronic conditions. *Med Care*. 2014;52(Suppl):3:S7-S14.
 25. Chodosh J, Morton S, Mojica W, Maglione M, Suttorp M H, Al. L et. Meta-analysis: chronic disease self-management programs for older adults. *Ann Intern Med*. 2005;143:427–38.
 26. Paterson B. The shifting perspectives model of chronic illness. *J Nurs Scholarsh*. 2001;33(1):21–6.
 27. Cairney J, Dudley D, Kwan M, Bulten R, Kriellaars D. Physical Literacy , Physical Activity and Health : Toward an Evidence - Informed Conceptual Model. *Sport Med* [Internet]. 2019;49(3):371–83. Available from: <https://doi.org/10.1007/s40279-019-01063-3>
 28. Higgs C, Cairney J, Jurbala P, Dudley D, Way R, Mitchell D. *Developing Physical Literacy: Building a New Normal for all Canadians. Physical Literacy in the Adult and Older Years*

- [Internet]. 2019. Available from: https://sportforlife.ca/wp-content/uploads/2019/09/DPL-2_EN_web_November_2019-1.pdf
29. International Physical Literacy Association [Internet]. Available from: <https://www.physical-literacy.org.uk/>
 30. Roetert EP, Kriellaars D, Ellenbecker TS, Richardson C. Preparing Students for a Physically Literate Life. *J Phys Educ Recreat Danc* [Internet]. 2017 Jan 2;88(1):57–62. Available from: <https://doi.org/10.1080/07303084.2017.1252554>
 31. Whitehead 1 M. The Concept of Physical Literacy. *Eur J Phys Educ* [Internet]. 2001 Jan 1;6(2):127–38. Available from: <https://doi.org/10.1080/1740898010060205>
 32. Whitehead M. The history and development of physical literacy. *ICSSPE Bull*. 2013;65:1–7.
 33. Edwards LC, Bryant AS, Keegan RJ, Morgan K, Jones AM. Definitions, Foundations and Associations of Physical Literacy: A Systematic Review. *Sports Med* [Internet]. 2017 Jun 30;47(1):113–26. Available from: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC5215133/>
 34. Roetert EP, MacDonald LC. Unpacking the physical literacy concept for K-12 physical education: What should we expect the learner to master? *J Sport Heal Sci* [Internet]. 2015;4(2):108–12. Available from: <http://www.sciencedirect.com/science/article/pii/S2095254615000241>
 35. Whittemore R, Knafelz K. The integrative review: updated methodology. *J Adv Nurs*. 2005;52(5):546–53.
 36. Whitehead M. The concept of physical literacy. *Eur J Phys Educ*. 2001;6:127–38.

37. Frontera WR, Hughes VA, Fielding RA, Fiatarone MA, Evans WJ, Roubenoff R. Aging of skeletal muscle: a 12-yr longitudinal study. *J Appl Physiol* [Internet]. 2000 Apr 1;88(4):1321–6. Available from: <https://doi.org/10.1152/jappl.2000.88.4.1321>
38. Melzer D, Gardener E, Guralnik JM. Mobility disability in the middle-aged: cross-sectional associations in the English Longitudinal Study of Ageing. *Age Ageing* [Internet]. 2005 Nov 1;34(6):594–602. Available from: <https://doi.org/10.1093/ageing/afi188>
39. Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol* [Internet]. 2008;8(1):45. Available from: <https://doi.org/10.1186/1471-2288-8-45>
40. Joanna Briggs Institute. Critical Appraisal Tools [Internet]. 2017. Available from: <https://joannabriggs.org/critical-appraisal-tools>
41. Baxter S, Killoran A, Kelly MP, Goyder E. Synthesizing diverse evidence: the use of primary qualitative data analysis methods and logic models in public health reviews. *Public Health* [Internet]. 2010;124(2):99–106. Available from: <http://www.sciencedirect.com/science/article/pii/S0033350610000041>
42. Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia. Available at www.covidence.org.
43. Moher D, Liberati A, Tetzlaff J, Altman DG. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *BMJ* [Internet]. 2009 Jul 21;339:b2535. Available from: <http://www.bmj.com/content/339/bmj.b2535.abstract>
44. Almond L. What is the relevance of Physical Literacy for Adults? *Int Counc Sport Sci Phys Educ*. 2015;65(Bulletin Feature Physical Literacy):215–20.

45. Whitehead M, Taplin L. Physical Literacy as a Journey. *Int Counc Sport Sci Phys Educ*. 2013;54(Bulletin Special Edition):52–60.
46. Kitchen A. Physical Literacy Movement Preparation For Adults and Older Adults. 2014;
47. Edwards LC, Bryant AS, Keegan RJ, Morgan K, Cooper S-M, Jones AM. 'Measuring' Physical Literacy and Related Constructs: A Systematic Review of Empirical Findings. *Sport Med* [Internet]. 2018 Mar;48(3):659–82. Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=127943333&site=ehost-live>
48. Huang Y, Sum K-WR, Yang Y-J, Chun-Yiu Yeung N. Measurements of Older Adults' Physical Competence under the Concept of Physical Literacy: A Scoping Review. *Int J Environ Res Public Health* [Internet]. 2020 Sep 9;17(18):6570. Available from: <https://www.mdpi.com/1660-4601/17/18/6570>
49. Matz-Costa C, Lubben J, Lachman ME, Lee H, Choi YJ. A Pilot Randomized Trial of an Intervention to Enhance the Health-Promoting Effects of Older Adults' Activity Portfolios: The Engaged4Life Program. *J Gerontol Soc Work* [Internet]. 2018;61(8):792–816. Available from: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=medl&NEWS=N&AN=30395791>
50. Stathokostas L, Speechley M, Little RMD, Doerksen S, Copeland J, Paterson D. Long-term Evaluation of the "Get Fit for Active Living" Program. *Can J Aging / La Rev Can du Vieil* [Internet]. 2017;36(1):67–80. Available from: <https://www.muse.jhu.edu/article/648490>.
51. Holler P, Jaunig J, Amort F-M, Tuttner S, Hofer-Fischanger K, Wallner D, et al. Holistic

- physical exercise training improves physical literacy among physically inactive adults: a pilot intervention study. *BMC Public Health* [Internet]. 2019 Apr 11;19(1). Available from: <http://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=135839708&site=ehost-live>
52. Stathokostas L, Speechley M, Doerksen S, Patterson D. The Get Fit for Active Living Demonstration Project : Evaluation of a Canadian Older Adult Physical Activity Education Program. Western University; 2016.
53. Stathokostas L, Gotz A, Clark P. What Exactly is Physical Literacy? Perspectives from older adults and those who work with older adults [Internet]. Active Aging Canada. 2020. Available from: <https://www.activeagingcanada.ca/assets/pdf/practitioners/physical-activity-literacy/Physical-Literacy-and-Older-Adults.pdf>
54. Jones GR, Stathokostas L, Young BW, Wister A V, Chau S, Clark P, et al. Development of a physical literacy model for older adults -- a consensus process by the collaborative working group on physical literacy for older Canadians. *BMC Geriatr* [Internet]. 2018 Jan;18(1):13. Available from: <https://doi.org/10.1186/s12877-017-0687-x>
55. McMahon SK, Park YS, Lewis B, Guan W, Oakes JM, Wyman JF, et al. Older Adults' Utilization of Community Resources Targeting Fall Prevention and Physical Activity. *Gerontologist* [Internet]. 2019;59(3):436–46. Available from: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=medl&NEWS=N&AN=29401219>
56. Campelo AM, Katz L. Older Adults' Perceptions of the Usefulness of Technologies for Engaging in Physical Activity: Using Focus Groups to Explore Physical Literacy. *Int J*

Environ Res Public Health [Internet]. 2020;17(4). Available from:

<http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=prem&NEWS=N&AN=32053937>

57. Roetert EP, Ellenbecker TS, Kriellaars D. Physical literacy : why should we embrace this construct ? Br J Sports Med. 2018;52(20):1291–2.
58. Dudley D, Cairney J, Wainwright N, Kriellaars D. Critical Considerations for Physical Literacy Policy in Public Health, Recreation, Sport and Education Agencies. Quest [Internet]. 2017;69(4):436–52. Available from:
<http://dx.doi.org/10.1080/00336297.2016.1268967>
59. Roetert EP, Jefferies SC. Embracing Physical Literacy. J Phys Educ Recreat Danc [Internet]. 2014;85(8):38–40. Available from:
<https://www.tandfonline.com/doi/abs/10.1080/07303084.2014.948353>
60. Longmuir PE, Tremblay MS. Top 10 Research Questions Related to Physical Literacy. Res Q Exerc Sport. 2016;87(1):28–35.
61. Nielsen-Bohlman L, Panzer A, Kindig D. Health literacy: a prescription to end confusion. Washington, District of Columbia: National Academies Press; 2004.
62. Steffen T, Hacker T, Mollinger L. Age- and gender-related test performance in community-dwelling elderly people: SIX-Minute Walk Test, Berg Balance Scale, Timed Up & Go Test, and gait speeds. Phys Ther. 2002;82(2):128–137.
63. Liu J, Quach B, Chung P. Further understanding of the Senior Fitness Test: Evidence from community-dwelling high function older adults in Hong Kong. Arch Gerontol Geriatr. 2019;82:286–92.

64. Goldberg A, Casby A, Wasielewski M. Minimum detectable change for single-leg-stance-time in older adults. *Gait Posture* [Internet]. 2011;33(4):737–9. Available from: <http://www.sciencedirect.com/science/article/pii/S0966636211000701>
65. Kim S-H, Park S. A Meta-analysis of the correlates of successful aging in older adults. *Res Aging*. 2016;39(5):657–77.
66. Ontario Physiotherapy Association: *Physiotherapy in Primary Health Care*. 2017.
67. Roetert EP, Ortega C. Physical Literacy for the Older Adult. *Strength Cond J*. 2019;41(2):889–99.
68. Petrushevski C, Richardson J, MacDermid J, Wilson M. Framing Physical Literacy for Adults through a Rehabilitation Lens: An Expert Consensus Study. 2021.
69. Jones G, Stathokostas L. Letter to the Editor: Can Older Adults “Walk” Their Way to Successful Aging? The Case for Physical Activity Literacy for an Aging Population. *J Aging Phys Act* [Internet]. 2016;24(3):341. Available from: <http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=med12&NEWS=N&AN=27622659>

Figure 1: PRISMA flow diagram

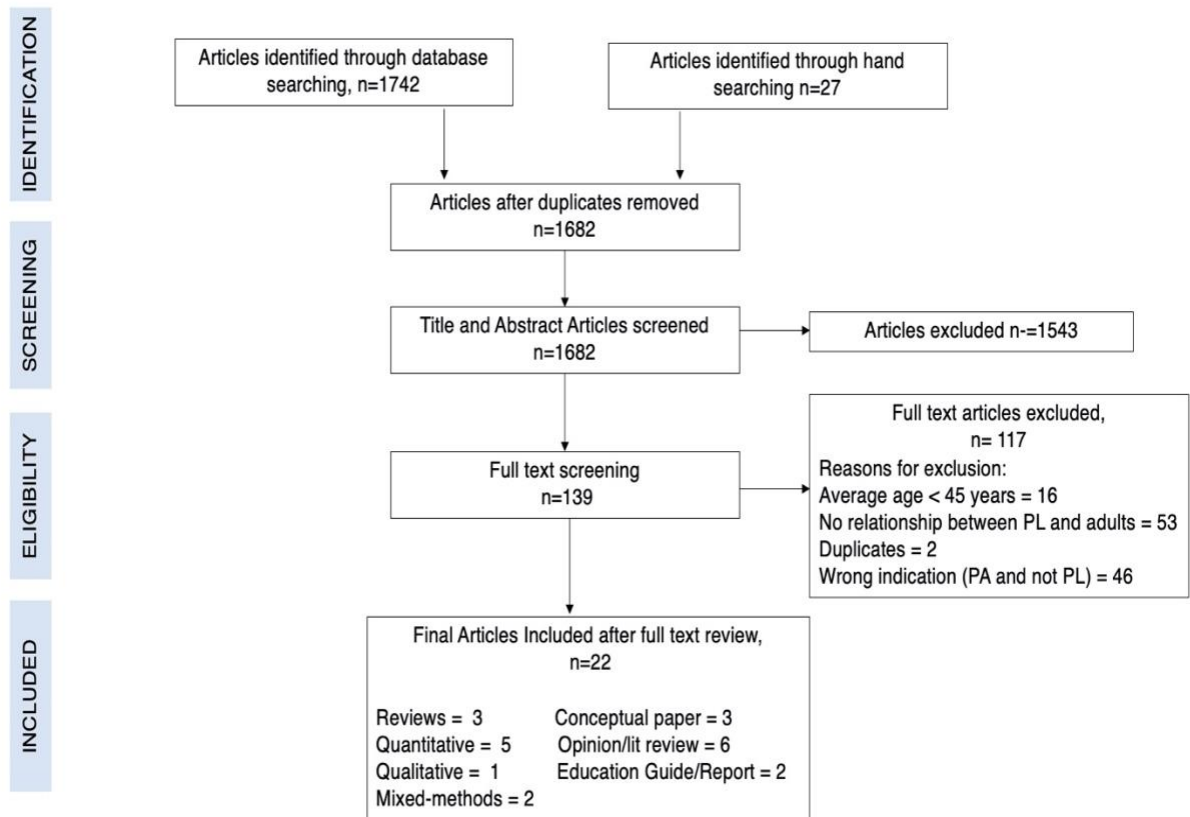


Table 1: Article Identification Process

Process	Detail
Sampling Strategy	Selective Databases: from medicine, sports, allied health, nursing, science and social science fields within specified limits Journal hand searching from reference lists
Type of Article	All grey literature (reports, un-published papers/data, government documents and information documents), qualitative research (phenomenology, grounded theory, ethnography, action research and exploratory approaches, quantitative research (randomized controlled trials, quasi-experimental trials, before and after trials) and systematic reviews
Approaches	Citation searches, cross referenced with google scholar and contact with authors
Range of Years	Beginning of January 2000 to March 2021
Language	English
Inclusion and exclusions	Inclusion: Empirical and theoretical research aimed at framing physical literacy for adults No exclusion
Key terms used	“physical literacy” OR “physical activity”, AND “adults” OR “aging” AND “rehabilitation” OR “mobility” OR “physical functioning” OR “mobility” OR “health promotion” OR “prevention” OR “public health”
Electronic Sources	Medline Ovid, CINAHL, Cochrane Library, Embase, and AMED

Table 2: Description of the Literature

Article Description	Citation, Year	Study/Article type	Country	Population	Social Sector Promoting Physical Literacy	Theories and Frameworks referenced
Reviews	Edwards, 2018(47)	Systematic Review	UK	All ages	Education Sport Community	Phenomenological
	Edwards, 2017(33)	Systematic Review	UK	All ages	Education Sport Community	Monist/holistic ontology Phenomenological Epistemology
	Huang, 2020(48)	Scoping Review	China	Community adults: avg age = 65- 74 years	Community	Self-efficacy
Quantitative	Matz Costa, 2018(49)	RCT	US	Inactive community older adults: avg age = 75.5 years	Community	The Social Model of Health Promotion
	Stathokostas, 2017(50)	RCT	Canada	Inactive community adults and older adults avg age = 70.3 years	Community	Transtheoretical Model of the Stages of Change
	Holler, 2019(51)	Quasi-experimental Pilot Study	Austria	Inactive community adults: avg age = 45 years	Community	Self-efficacy
	Stathokostas, 2016(52)	Pre-post Study	Canada	Inactive community older adults: avg age = 70 years	Community	Self-efficacy
	Stathokostas, 2020(53)	Cross-sectional Survey	Canada	Community adults and older adults: avg age = 70 years	Community	NA
Qualitative	Monte Campelo, 2020(56)	Qualitative Focus Groups	Canada	Community older adults: avg age = 73.5 years	Community	Theory of Diffusion of Innovations Technology
Mixed Methods	Jones, 2018(54)	Mixed Methods Consensus Study and Conceptual Model presented	Canada	Health professionals discussing PL for community older adults, ≥ 65 years	Health Promotion Public Health/Policy Community	Social Cognitive Theory Self-Efficacy

	McMahon, 2019(55)	Mixed Methods Inductive Sequential	US	Community older adults: avg age = 72 years	Community	Behaviour Change Theory
Grey Literature	Cairney, 2019(27)	Literature Review and Conceptual Model presented	Canada	All ages	Health Promotion Education Sport	Self-determination Self-efficacy
	Longmuir, 2016(60)	Literature review	Canada	All ages	Education Sports Community	NA
	Dudley, 2017(58)	Literature review and conceptual model presented	Australia	All ages	Public Health/Policy Health Promotion Sport Education	The four pillars of physical literacy policy
	Roetert, 2019(67)	Literature review and conceptual model presented	US	Community older adults, ≥ 65 years	Health Practitioners PA promotion Community	Ecological Model Pesce's Gross Motor Competencies Training Selection Optimization and Compensation
	Roetert, 2018(57)	Opinion Paper	US	All ages	Health Practitioners Sports Education	NA
	Roetert, 2014(59)	Opinion paper	US	All ages	Education Community	NA
	Higgs, 2019(28)	Physical Literacy information package designed for all ages	Canada	All ages	Education Health Practitioners PA Promotion Sports Community	NA
	Almond, 2015(44)	Opinion Paper	UK	All ages	Education Health Practitioners Community	NA
	Whitehead, 2013(45)	Opinion paper	UK	All ages	Community	NA
	Jones, 2016(69)	Commentary	Canada	Older Adults	Sport PA promotion Community	NA
Kitchen, 2014(46)	Commentary	Canada	Older Adults	Community	NA	

Table 3: Results: Physical Literacy Components

Whitehead physical literacy components	No. (%)
Engagement in physical activity	22
Motivation	17
Confidence	17
Knowledge/understanding of PA	12
Physical competence	4
Value of physical activity	2

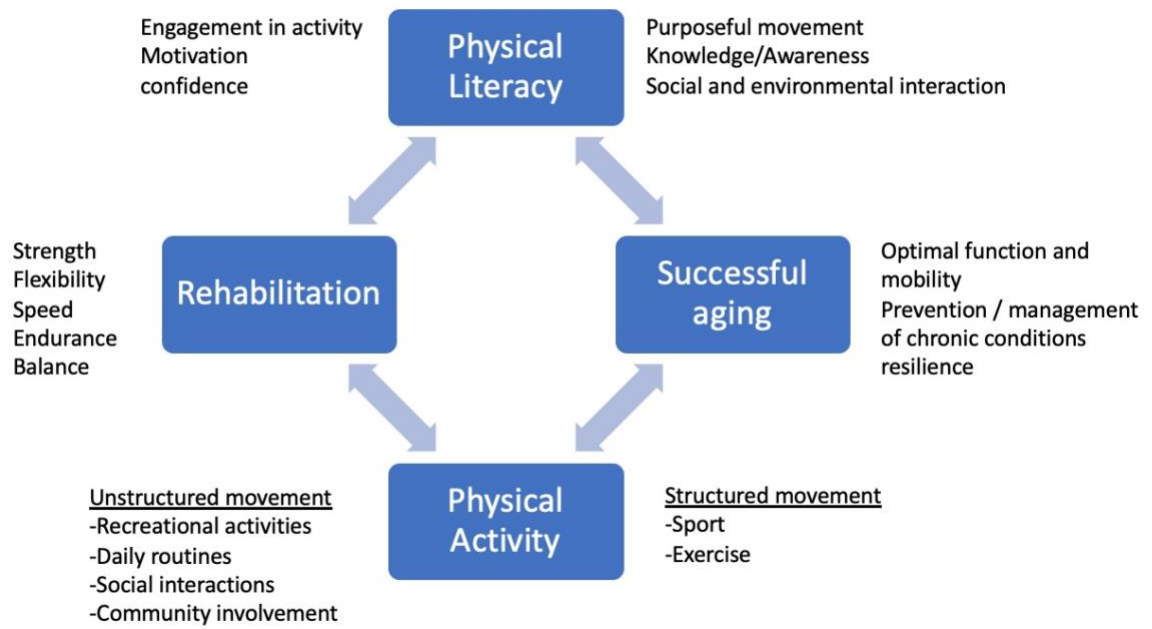
New Physical literacy components	No. (%)
Meaningful person centered and purposeful activities	18
Knowledge of body changes related to aging	12
Social interactions/interpersonal relationships	12
Diversity/variety of movement	11
Physical/age adaptation	10
Environmental awareness/understanding	9
Positive affect/attitude	6
Self-regulation	6
Adequate balance/strength/mobility/endurance	4
Sustained movement	3
Safety awareness	3
Cognitive activity	3
Resilience	2
Proficiency of movement/motor skills	2
Capacity for an active lifestyle	2
Optimize choices/maximize success	1
Mastery experience	1
Diet	1

Table 4: Summary of studies which evaluated physical literacy interventions

Author, Year, Study Design	Study Objective	Population	PL Interventions	Outcomes utilized to measure PL	Results
Matz Costa (49), 2018 RCT	To evaluate the feasibility and outcomes of the Engaged4Life program (personally meaningful activity program).	Inactive community dwelling adults Average age = 75.5 N=30	PL intervention: Tech-assisted self-monitoring Psychoeducation Goal setting One on one peer mentoring Control group: self-monitoring (no tech)	<ul style="list-style-type: none"> Physical activity: # of steps (Fitbit) Cognitive Activity: # of cognitive activities engaged in each day (from a list of 14) Social Interaction: # of social interactions engaged in each day and how stressful or positive these engagements were (scale of 1-5) Personal Meaning: 4 questions that were rated on a scale 0-2 asking about what they did that day that was personally meaningful 	Improvements in all 4 domains (greatest for # of steps) for the intervention group, however study not powered to detect a significant difference between the self-monitoring and the multi-intervention PL groups
Stathokostas (50), 2017 Cluster RCT	To study the longer-term levels of adherence to PA of older adults who have participated in the GFAL program; To determine the long-term functional fitness changes post-GFAL participation; To determine the long-term changes in psychosocial determinants of PA; To provide an exploratory description of factors associated with continued PA participation and to compare long-term GFAL outcomes to a group receiving booster sessions.	Community dwelling healthy, but inactive older adults N=176 and average age = 70.3	Eight-week community-based group GFAL program in 5 communities Participants attended 3 exercise sessions with one session including an additional education session Education topics included benefits of PA, strengthening and stretching, healthy eating, exercise adherence, exercise for chronic diseases, safety, and maintaining an exercise program at. The exercise classes included a cardio,	<ul style="list-style-type: none"> Self-efficacy (lifestyle and task specific) Physical function (Short SPPB) Mobility disability (400-meter walk) Physical Fitness (Seniors Fitness Test) PA (Phone FiTT interview) Exercise Participation 	Improvements in exercise adherence with 66% exercise retention at 12 months. Functional and physical fitness outcomes gained during the eight-week GFAL program were maintained at the six-month follow up. Lack of motivation was reported as the second most common reason (32%) reported by non-adherents in the study. No change in self-efficacy and outcomes expectations.

			strength, flexibility and balance.		
Holler (51), 2019 Quasi-experimental	To assess the effects of a holistic physical exercise training on PL among physically inactive adults.	Inactive community dwelling adults Average age = 45 N=60	Exercise: strength, endurance and functional exercises Education with print material Cognitive exercises Physical activity games (involving walking and running) Tailoring exercises and education to meet participant needs Positive feedback	The following subjective reports (questionnaires) were used to provide a total PL score <ul style="list-style-type: none"> Physical activity: IPAQ-SF Attitude towards a physically active life: Stanford 5 City questionnaire Exercise Motivation: Sport motivation Scale Exercise self-confidence: 3 Self-efficacy scales Exercise knowledge: open ended questions 	Significant improvements were found for the domains of PA behaviour and exercise self-efficacy with no intervention effect for the other domains
Stathokostas (50), 2016 Pre-post study	To determine the functional fitness and psychosocial changes over an 8 week Get Fir for Active Living (GFAL) program for sedentary older adults	Community dwelling healthy, but inactive older adults Average age = 70 N= 210	Education on exercises for chronic conditions, safety and how to maintain movement at home or community. Build PL skills and confidence through experiences in the gym Motivation strategies including goal setting.	<ul style="list-style-type: none"> Physical function: SPPB Mobility Disability: 400-meter walk General flexibility: seniors fitness test Self-efficacy scales including task specific self-efficacy and lifestyle self-efficacy Outcome expectations scale 	Significant improvements for self-efficacy, and SPPB. The timed up and go and LE strength tests improved significantly

Figure 2: Physical literacy for adults through a rehabilitation lens



Supplementary Table s1. Assessment Criteria for Text and Opinion

JBI Critical Appraisal Checklist	Cairney, 2019(27)			Longmuir, 2016(60)			Dudley, 2017(58)			Roetert, 2019(67)		
	yes	no	unclear	yes	no	unclear	yes	no	unclear	yes	no	unclear
Assessment Criteria												
Is the source of the opinion clearly identified?	X			X			X			X		
Does the source of opinion have standing in the field of expertise?	X			X			X			X		
Are the interests of the relevant population the central focus of the opinion?	X				X		X			X		
Is the stated position the result of an analytical process, and is there logic in the opinion expressed?	X			X			X			X		
Is there reference to the extant literature?	X			X			X			X		
Is any incongruence with the literature/sources logically defended?	X			X			X				X	

JBI Critical Appraisal Checklist	Roetert, 2018(57)			Roetert, 2014(59)			Higgs, 2019(28)			Almond, 2015(44)		
	yes	no	unclear	yes	no	unclear	yes	no	unclear	yes	no	unclear
Assessment Criteria												
Is the source of the opinion clearly identified?	X			X			X			X		
Does the source of opinion have standing in the field of expertise?	X			X			X				X	
Are the interests of the relevant population the central focus of the opinion?		X			X		X				X	
Is the stated position the result of an analytical process, and is there logic in the opinion expressed?		X		X			X			X		
Is there reference to the extant literature?	X			X			X			X		
Is any incongruence with the literature/sources logically defended?	X				X			X			X	

JBI Critical Appraisal Checklist	Whitehead, 2013(45)			Jones, 2016(69)			Kitchen, 2014(46)					
	yes	no	unclear	yes	no	unclear	yes	no	unclear	yes	no	unclear
Assessment Criteria												
Is the source of the opinion clearly identified?	X			X			X					
Does the source of opinion have standing in the field of expertise?	X			X			X					
Are the interests of the relevant population the central focus of the opinion?	X			X			X					
Is the stated position the result of an analytical process, and is there logic in the opinion expressed?		X		X				X				
Is there reference to the extant literature?		X		X				X				

Is any incongruence with the literature/sources logically defended?		X			X			X				
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Supplementary Table s2. Assessment Criteria for Qualitative Research

JBI Critical Appraisal Checklist	Monte Campelo, 2020(56)		
	yes	no	unclear
Assessment criteria			
There is a congruity between the stated philosophical perspective and the research methodology	X		
There is congruity between the research methodology and the research question or objectives	X		
There is congruity between the research methodology and the methods used to collect data	X		
There is congruity between the research methodology and the representation and analysis data	X		
There is congruity between the research methodology and the interpretation of results	X		
There is a statement locating the researcher culturally or theoretically		X	
The influence of the researcher on the research, and vice versa, is addressed			X
Participants, and their voices, are adequately represented	X		
The research is ethical according to current criteria or, for recent studies, there is evidence of ethical approval by an appropriate body	X		
Conclusions drawn in the research report do appear to flow from the analysis, or interpretation, of the data	X		

Supplementary Table s3. Mixed Methods Studies

Mixed Methods Appraisal Tool (MMAT)	Jones, 2018(54)			McMahon, 2019(55)		
	yes	no	unclear	yes	no	unclear
Assessment Criteria						
Are the sources of qualitative data (archives, documents, informants, observations) relevant to address the research question (objective)?	X			X		
Is the process for analyzing qualitative data relevant to address the research question (objective)?	X			X		
Is appropriate consideration given to how findings relate to the context, e.g., the setting, in which the data are collected?			X	X		
Is appropriate considerations given to how findings relate to the researchers' influence, e.g., through their interactions with participants?			X			X
Is the sampling strategy relevant to address the quantitative research question (quantitative aspect of the mixed methods question)?	X			X		
Is the sample representative of the population under study?	X			X		
Are measurements appropriate (clear origin, or validity known, or standard instrument)?	X			X		
Is there an acceptable response rate (60% or above)?	X			X		
Is the mixed methods research design relevant to address the qualitative and quantitative research questions, or the qualitative and quantitative aspects of the mixed methods question (or objective)?	X					X
Is the integration of qualitative and quantitative data (or results) relevant to address the research question (objective)?	X			X		
Is appropriate consideration given to the limitations associated with this integration, e.g., the divergence of qualitative and quantitative data (results) in triangulation design?	X					X

Supplementary Table s4. Assessment Criteria for Cross-sectional studies

JBI Critical Appraisal Checklist	Stathokostas, 2020(53)		
	yes	No	unclear
Assessment Criteria			
Were the criteria for inclusion in the sample clearly defined?	X		
Were the study subjects and the setting described in detail?		X	
Was the exposure measured in a valid and reliable way?	X		
Were objective, standard criteria used for measurement of the condition?	X		
Were confounding factors identified?	X		
Were strategies to deal with confounding factors stated?			X
Were the outcomes measured in a valid and reliable way?	X		
Was appropriate statistical analysis used?	X		

Supplementary Table s5. Assessment Criteria for Quasi-experimental studies

JBI Critical Appraisal Checklist	Stahokostas, 2016(52)			Holler, 2019(51)		
	yes	no	unclear	yes	no	unclear
Assessment Criteria						
Is it clear in the study what is the 'cause' and what is the 'effect' (i.e., there is no confusion about which variable comes first)?	X			X		
Were the participants included in any comparisons similar?	X		X	X		
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	X		X			X
Was there a control group?		X			X	
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	X			X		
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	X			X		
Were the outcomes of participants included in any comparisons measured in the same way?	X			X		
Were outcomes measured in a reliable way?	X			X		
Was appropriate statistical analysis used?	X			X		

Supplementary Table s6. Assessment Criteria for Randomized Controlled Trials

JBI Critical Appraisal Checklist	Stathokostas, 2017(50)			Matz Cost, 2018(49)		
	yes	no	unclear	yes	no	unclear
Was true randomization used for assignment of participants to treatment groups?		X		X		
Was allocation to treatment groups concealed?			X	X		
Were treatment groups similar at the baseline?	X			X		
Were participants blind to treatment assignment?		X		X		
Were those delivering treatment blind to treatment assignment?	X			X		
Were outcomes assessors blind to treatment assignment?	X			X		
Were treatment groups treated identically other than the intervention of interest?	X			X		
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	X			X		
Were participants analyzed in the groups to which they were randomized?	X			X		
Were outcomes measured in the same way for treatment groups?	X			X		
Were outcomes measured in a reliable way?	X			X		
Was appropriate statistical analysis used?	X			X		
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	X			X		

Supplementary Table s7. Assessment Criteria for Systematic Reviews

JBI Critical Appraisal Checklist	Edwards, 2017(33)			Edwards, 2018(47)			Huang, 2020(48)		
	yes	no	unclear	yes	no	unclear	yes	no	unclear
Assessment Criteria									
Is the review question clearly and explicitly stated?	X			X			X		
Were the inclusion criteria appropriate for the review question?	X			X			X		
Was the search strategy appropriate?	X			X			X		
Were the sources and resources used to search for studies adequate?	X			X			X		
Were the criteria for appraising studies appropriate?			X	X			X		
Was critical appraisal conducted by two or more reviewers independently?	X				X				X
Were there methods to minimize errors in data extraction?		X				X	X		
Were the methods used to combine studies appropriate?	X			X			X		
Was the likelihood of publication bias assessed?			X	X				X	
Were recommendations for policy and/or practice supported by the reported data?	X			X			X		
Were the specific directives for new research appropriate?	X			X			X		

Supplementary Table s8: Summary of Papers

Author and Year	Level of Evidence and Study Design	Country Population Sample size	PL definition	Study/Article Purpose	Key contextual information related to PL and adults	Theories or framework discussed	Professional Associations	Main Outcome measure discussed/ assessed	Future research
Edwards (35), 2018	Level 2A Systematic review	UK All ages	Y (70% of papers used Whitehead definition)	To review and evaluate the measurement and assessment attempts of PL and its constructs	Self-report measures are used to assess PL for adults. These measures ask questions related to PA and may not relate to the activities older adults do through the day (i.e., gardening)	phenomenological	Children/ Academic/ Schools Sport Adults Older adults	PL is holistic and cannot be measured/assessed in the traditional/ conventional sense. Self-report measures to assess adults may not be accurate	Future research should assess PL beyond the constructs of physical proficiencies and use a more holistic approach
Edwards (23), 2017	Level 2A Systematic review	UK All ages	Y (70% of papers used Whitehead definition)	Conduct a SR of the PL construct, define the properties of PL and theoretical associations of the construct	Children and adults can all develop PL. The same constructs for children can be used for adults. Adults PL is associated with previous PA experience and positive experiences from school and others	Monist/ holistic ontology and phenomenological epistemology	Children/ Scholars/ Academic Sport Adults Older adults	Current literature contains different representations of PL. There is the sport representation of PL and the Margaret Whitehead holistic representation of PL with difference philosophical underpinnings	Theory development and research is needed to better approach PL. Clear definitions of PL are needed so that these can be translated into practical setting
Huang (36), 2020	Level 2A Scoping Review	China Average age = 65-74	Y – Whitehead definition	To identify and analyze gaps in the topic of PL among older adults and explore the measurement of older adults' physical competence under the concept of PL	Physical adaptations Self-supportive Age adaptation Optimizing choices Maximize success Proficiency in movement capacities and movement patterns. Adequate balance, strength and mobility play a crucial role	holistic	Community Older adults	No studies measured physical competence under the concept of PL. Most quantitative measurements looked at gait speed, timed up and go, sit to stand test, stabilometer and posture platforms and 1 rep max test. Single leg stance was also used a lot. Simple capacities, combined capacities and complex capacities were used. Physical competence can never be the sole constituent of PL	There is limited research to assess physical competence for older adults. Limited attention to positioning PL in public health
Matz-Costa (37), 2018	Level 2b RCT	US Average age – 75.5 In-active community dwelling adults Men and women N=30	No definition of PL reported	evaluate participants' adherence to and engagement with the Engaged4Life Program and assess the primary and secondary outcomes of the intervention, compared to a technology-assisted self-monitoring only control group, for the purpose of informing future efficacy trials.	physical activity (move) cognitive activity (think) social interaction (connect) The "engagement model" empowers older adults to enhance or supplement their existing "activity portfolios" in ways that naturally incorporate physical activity, cognitive activity and social interaction. This approach prioritizes personally meaningful activities	The Social Model of Health Promotion (SMHP), proposed by Linda Fried	Community Older adults	Recruitment is feasible and engagement was high No difference between the control (self-monitoring) group and the Engaged4Life (tech assisted self-monitoring, psychoeducation and goal setting, and one on one peer mentoring) group. Outcomes: # of steps = no statistical difference between groups as they both increased Cognitive activity = no stat diff Social interaction = no stat diff Personal meaning = no stat diff	High engagement for a self-empowering program with PL principles. More research is needed to evaluate long term outcomes

Stathokostas (38), 2017	Level 2b Cluster randomization trial	Canada Average age = 70.3 n=176 Inactive community dwelling adults	No mention of PL definition, however, study is addressing many of the constructs of PL	1) study the longer-term (six- and 12-month) levels of adherence to physical activity of older adults who have participated in the GFAL program; (2) determine the long-term (six-month) functional fitness changes post-GFAL participation. (3) determine the long-term (six- and 12-month) changes in psychosocial determinants of physical activity. (4) provide an exploratory description of factors associated with continued physical activity participation and issues related to noncompliance; and (5) compare long-term GFAL outcomes to a group receiving booster sessions.	Self-efficacy Awareness knowledge The GFAL program provides novice older adults an introduction to the benefits of exercise, builds participants' skills, physical literacy, and confidence through experiences in the gymnasium, weight room, and education sessions. Education topics included: benefits of physical activity, motivation, goal setting, and exercise adherence, exercise for various chronic diseases, safety, and maintaining an exercise program at home or in the community.	transtheoretical model of the stages of change. Self-efficacy	Community inactive older adults	Self-efficacy outcomes expectations, Physical Function – SPPB, Mobility disability – 400-meter walk, General flexibility - seniors fitness test, Task specific self-efficacy, and lifestyle self-efficacy. Self-efficacy and SPPB improved significantly, as well as timed up and go and LE strength tests Phone FiTT for exercise participation and Exercise participation as measured by the stages of change	Long term adherence is determined by progressing adults through the stages of change and using multi-dimensional principles to increase confidence and motivation with movement, as well as education
Holler (39), 2019	Level 2b Non-RCT Pilot study	Austria Inactive community dwelling adults Average age = 45 N=60	Yes - Whitehead	A 15-week pilot study to assess the effects of a holistic physical exercise training on PL among physically inactive adults. First attempt to measure PL in inactive adults	PA behaviour, attitude towards physically active lifestyle, exercise motivation, exercise knowledge, exercise self-confidence Intervention included either strength, endurance or a multimodal related activity. Education, cognitive exercise games involving walking and running. Promote mastery experiences (self-efficacy) by tailoring to physical and mental capacities of participants. Positive feedback and print materials for guidelines and tips. 15-week intervention	Self-efficacy	Community adults	Outcomes looked at compliance and total physical literacy score based on developed questionnaires. IPAQ-SF was used for physical component (PA), attitude toward a physically active life was assessed with the Stanford 5 City study questionnaire, exercise motivation was assessed with the sport motivation scale and exercise self-confidence was measured with 3 scales. Exercise knowledge was assessed with open ended questions. These were used to give a total PL score. Significant improvements were found for the domains of PA behaviour and exercise self-efficacy	This is a non-validated measurement tool for adults. Results are useful for further public health activities for physically inactive adults

								with no intervention effect for the other domains	
Stathokostas (40), 2016	Level 2b Pre-post study	Canada Community dwelling healthy inactive older adults N= 210 Average age - 70	No mention of PL definition, however, study is addressing many of the constructs of PL	The purpose was to determine the functional fitness and psychosocial changes over the eight-week program in previously sedentary older adults	Self-efficacy Awareness knowledge The GFAL program provides novice older adults an introduction to the benefits of exercise, builds participants' skills, physical literacy, and confidence through experiences in the gymnasium, weight room, and education sessions. Education topics included: benefits of physical activity, motivation, goal setting, and exercise adherence, exercise for various chronic diseases, safety, and maintaining an exercise program at home or in the community.	Self-efficacy	Community inactive older adults	Self-efficacy and outcomes expectations, Physical Function – SPPB, Mobility disability – 400-meter walk, General flexibility - seniors fitness test, Task specific self-efficacy, and lifestyle self-efficacy. Self-efficacy and SPPB improved significantly, as well as timed up and go and LE strength tests	Improving self-efficacy is key to making physical changes
Stathokostas (41), 2020	Level 3 Quantitative Study – Cross-sectional Survey Analysis	Canada N=725 Adults and older adults. Average age = 70	Yes - Whitehead	A survey of older adults was conducted understand if PL was a familiar term to them and what it meant to them and if they would like to learn more. The purpose of this is to ensure effective materials are developed to promote PL for adults and older adults		NA	Community dwelling adults and older adults		
Jones (42), 2018	Level 3 Mixed Methods Consensus study and conceptual model	Canada Adults ≥65 years	Yes, Whitehead definition	Assemble a collaborative working group of researchers with perspective of PA and aging and develop an evidence-based model of PL for older adults. The aim of this project is to develop a framework that captures integral aspects of PL that validly organized and presents key facts in a manner that can be used to guide informational approaches that promote with respect to knowledge exchange among older adults,	Intrapersonal elements: motivation, confidence, physical competence, knowledge and understanding, prioritizing and sustaining engagement in physical activities (outcome expectations, perceptions of older age, attitudes), individual factors (sex, income etc.) Interpersonal: personal relationships (formal and informal)	ecological approach, concepts from social cognitive theory (self-efficacy, outcome expectations)	Community dwelling older adults, health promotion, policy change in public health	The individual older adult is at the center of the PL model: Addresses motivation and how this will change with other adults - health and maintaining physical and mental independence may be potent motivators for PA participation confidence to make and sustain feasible changes and confidence to overcome barriers knowledge and understanding older adults tend to have limited knowledge of current PA recommendations for their age-group sustaining engagement: Negative	

				knowledge use by practitioners and knowledge creation by researchers.				stereotyping of old age There must also be a consideration for an examination of PL from a life course perspective. Organizational: Personal relationships such as family, friends, and broader personal social networks Community: Socio-cultural norms and expectations, Built environment, Natural environment, Policy	
McMahon (43), 2019	Level 3 Mixed Methods Inductive sequential	US Older adults average age = 72 N=102	No mention of PL definition – use of PL constructs	To explore older adults' use of community resources. Answers to these questions will provide information about utilization to improve our understanding of which resources might need to be bolstered or better disseminated, and which needs, and gaps might persist.	awareness, intrinsic motivation, confidence, physical activity, walking, personally meaningful	Behaviour Change	Community dwelling older adults	Older adults used resources that support walking most frequently 4 Themes emerged: 1) Identifying a Broad Range of Local Community Resources - primarily walking 2) Learning From Trusted Sources - friends they can relate to 3) The Dynamic Gap Between Awareness and Use of Community Resources - awareness does not lead to use 4) Using Internal Resources to Avoid Fall - not using or aware of fall prevention classes	Further support is needed for fall prevention and PA. Efforts should include research that looks at how to best disseminate, implement and promotion strategies. More collaborations are needed with experts in these fields.
Monte Campelo (44), 2020	Level 3 Qualitative study with focus groups	Canada Older adults Average age = 73.5 N=15	Yes, Whitehead	This study aims to examine older adults' perceptions of the use of wearable and exergame technologies to engage in physical exercise programs and improve PL. Also aims to describe older adults' perceptions of the use of technologies to engage in physical exercise programs.	cognitive, affective, behavioral and physical exercise self-regulation	PL theoretical framework theory of diffusion of innovations technology acceptance model	Community dwelling older adults	Themes that emerged from the focus groups teaching technology skills knowledge about PA How to use technology, i.e., Fitbit Competitiveness Concerns for others Confidence Cooperation Enjoyment Gratefulness Motivation Sense of humour Innovative ways to engage PA Family interaction Peers' interaction Season weather challenges Size of exercise group Balance control Motor skills Physical rehabilitation	Current evidence supports the use of the PL concept with older adults focusing on the following challenges:1. Increasing their health-related quality of life;2. Achieving the recommended PA amount;3. Continuing their participation in social, economic, and cultural activities

								Sense of exercise progression Sense of improvement Sense of physical competence	
Cairney (45), 2019	Level 5 Conceptual Model	Canada All ages	Discusses different definition for PL and argues that PL can be pragmatic and measured based on physical competence, positive affect and motivational constructs.	1) present a conceptual model positioning PL as a health determinant based on how public health may see PL as health promotion and disease prevention 2) Evidence to support PL as a health determinant	The model takes a life course approach from early childhood to old age. confidence/motivation, social participation, positive affect: fun, happiness, enjoyment, movement competence: land, air, water and knowledge. Individual factors and environmental contextual	self-determinati on theory and self-efficacy	Health promotion Argues that PL can be a determinant of health and measured Education Children Physical activity and sport researchers	Conceptual framework demonstrating the relationship between PL and health promotion and disease prevention with a public health view to have a broader impact. The definition of PL in this paper is positioned to include children and adults throughout the life-course. No distinction is made between defining PL for children and PL for adults.	More research is needed regarding PL and a health determinant
Longmuir (49) 2016	Level 5 Literature Overview and 10 research questions proposed	Canada All ages	Yes, Whitehead	To collect the top 10 research questions related to physical literacy based on current literature and expert opinion.	physical activity behavior is a barometer of physical literacy motivation individual and environmental factors The same PL constructs for children are used for adults in this paper	NA	Education Children Community adults	Are the benefits of an intervention that increases physical literacy at one age/developmental stage maintained through later developmental/life stages What interventions are most effective for enabling those with lower physical literacy to restart their physical literacy journey? Do interventions for remediation need to differ from interventions to maintain current levels of physical literacy?	There is still much to learn about PL and there are currently more questions than answers New research efforts are needed to better measure PL
Dudley (47), 2017	Level 5 Conceptual Model	Australia All ages	Many different definitions of PL including Whitehead. Dudley's definition is the main reference: PL is an umbrella concept that captures the knowledge, skills, understanding	Traces the progression of being (and becoming) literate and this relates to PL. Presents a model that identifies four pillars of policy formulation for health, sport, and education when examining PL. There must be a	Movement competencies (movement skill development) Rules tactiles and strategies of movement, motivation and behavioural skills of movement, personal and social attributes of movement Pillar 3 – The journey of movement –	The four pillars of Physical Literacy Policy	Public Health recreation Policy Health promotion Sport Education Practitioners in health and sport, health disciplines	PL still does not have the research behind it to support best practice in reduction of chronic conditions or the promotion of PA participation Education, recreation, sport and public health agencies have a role in ensuring physically literate individuals	Policymakers need to ensure that individuals are given opportunities to acquire a vast array of MCs. People need to be equipped with not only competency skills for now but that capacity to innovate and adapt their

			s, and values related to taking responsibility for purposeful physical activity and human movement across the life course, regardless of physical or psychological constraint.	process to ensure all four of these pillars (movement competencies, movement contexts, the journey of movement, and power structures of movement) have been addressed.	movement competencies will change to meet their physiological capability			Dudley’s definition allows for practical measurement and may be more useful for practitioners, especially with measurement of change. Also, more useful with implementing PL into public health, sport and education policy	movement needs to future movement settings There is a need for physically literate societies
Roetert (55), 2019	Level 5 Conceptual model	US Older adult	Yes, Whitehead	To review the concept of PL and discuss the role of PL for the older adult and how strength and conditioning can support this view. Introduce ecological action items to support PL journey as a guide for practitioners in the various physical activity–related fields. Introduce a basic, beginner resistance training program focused specifically on the inactive and moderately active older adult. The program addresses key posture, stability, balance, and strength exercises identified as being helpful in promoting ADLs	Sustained engagement: competence, confidence, motivation, knowledge/ understanding, social interaction, movement, enjoyment, age adaptation, environment, age-appropriate experiences, culture, community, social inclusion Resistance exercises Self-efficacy Participation Engagement Lifelong journey Movement skills Diversity of PA	Ecological Model Pesce’s Gross motor competencies training Selection, optimization and compensation (SOC)	Strength and conditioning practitioners community Older adults Physical Activity promoters Health practitioners	The model proposed focused on sustained engagement and the constructs that contribute to this. Strength and resistance functional exercises and improve PL	Specific programs and activities for older adults supporting PL have not been addressed fully in the literature. A PL exercise program is proposed with 5 functional resistance exercises focusing on key movement skills to prevent injuries and increase participation PL is a personal lifelong journey
Roetert (46), 2018	Level 5 Opinion Paper	US All ages	Yes, Whitehead	The purpose of this article is to provide some background, about the potential greater adoption of physical literacy as a key component in sports medicine. The paper presents PL constructs and a model that can be used to go beyond sports and influence health	PA Behaviour, motivation, motor skills, positive affect	NA	Sports Medicine Health Care Physical Education	With aging PL is not considered a skill, but rather a disposition to use experience, understanding and abilities to interact effectively within the world PL offers this holistic approach to enable active participation across the lifespan and sports medicine professionals can have a profound influence on its	The development of PL individuals will require collective action among organizations and sectors to achieve success More research beyond the sectors of physical education and sport needs to be stimulated Healthcare professionals

				professionals for individuals of all ages.				continued development. The healthcare and sports medicine sectors can play an integral role in promoting physical activity for a lifetime and help develop confident and competent movers of all ages and in all environments (land, air, water, snow, ice).	need to embrace PL principles into their programs
Roetert (48), 2014	Level 5 Opinion Paper	US All ages	Yes, Whitehead	The purpose of this article is to provide some background, about the potential greater adoption of physical literacy as a key component in the field of education	PL should be carried throughout the life course. PL is a crucial acquisition and means for active participation in the societies and economies of the 21st century	NA	Education Community adults	There are many definitions of PL that continue to evolve over the years. Whitehead (2010) has proposed that physical literacy should not be viewed simply as a state of being but rather as a capability that has to be developed and maintained throughout the course of a person's life. She further stated that physically literate individuals will achieve an enhanced quality of life-related to the development of self-esteem, self-confidence, healthier lifestyles, and more positive relationships with others. Most importantly, however, is the belief that physical literacy can be achieved by all.	PL is essential for full development and achievement.
Higgs (50), 2019	Level 5 Information Package	Canada All ages	Yes, Whitehead	Presents a document that can be used by many disciplines to support PL through all stages of life. Discuss strategies on how to deliver these programs. This is a rationale and roadmap for all to use to engage in an active lifestyle founded on PL.	full human capacities, involving larger muscle groups Embodiment poise, economy and confidence in a wide variety of physically challenging situations Outline the age-related stages of the physical literacy journey And advocate for the physical literacy	NA	Education Program Designers Recreational Professionals Parents and Coaches Sport Leaders Health Practitioner Older adults	physical literacy must encompass more than physical movement, it must include an ability to 'read' the environment and to respond effectively.	Family, peers and the medical profession are all significant here and opportunities for activity should be readily available in the local environment.

					as a journey metaphor				
Almond(32), 2015	Level 5 Opinion Paper	UK All ages	Yes, Whitehead	To explore how PL can be applied to adults. To discuss how practitioners work with adults and the significance of empowerment in the promotion of PL.	Movement capability Value and inspire PA Energize and enrich lives Purposeful physical pursuits Significant to life Meaningful engagement Empowerment and agency Self-control and self-regulation Competence potential Resource for living well Self-movement resilience	NA	Education Children Adults Older adults Health professionals	PL is a personal interpretation	PA cannot be the central focus of PL
Whitehead, (33) 2013	Level 5 Opinion Paper	UK All ages	Yes, Whitehead	Outline the age-related stages of the physical literacy journey Advocate for the physical literacy as a journey metaphor	Engaging in a variety of movement experiences movement of different types, in different environments and under different circumstances. motivation, confidence, competence, and knowledge and understanding are at the heart of the disposition. Physical activity PL is not a state that is reached and then persists throughout life – setbacks caused my chronic conditions is an issue to attend to There appears to be a trigger or significant event that causes the PL journey to change direction	NA	Older adults Adults Community programs	Every individual will experience a unique PL journey. Different phases according to the age of the individual. An individual can be seen to travel through six stages. where physical literacy has been established, Community facilities are essential for physical literacy to be maintained. In older age, physical literacy needs to be sustained within the context of changes in the physical potential of the individual.	With a sound understanding of the value of physical activity and a lifetime of positive experiences in exercise, the older person can embrace physical literacy in a modified form.
Jones, (56) 2016	Level 5 Commentary	Canada Older adults	Yes, uses the term physical literacy and quotes Whitehead	Inspiring a movement directed at promoting physical activity literacy for older adults, who can do much more than simply	Physical activity adoption Physical movement skills Self-efficacy	NA	Older adults Sport and physical activity	No approach available to frame physical activity literacy for older adults There are a narrow range of exercises	Innovative research into teaching older adults' new activities or relearning past skills to increase their repertoire of

				walking for exercise. Inspire physical activity adoption and maintenance for the longer term. Building upon physical movement skills to improve self-confidence and create an opportunity for older adults to access a greater diversity of physical activity choices that will inevitably support successful aging.				chosen for older adults Older adults should be exposed to variety of physical activity experiences to increased physical functioning and QOL They need to learn new skills or relearn past skills to increase their repertoire of PA opportunities	physical activity opportunities is warranted
Kitchen (34), 2014	Level 5 PL Movement Guide	Canada Older adults	Yes, Whitehead	a PL exercise program designed for older adults. The goals of the Movement Preparation are: To improve the way adults move and reduce the risk of falls or injury during physical activity. To make life easier for adults: to increase the ease of execution of ADLs and to improve strength and stamina to enjoy rec activities. To develop both skills and confidence in movements that help increase both aptitude and ability to participate in unfamiliar activities. To foster a more physically active and healthy lifestyle.	Movement Preparation Exercise Program: balance, reaction, speed and agility and feel more confident performing daily tasks and recreation activities Execution of movements Movement skills Physical activity Participation in unfamiliar activities	NA	Community Older adults	To provide a guide for older adults to improve the way adults move (decrease falling risk and injury), improve ADL abilities, improve strength and stamina, to develop skills and confidence in movements, to foster a physically active and healthy lifestyle	Integrate PL programs into the community for older adults

CHAPTER 3:

**FRAMING PHYSICAL LITERACY FOR ADULTS THROUGH A REHABILITATION LENS: AN EXPERT
CONSENSUS STUDY**

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**Framing Physical Literacy for Adults through a Rehabilitation Lens:
An Expert Consensus Study**

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Abstract

Objective: With almost 2 million Canadians reporting a mobility limitation there is a need for population health efforts to promote physical literacy principles for aging adults and adults with chronic conditions. Research indicates a positive relationship between physical literacy and healthy aging; however, there remains a lack of consensus on what components are required to become a physically literate adult. The objective of this study was to understand how physical literacy for adults is characterized from the perspectives of healthcare professionals.

Methods: Physiotherapy leaders and physical literacy researchers identified as rehabilitation experts through sampling criteria were invited to an online consensus panel. Panelists were presented with 6 questions related to physical literacy and rehabilitation to answer anonymously. A nominal group technique was used for idea generation, clarification, and ranking.

Results: Seven experts participated in the consensus forum. Confidence and safety with movements, motivation and commitment to physical activity, the ability to self-monitor changes in physical function and understanding the benefits of physical activity were reported as the top key components when defining physical literacy for adults.

Conclusion: Findings from our consensus study indicate that there is a need to re-conceptualize the current physical literacy definition to include the rehabilitation needs of adults living with chronic conditions. Having an awareness of purposeful activities, the benefits of movement and how to sustain movement, through fluctuations in health, is the foundation to becoming a physically literate adult. Designing programs that promote physical literacy have potential to improve function and mobility for aging adults.

Key words: Physical literacy, adults, chronic conditions, rehabilitation, physiotherapy, health promotion

Background

The prevalence of chronic conditions has continued to rise dramatically over the last decades, posing serious public health concerns (Roberts et al. 2015). Multimorbidity, defined as the co-occurrence of two or more chronic conditions, is a challenge for our healthcare system due to the various competing health demands and the coordination of care that is required to effectively manage multiple health issues (Broemeling et al. 2014). Musculoskeletal changes associated with aging such as decreased muscle strength, impaired balance, decreased flexibility and pain further contribute to the function and mobility challenges that are commonly linked to multimorbidity (Broemeling et al. 2014).

Although the health benefits of physical activity for aging adults and adults with chronic conditions are well established, less than 1 in 4 Canadian adults are meeting the physical activity guidelines (Clarke et al. 2019). Public health efforts aimed at increasing physical activity for aging adults have demonstrated mixed outcomes with short term behavior changes reported more often than long term behavior changes (Howlett et al. 2019; Norman et al. 2007). Engaging in and sustaining movement continues to be a problem, specifically for adults who are living with multimorbidity.

With almost 2 million Canadians reporting a mobility limitation there is a need for population health efforts involving healthcare professionals who specialize in movement impairments to address the functional needs and mobility barriers of adults living with chronic conditions (Statistics Canada 2013). If aging adults and adults with multimorbidity are to improve and sustain their physical function through movement activities and rehabilitation strategies, they will require a level of physical literacy as the foundational support (Sum et al. 2020).

The term physical literacy has been cited in the literature more frequently over the last 30 years, specifically within sport and education fields as a result of the work of Whitehead (Edwards et al. 2017). Whitehead describes physical literacy as a philosophical and multi-dimensional construct that embodies a holistic approach to the mind and body (Whitehead 2001). She explains physical literacy as a journey and lived embodiment to a better quality of life (Whitehead 2001). There are varying definitions in the literature, however Whitehead's definition of physical literacy as "the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life" is widely accepted and is supported by the International Physical Literacy Association (Tremblay et al. 2018). Many sectors in Canada, including sport, recreation, physical activity, education, and public health have embraced physical literacy and are making it a core priority. According to Whitehead, physical literacy is intended to be a lifelong journey that encompasses an individual's physical (movement competence), affect (motivation and confidence) and cognitive (knowledge and understanding) dimensions (Whitehead 2001). Research in physical literacy has mainly focused on physical education for children and youth and little is known about the benefits of physical literacy for adults and older adults (Giblin et al. 2014).

An integrative review was recently conducted to understand which critical components are currently used to frame physical literacy for aging adults (≥ 45 years) (Petrusovski et al, 2021). A total of 22 articles that met the inclusion criteria were identified. Most papers were conceptual models and literature reviews and only 4 quantitative physical literacy intervention studies for adults were identified, indicating a paucity of published material confirming the necessary components comprising a physically literate adult. Interestingly, when describing physical literacy for adults, several new reported components that differ from the traditional

physical literacy definition were identified. Meaningful and/or purposeful activities, knowledge of age-related changes, social interaction and diverse activities were among the top 4 components reported when describing physical literacy for adults (Petrusevski et al, 2021).

As individuals age and adjust to chronic conditions, their competence with motor tasks and confidence with movement may decline, and their knowledge and understanding of how to move and maintain mobility may change. The set of skills necessary for an older adult to acquire or re-acquire physical literacy, will increasingly focus on maintaining adequate function and mobility to ensure physical independence. These physical literacy components for adults aligns with the goals and strategies of rehabilitation. When considering The World Health Organization's definition of rehabilitation as "a set of interventions designed to optimize function and reduce disability in individuals with health conditions in interaction with their environment" it is evident that the physical literacy components with adults support the goals and strategies of rehabilitation (WHO 2022). Physical literacy is a multifaceted construct and, therefore, increasing physical activity alone will likely not address all the required physical literacy domains, such as exercise self-confidence, and physical activity behavior that is needed to increase uptake and sustainability of physical activity.

Research indicates a positive relationship between physical literacy and healthy aging; therefore, it is important to develop and implement population health programs that focus on improving physical literacy for aging adults who are living with multimorbidity to lessen the burden on our healthcare system (Sum et al. 2020). However, before we can design programs to promote physical literacy, we must first define and frame physical literacy for adults through a rehabilitation lens, incorporating all the important constructs that embody a physically literate adult. It is important to look beyond the sports and physical activity realm to include physical

literacy constructs within the physical, affective, and cognitive domains that will improve the important outcomes related to rehabilitation and the management of chronic conditions for adults and older adults. The specific aims of the present study were to understand how physical literacy for adults is characterized from the perspectives of primary care physiotherapists, rehabilitation researchers and public health leaders.

Methods

Design

A comprehensive expert consensus approach was used to pursue a common understanding and harmonization of physical literacy constructs important to adults who are living with chronic conditions. An on-line face to face working group meeting with a Nominal Group Technique (NGT) was utilized to achieve consensus (McMillan et al 2016). Through discussion, participants were asked to:

1. Share ideas and experiences to better understand what the important components are when defining physical literacy for adults and for adults with chronic conditions.
2. Identify what rehabilitation principles/strategies should be included in a physical literacy public health program for adults who are living with chronic conditions.
3. Share ideas on how rehabilitation knowledge can be disseminated at a population level to improve physical literacy for individuals most in need.

The Nominal Group Technique was chosen as an optimal method for this study, as it is designed to generate ideas, explore opinions, and determine priorities with facilitation by a group leader (McMillan et al. 2016; Potter et al. 2004). This method also includes participants with lived experiences in the topic discussed. We planned for 7-10 expert

panelists, as is recommended with the nominal group technique (McMillan et al. 2016). The aim was to establish a panel that was large enough to represent the views of different stakeholders but also small enough to create discussion and reach consensus.

Ethical Approval

Ethics approval for the study was obtained from the Hamilton Integrated Research Ethics Board (Project ID: 8062). All panel members gave their written consent to participate in the study.

Sampling and Recruitment

Leaders in rehabilitation and research were sought from various fields to leverage different points of view on physical literacy and aging. The forum selection criteria included the following criteria:

- a) Physical therapists in primary care and/or in the management of chronic conditions OR clinical researchers with publications in the fields of physical literacy or rehabilitation research
- b) Innovative leaders in the rehabilitation/physiotherapy profession and/or primary care and population health
- c) An interest in sharing knowledge and improving health outcomes for aging adults and adults with chronic conditions using rehabilitation and mobility strategies
- d) English speaking

Purposive sampling based on the above criteria resulted in 10 identified participants, including 6 physiotherapists and 4 clinical researchers. An invitation email describing the study, the participant requirements and the proposed date for the consensus forum was sent to potential participants. Five sampled participants were unable to commit to the forum date and time. The

sample recruitment was asked to identify additional participants for the consensus forum using the sampling criteria. From there, 2 additional participants were identified by the group. Our final sample included 7 experts in the areas of physical literacy, rehabilitation, physical therapy, and knowledge translation from across Canada and the United States

Prior to the consensus workshop, panelists were sent a package of pre-readings to complete for the consensus meeting. The pre-readings consisted of a background information related to the prevention and management of multiple chronic conditions for adults and the relationship with physical literacy. Refer to Supplementary Material 1. The definition of physical literacy (“the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life”) was presented in the pre-readings for the participants to review. In addition, a document summarizing the results of our recent integrative review on physical literacy and aging adults was also presented (Petrusovski et al. 2021). Findings from the integrative review, such as emerging constructs used to define physically literate adults, as well as current physical literacy interventions designed for adults were summarized in the pre-readings for the panelists.

Expert Consensus Group Data Collection

A two-hour facilitated consensus workshop was conducted virtually using an electronic meeting system (EMS) and led by an expert group facilitator from Queens University Executive Decision Center at the Smith School of Business. This consensus workshop aimed to support idea generation, idea consolidation, idea evaluation and planning (Fitch et al. 2001). At the meeting, panelists were presented with six questions related to the necessary physical literacy components required to maintain physical activity, and physical functioning for aging and adults and adults

with chronic conditions. Refer to Table 1. Anonymous responses were aggregated and displayed on a shared screen. Participants were able to submit multiple responses to each question. Panelists openly discussed all selected answers for group consensus on common themes. The group was then asked; “which of these are the most important components.” Individuals anonymously selected their top 5 choices, and the overall results were then displayed on the screen to the group for further discussion. Predetermined levels of agreement are chosen. Through the group rating process, items on the list are either accepted, rejected, or carried forward for an additional round of rating. Participants are provided with facilitator-led feedback on the group’s ratings for each item, which is carried forward to the next round.

Results

A working group of 7 clinical and academic experts were included in the consensus meeting. This involved 3 physiotherapists with a range of backgrounds, including an experienced sports and manual physical therapist with a successful health promotion/prevention clinic targeting older adults, a physical therapist and clinical research coordinator in the field of optimal aging and a physical therapist leading Ontario health system strategy and policy planning related to chronic conditions and aging. The remaining 4 academic leaders included 3 physiotherapists and professors in the field of optimal aging, mobility, and functional outcomes, and 1 Registered Nurse, Epidemiologist and Professor in the field of chronic conditions and the prevention of disability in older adults. The majority of the consensus participants were from Canada with 1 academic expert from the United States.

Response rates from consensus group participants were 100% (7/7) for all 6 consensus questions.

Defining Physical Literacy for adults with chronic conditions

Fifteen components were reported as the most important components of physical literacy for adults (>45 years) from a health and rehabilitation perspective, (Figure 1). Group consensus resulted in the following top 5 components: 1) confidence and/or self-efficacy with movement (n=6), 2) confidence in safety of movement and making decisions related to activities that are safe (n=5), 3) motivation and commitment to physical activity (n=5), 4) the ability to self-monitor changes in physical function (n=5) and 5) understanding the benefits of physical activity and what to do despite physical limitations (n=5). When asked “how would you describe a physically literate adult”, a total of 10 characteristics were reported (Figure 2). Consensus resulted in the following 4 priority attributes: 1) overcomes limitations & barriers to movement and adapts to engage in physical activity and able to move with optimal movement patterns with consideration for any physical limitations (n=6), 2) being active and engaged in some form of physical activity as a strategy to maintain one’s health and function (n=6), 3) educated and knowledgeable around benefits of physical activity/movement and expresses value and importance of physical activity for health and 4) has resources, access and supports to seek out different activities/opportunities to maintain function (n=5).

The intersection of physical literacy and rehabilitation for adults and older adults with chronic conditions

There were 9 responses to the question “how does being physically literate support the aging process”, (Figure 3). All 7 participants agreed that being physically literate improved the number of years lived with better functional health and greater independence as the priority

answer (n=7). The following ideas were also reported; physical literacy combats mental health struggles associated with declining function/independence (n=5), being physically literate limits unnecessary deconditioning, which can lead to development of new health conditions and increased risk of falls (n=5), physical literacy lowers risk for chronic conditions (n=5) and physical literacy can promote community engagement and minimize isolation (n=5).

Participants provided 13 responses when asked “which rehabilitation strategies can be shared at a population level to improve physical literacy for aging adults and adults with chronic conditions?” A total of 13 responses were recorded (Figure 4). Consensus identified the following population level priorities: 1) exercise programs that promote upright balance, mobility, and speed (n=6), 2) incorporate self-efficacy and self-management strategies into public health programs (n=5), 3) strategies designed to reduce fall risk (n=4), 4) education on the importance of body mechanics/strategies to reduce injury risk in ADLs (n=4), 5) education on the importance of maintaining aerobic capacity (i.e.: walking tolerance) (n=4), 6) education on the importance of maintaining strength (n=4) and 7) education on how to manage symptoms common to chronic conditions (fatigue, pain, stress, etc.) (n=4).

Lastly, participants were asked “how can we effectively disseminate these proposed rehabilitation strategies using non-targeted (universal) approaches and a targeted approaches at the population level?” (Figure 5). Participants were provided with the following explanation and examples of non-targeted and targeted approaches: Targeted health promotion initiatives apply to a priority sub-group within a broader, defined population. For example, designing community health hubs in low-income neighborhoods would be a targeted approach to increase access to

healthcare for individuals in need. Non-targeted or universal health promotion approaches apply to an entire population, such as all adults over the age of 45 years. For example, public health messaging to increase physical activity via television and radio is a universal approach and has the potential to reach all individuals, regardless of race or income. Ten non-targeted dissemination approaches were identified by the participants. Consensus provided the following 5 priorities: 1) advocating with municipalities to enable built environments to encourage physical activity (reducing structural barriers, increasing equity and access) (n=6), 2) embed efforts within existing government bodies/infrastructure (e.g. Ontario Health Teams in Ontario) to integrate goals within infrastructure (n=5), 3) use of public spaces (e.g. libraries, community centres) (n=5), 4) working with primary care health centres to disseminate exercise prescription strategies or general education (n=5), 5) improve public health messaging about the benefits of physical activity (n=4) and the use of visual graphics to support physical literacy in public spaces (i.e. bus stops, malls) (n=4).

Nine targeted dissemination strategies were suggested by the panel (Table 7). Consensus identified the following top 5 strategies: Partnering with disease-specific organizations (e.g. arthritis, diabetes, etc.) (n=7), working with Indigenous communities or other vulnerable groups (n=6), participating in existing programming at different community centres or public spaces (n=5), partnering with disease specific outpatient or ambulatory care programs in hospitals or primary care (n=5) and partnering with mental health associations/organizations to co-design programs (n=4). Refer to Figure 6 for a list of all targeted dissemination strategies suggested by the panel.

Discussion

Findings from our consensus study indicate that important constructs related to acquiring physical literacy as an aging adult may differ from those constructs representing the current physical literacy definition. Framing physical literacy for adults with the inclusion of rehabilitation resources and a focus on optimal mobility and function strategies may add value in promoting the maintenance of movement for life. In the older adult population, the ability and confidence one has to participate in various physical activities is a strong predictor of life-long participation in healthy sustaining physical activity opportunities (Stathokostas et al. 2017). Our consensus study of health and rehabilitation professionals confirms this finding, as confidence/self-efficacy for movement was rated as the most important physical literacy component for adults (>45 years). Interestingly, confidence in safety of movement (and having confidence to choose safe activities) was rated the second most important priority of physical literacy for adults. This demonstrates the difference in how one may describe physical literacy for children and youth compared to aging adults with and without chronic conditions. Safety with movement and choosing safe activities is not expressed in the current physical literacy definition, however this appears critical for aging adults. For adults who are experiencing changes in their function and mobility and living with challenges associated with chronic conditions, such as pain, decreased strength and loss of range of motion, it is important that they understand their functional level and have the option to choose safe and physically appropriate challenges (Nicolson et al. 2017). Becoming a physically literate adult happens when adults experience the optimal degree of challenge for their stage of development and current physical competence (Dudley et al. 2017). Encouraging opportunities for adults to try new activities and progress their physical ability in a safe environment with rehabilitation coaches provides

opportunities to succeed with the physical literacy journey. The consensus panelists rated motivation and commitment to physical activity as the third most important physical literacy component for adults. Having the motivation to move and to move purposefully, regularly and with attention to changes in movement patterns has consistently shown to be integral for the development of physical literacy through all ages (Edwards et al. 2017). However, for adults who are experiencing fluctuations in their health, maintaining a commitment to movement, despite health setbacks, can become increasingly difficult. Developing goals, setting expectations, and overcoming barriers is key to helping adults stay motivated to move (Richardson et al. 2014; Boulton et al. 2019).

Having the ability to self-monitor changes in function and mobility was rated as the fourth most important physical literacy component for adults. If adults are able to learn how to monitor changes in their physical function and mobility, such as walking speed, balance or lower extremity strength, they will be able to take proactive approaches to decrease their risk for further health related complications (Richardson et al. 2012). For example, research demonstrates that for community dwelling older adults, each reduction of 0.1 m/s in gait speed is associated with a 12% increased risk of early mortality and an 8% increased risk of cardiovascular disease (Veronese et al. 2018). Measuring walking speed is a demonstrated reliable and valid outcome measure for assessing and monitoring functional status for adults and older adults (Middleton et al. 2015). Therefore, publicly funded physical literacy programs to educate individuals on the importance of monitoring their own walking speed and how to measure one's walking speed and compare one's results to normative values will add value in addressing patient and healthcare needs.

There was overwhelming consensus from our study participants that developing and maintaining physical literacy for adults is consistent with the goal of successful aging and optimizes opportunities for improving the aging process. Physically literate adults can overcome barriers and make changes to their environment and physical adaptations to maintain the functional ability to do the activities they value, especially when experiencing the challenges associated with chronic conditions. This is synonymous with optimal aging, as adults who develop physical literacy are able to compensate and modify activity by optimizing choices, maximizing success and maintaining higher levels of functioning across all dimensions.

The consensus group agreed that to effectively disseminate this knowledge to a large audience, public health messages should move beyond the promotion of exercise to include targeted information specific to aging adults and adults with chronic conditions while supporting the enhancement of physical literacy. Physical therapists as rehabilitation specialists have an important role to play in moving rehabilitation strategies upstream with the goal of encouraging healthy, active living and maintaining mobility. Adopting population health initiatives in physical therapy practice will help inform the development of interventions and policies that improve disparities, such as multimorbidity (Magnusson et al. 2019).

Strengths and Limitations

There is a paucity of physical literacy recommendations for adults found in the literature and current discussions are based on expert opinion, together with a dearth of supporting evidence (Cornish et al. 2020). Undertaking a virtually delivered consensus exercise with an expert panel of health professionals and researchers with experience in physical literacy and rehabilitation allowed us to gain valuable data on the strength and extent of agreement for each

topic discussed. In addition, the forum allowed discussion around each panelist's reasoning for their answers and ratings. Although consensus forums are recognized as an effective tool for determining expert consensus, they have also been criticized as being vulnerable to a variety of biases (Nair et al. 2011). Including a diverse group of academic professionals, such as professors and optimal aging researchers and rehabilitation experts, such as clinical physical therapists and policy advocates in the forum may have produced alternate results. Including more stakeholders, such as patient and policy advisors may provide broader recommendations. It is also possible that framing the evidence prior to the consensus meeting could influence judgements and recommendations of the panel.

Implications for Practice, Policy, and Research

Improving and maintaining physical literacy for adults should be considered a potential strategy to tackle the ongoing challenges of functional and mobility decline secondary to aging and chronic conditions. Developing and/or adapting educational materials and public health messages so that persons with different levels of physical literacy skills can use the physical activity and rehabilitation information to make informed health decisions is paramount to addressing physical function and mobility disparities. Exercise programs that promote a variety of meaningful movement challenges such as strengthening, flexibility, balance, posture, and endurance activities are required. Incorporating behavior change strategies, such as self-efficacy for exercise and self-monitoring for age related changes are required to maximize effectiveness (Michie et al. 2011).

Evidence suggests that health promotion interventions focusing on modifying lifestyle behaviours are more effective if both targeted and non-targeted (universal) approaches are

utilized (National Collaborating Centre for Determinants of Health 2013; King et al. 2015).

Our consensus study agreed that a blended dissemination approach to increase awareness around physical literacy is needed. Partnering with condition representative organizations such as Diabetes Canada or The Arthritis Association and developing a physical literacy program with institutes that share a common vision for the management of chronic conditions will reach adults who may benefit the most. At the same time, there is a need to increase public health messaging about the importance and benefits of becoming a physically literate adult. This can be done through use of public spaces, such as libraries and community centres and working with geographic health authorities. Additionally, there is a need to advocate and reach out to municipalities to enable built environments by reducing structural barriers and encourage walking neighborhoods for adults and older adults.

Conclusions

A shift in public understanding of the importance of physical literacy for aging adults and adults with chronic conditions can positively influence key aging outcomes and help guide program development to integrate rehabilitation strategies. This expert consensus study has highlighted that physical literacy for adults and adults with chronic conditions involves increasing one's capacity to be able to choose safe and enjoyable movement activities, while monitoring one's own ability for movement, having the knowledge to identify early loss of movement components and knowing how to remediate restrictions. Having an awareness of the purposeful activities, the benefits of movement and how to sustain movement, through fluctuations in health and abilities, such as episodic fluctuations in multimorbidity is the foundation to becoming a physical literate adult and older adult. The rehabilitation profession, specifically physical therapy needs to

clearly define its role in health promotion and increase efforts in promoting physical literacy for adults. Establishing relationships with other health promoting professionals is needed to design and deliver publicly funded physical literacy programs that are grounded in rehabilitation principles for aging adults and adults with chronic conditions.

Contributions to Knowledge

What does this study add to existing knowledge?

- From the perspectives of rehabilitation experts, there is a need to re-conceptualize the current physical literacy definition to include the rehabilitation needs of aging adults.
- Physical literacy for adults and adults with chronic conditions involves increasing one's capacity to be able to choose safe and enjoyable movement activities, while monitoring one's ability for movement, having the knowledge to identify early loss of movement components and knowing how to remediate mobility restrictions.
- Having an awareness of purposeful activities, the benefits of movement and how to sustain movement, through fluctuations in health, is the foundation to becoming a physically literate adult.

What are the key implications for public health interventions, practice, or policy?

- Innovative population health approaches, designed and delivered by physiotherapists are needed to target the nearly 2 million Canadians who are living with mobility impairments.
- Framing public health programs with the identified rehabilitation and knowledge components needed to improve physical literacy for adults and delivered with a population health approach has potential to impact important functional health outcomes for adults and adults with chronic conditions.
- Building physically literate societies that are grounded in rehabilitation knowledge can promote positive health behaviours along the continuum of healthy aging.

References

- Boulton, E., Hawley-Hague, H., French, D.P., Mellone, S., Zacchi, A., Clemson, L., et al. Implementing behaviour change theory and techniques to increase physical activity and prevent functional decline among adults aged 61–70: The PreventIT project. (2019). *Progress in Cardiovascular Disease*, 62(2):147-156. doi:<https://doi.org/10.1016/j.pcad.2019.01.003>
- Broemeling, A.M., Watson, D.E., & Prebtani, F. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: implications for policy and practice. (2014) *Healthcare Quarterly*, 11(3),70-76. doi:10.12927/hcq.2008.19859
- Clarke, J., Colley, R., Janssen, I., & Tremblay, M. (2019). *Statistics Canada. Health Reports: Accelerometer-Measured Moderate-to-Vigorous Physical Activity of Canadian Adults, 2007 to 2017*. Available at: <https://www150.statcan.gc.ca/n1/en/catalogue/82-003-X201900800001>. Accessed February 2022.
- Cornish, K., Fox, G., Fyfe, T., Koopmans, E., Pousette, A., & Pelletier, C.A. (2020). Understanding physical literacy in the context of health: a rapid scoping review. *BMC Public Health*, 20(1):1569. doi:10.1186/s12889-020-09583-8
- Dudley, D., Cairney, J., Wainwright, N., & Kriellaars, D. (2017). Critical Considerations for Physical Literacy Policy in Public Health, Recreation, Sport and Education Agencies. *Quest*, 69(4):436-452. doi:10.1080/00336297.2016.1268967
- Edwards, L.C., Bryant, A.S., Keegan, R.J., Morgan, K., & Jones, A.M. (2017). Definitions, Foundations and Associations of Physical Literacy: A Systematic Review. *Sports Medicine*, 47(1),113-126. doi:10.1007/s40279-016-0560-7
- Fitch, K., Bernstein, S.J., Aguilar, M.D., Burnand, B., LaCalle, J.R., Lazaro, P., et al. (2001). *The*

RAND/UCLA Appropriateness Method User's Manual. RAND Corporation PP - Santa Monica, CA. https://www.rand.org/pubs/monograph_reports/MR1269.html.

Giblin, S., Collins, D., & Button, C. (2014). Physical Literacy: Importance, Assessment and Future Directions. *Sport Medicine*, 44,117-1184. doi:10.1007/s40279-014-0205-7

Howlett, N., Trivedi, D., Troop, N.A., & Chater, A.M. (2019). Are physical activity interventions for healthy inactive adults effective in promoting behavior change and maintenance, and which behavior change techniques are effective? A systematic review and meta-analysis. *Translational Behaviour Medicine*, 9(1),147-157. doi:10.1093/tbm/iby010

King, K., Meader, N., Wright, K., Graham, H., Power, C., & Petticrew, M., et al. (2015). Characteristics of Interventions Targeting Multiple Lifestyle Risk Behaviours in Adult Populations: A Systematic Scoping Review. *PLoS One*, 10(1). doi:e0117015. <https://doi.org/10.1371/journal.pone.0117015>

Magnusson, D.M., Eisenhart, M., Gorman, I., Kennedy, V.K., & Davenport, T. (2019). Adopting Population Health Frameworks in Physical Therapist Practice, Research, and Education: The Urgency of Now. *Physical Therapy*, 99(8):1039-1047. doi:10.1093/ptj/pzz048

McMillan, S.S., King, M., & Tully, M.P. (2016). How to use the nominal group and Delphi techniques. *International Journal of Clinical Pharmacy*, 38(3),655-662. doi:10.1007/s11096-016-0257-x

Michie, S., Ashford, S., Sniehotta, F., Dombrowski, S., Bishop, A., & French, D. (2011). A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychological Health*, 26(11):1479-1498. doi:10.1080/08870446.2010.540664.

Middleton, A., Fritz, S.L., & Lusardi, M. (2015). Walking speed: the functional vital sign.

Journal of Aging and Physical Activity, 23(2):314-322. doi:10.1123/japa.2013-0236

Nair, R., Aggarwal, R., & Khanna, D. (2011). Methods of formal consensus in classification/diagnostic criteria and guideline development. *Seminars in Arthritis Rheumatism*, 41(2):95-105. doi:doi: 10.1016/j.semarthrit.2010.12.001. Epub 2011 Mar 21. PMID: 21420149; PMCID: PMC3131416.

National Collaborating Centre for Determinants of Health. (2013). Let's Talk: Universal and Targeted Approaches to Health Equity. Antigonish, NS: National Collaborating Centre for Determinants of Health, St. Francis Xavier University.; 2013.

Nicolson, P.J.A., Bennell, K.L., Dobson, F.L., Van Ginckel, A., Holden, M.A., & Hinman, R.S. (2017). Interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee osteoarthritis: a systematic review and meta-analysis. *British Journal of Sports Medicine*, 51(10):791 LP - 799. doi:10.1136/bjsports-2016-096458

Norman, G., Zabinski, M., Adams, M., Rosenberg, D., Yaroch, A., & Atienza, A. (2007). A review of eHealth interventions for physical activity and dietary behavior change. *American Journal of Preventative Medicine*, 33,336-345.

Petrusovski, C., Morgan, A., MacDermid, J., Wilson, M., & Richardson J. (2021). Framing Physical Literacy for Adults: An Integrative Review. *Disability and Rehabilitation*, 16,1-12. PMID: 34913771 doi: [10.1080/0638288.2021.2012841](https://doi.org/10.1080/0638288.2021.2012841)

Potter, M., Gordon, S., & Hamer, P. (2004). The nominal group technique: a useful consensus methodology in physiotherapy research. *New Zealand Journal of Physiotherapy*, 32:126-130.

Richardson, J., Loyola-Sanchez, A., Sinclair, S., Harris, J., Letts, L., MacIntyre, N.J., et al. (2014). Self-management interventions for chronic disease: a systematic scoping review. *Clinical Rehabilitation*, 28(11):1067-1077. doi:10.1177/0269215514532478

- Richardson, J., Letts, L., Chan, D., Officer, A., Wojkowshi, S., Oliver, D., et al. (2012). Monitoring physical functioning as the sixth vital sign : evaluating patient and practice engagement in chronic illness care in a primary care setting – a quasi-experimental design. *BMC Family Practice*, 13(1):29. doi:10.1186/1471-2296-13-29
- Roberts, K., Rao, D., Bennett, T., Loukine, L., & Jayaraman, G. (2015). Prevalence and patterns of chronic disease multimorbidity and associated determinants in Canada. *Health Promotion and Chronic Disease Prevention Canada*, 35(6), 87-94. doi:10.24095/hpcdp.35.6.01. PMID: 26302227; PMCID:
- Stathokostas, L., Speechley, M., Little, R.M.D., Doerksen, S., Copeland, J., & Paterson, D. (2017). Long-term Evaluation of the “Get Fit for Active Living” Program. *Canadian Journal of Aging / La Rev Can du Vieil*, 36(1):67-80. <https://www.muse.jhu.edu/article/648490>.
- Statistics Canada. Disability in Canada: Initial findings from the Canadian Survey on Disability. <http://www.statcan.gc.ca/pub/89-654-x/89-654-x2013002-eng.pdf>. Published December 2013. Accessed February 2022.
- Sum, K.W.R., Li, M.H., Choi, S.M., Huang, Y., & Ma, R.S. (2020). In/Visible Physical Education and the Public Health Agenda of Physical Literacy Development in Hong Kong. *International Journal of Environmental Research and Public Health*, 17(9),3304. doi:10.3390/ijerph17093304
- Tremblay, M.S., Costas-Bradstreet, C., Barnes, J.D., Bartlett, B., Dampier, D., Lalonde, C. et al. (2018). Canada’s Physical Literacy Consensus Statement: process and outcome. *BMC Public Health*, 18(2),1034. doi:10.1186/s12889-018-5903-x
- Veronese, N., Stubbs, B., Volpato, S., Zuliani, G., Maggi, S., Cesari, M., et al. (2018). Association Between Gait Speed With Mortality, Cardiovascular Disease and Cancer: A Systematic Review and Meta-analysis of Prospective Cohort Studies. *Journal of the*

American Medical Directors Association, 19(11):981-988.

doi:10.1016/j.jamda.2018.06.007. Epub 2018 Jul 25. PMID:988 30056008.

Whitehead, M. (2001). The concept of physical literacy. *European Journal of Physical Education*, 6,127-138.

World Health Organization (WHO). <https://www.who.int/news-room/factsheets/detail/rehabilitation>. Accessed March 16, 2020.

Table 1: Consensus Questions

Objective 1: Defining Physical Literacy for Adults
1.1 What are the essential characteristics or attributes that should be included when defining or framing physical literacy for adults (≥ 45 years) from a health perspective (not a sport perspective)?
1.2 How would you describe a physically literate adult (≥ 45 years)?
Objective 2: Physical Literacy and Rehabilitation
2.1 How does being physically literate contribute to healthy ageing?
2.2 As adults age and are at an increased risk for multimorbidity, what rehabilitation strategies should be shared at a population level to improve physical literacy for adults?
2.3 If the above rehabilitation strategies were to be shared at a population level, how could we effectively get this information out to reach individuals most in need? What in-direct and direct delivery strategies do you suggest?
2.4 Is there a way to measure physical literacy for adults (≥ 45 years)?

Figure 1. Important physical literacy components

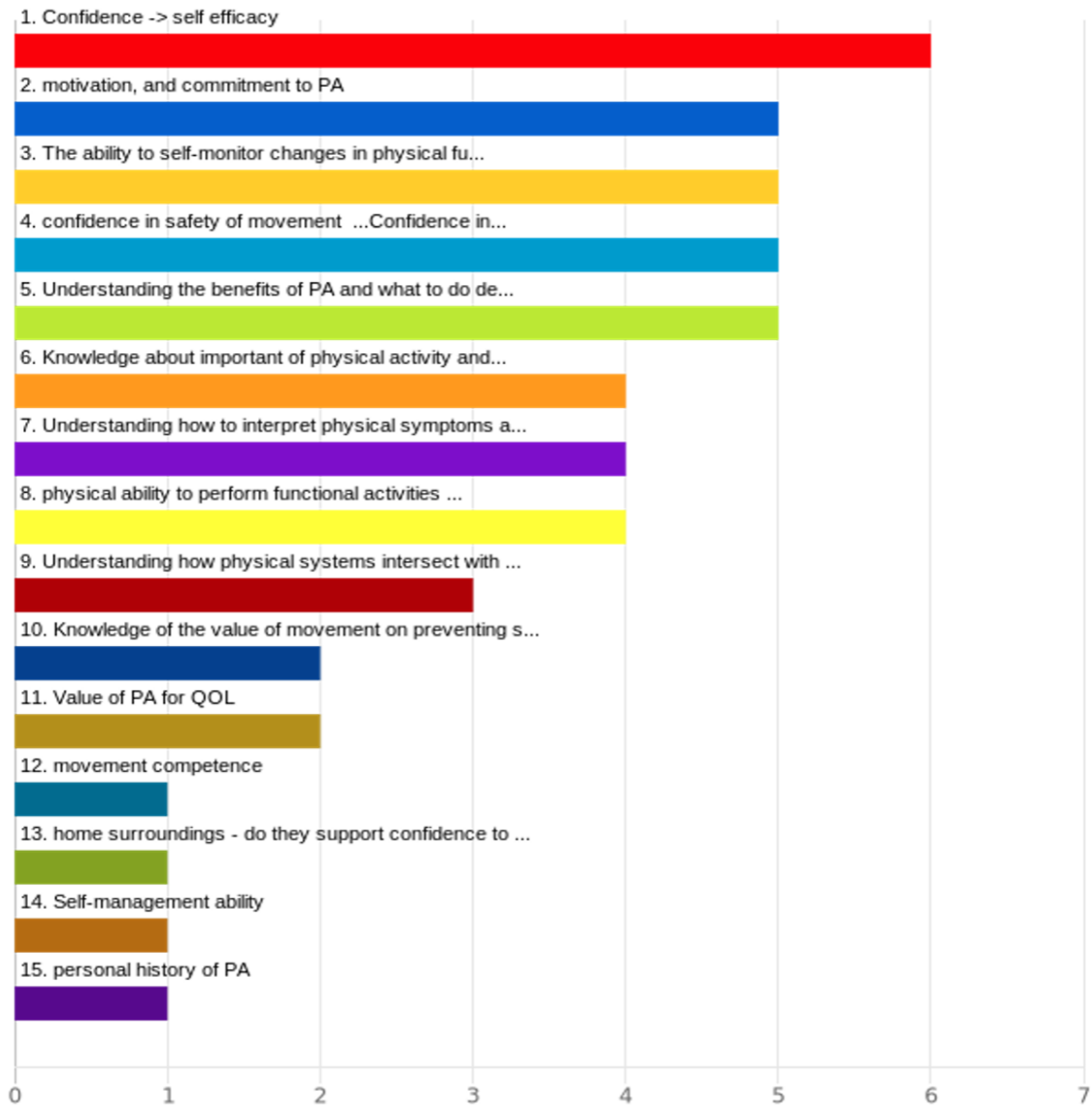


Figure 2. Physical literacy attributes for aging adults

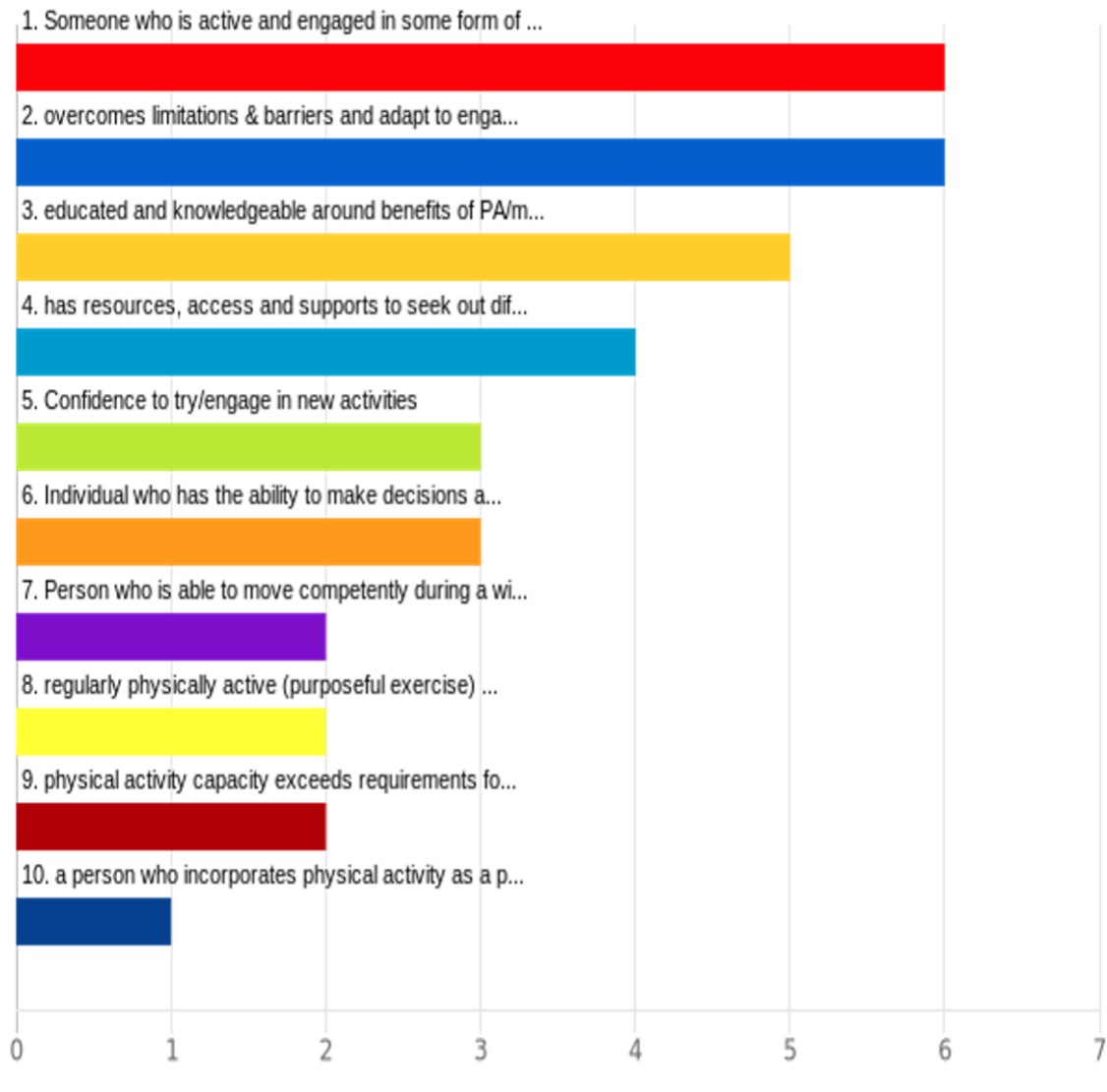


Figure 3. The link between physical literacy and the aging process

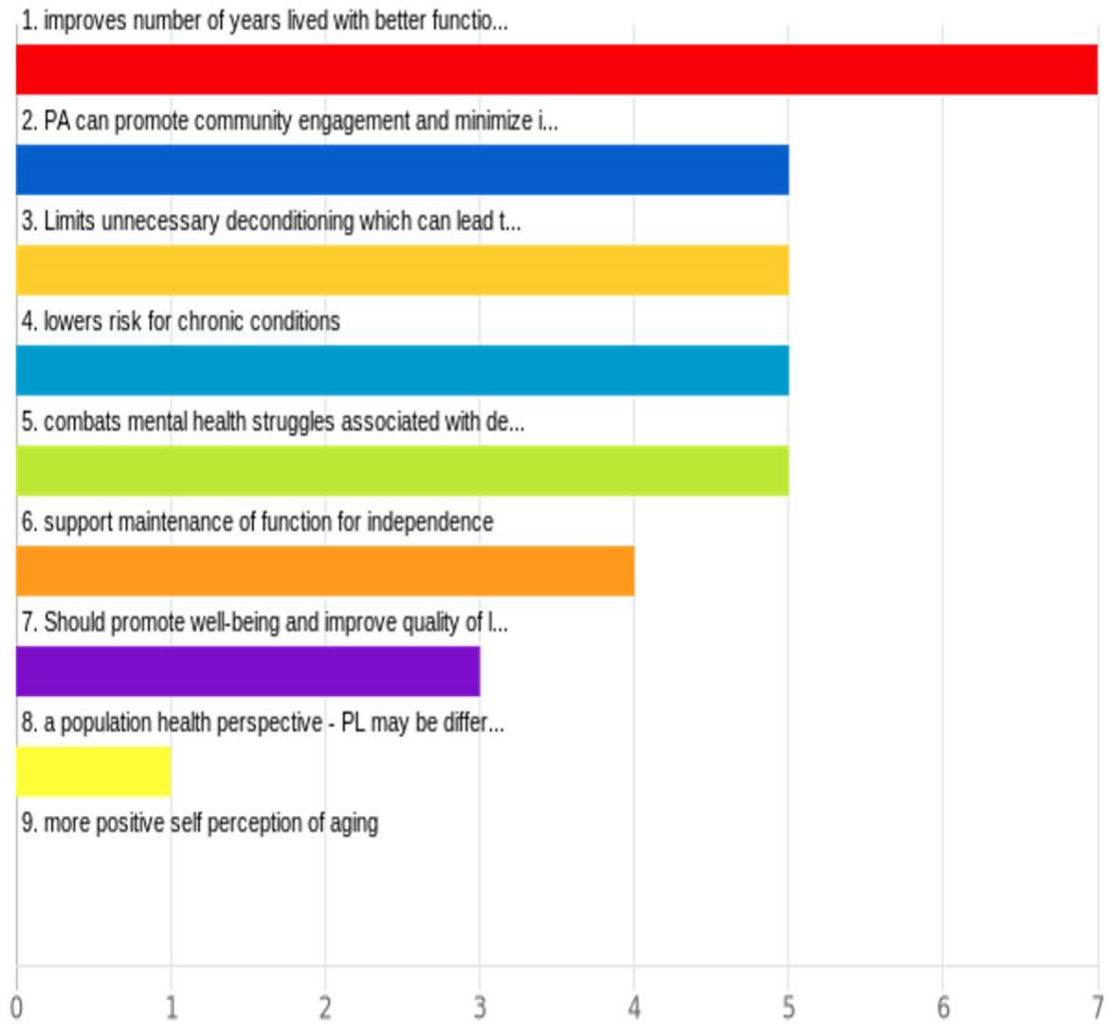


Figure 4. Rehabilitation strategies important to physical literacy and aging

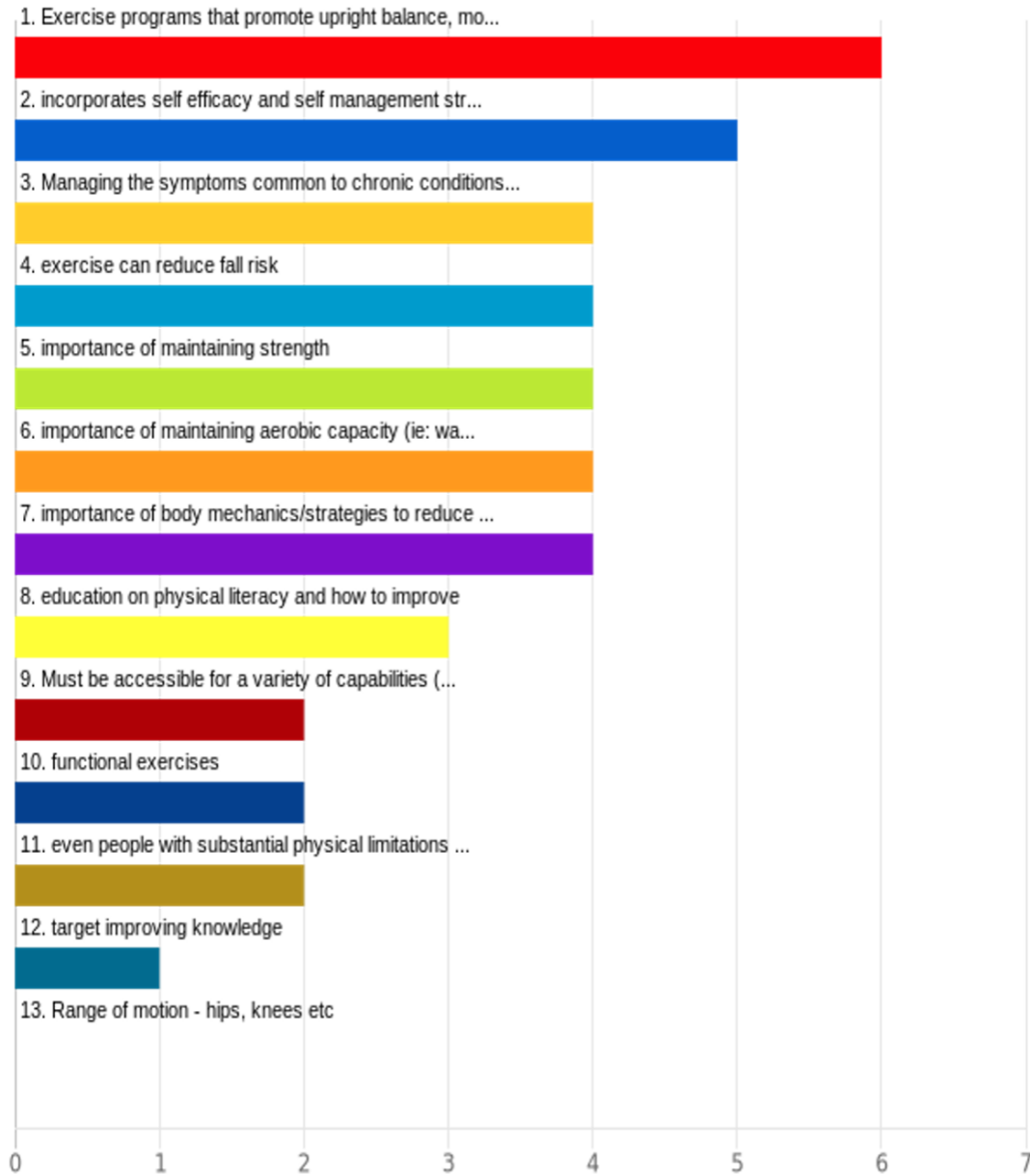


Figure 5. Non-targeted dissemination approaches

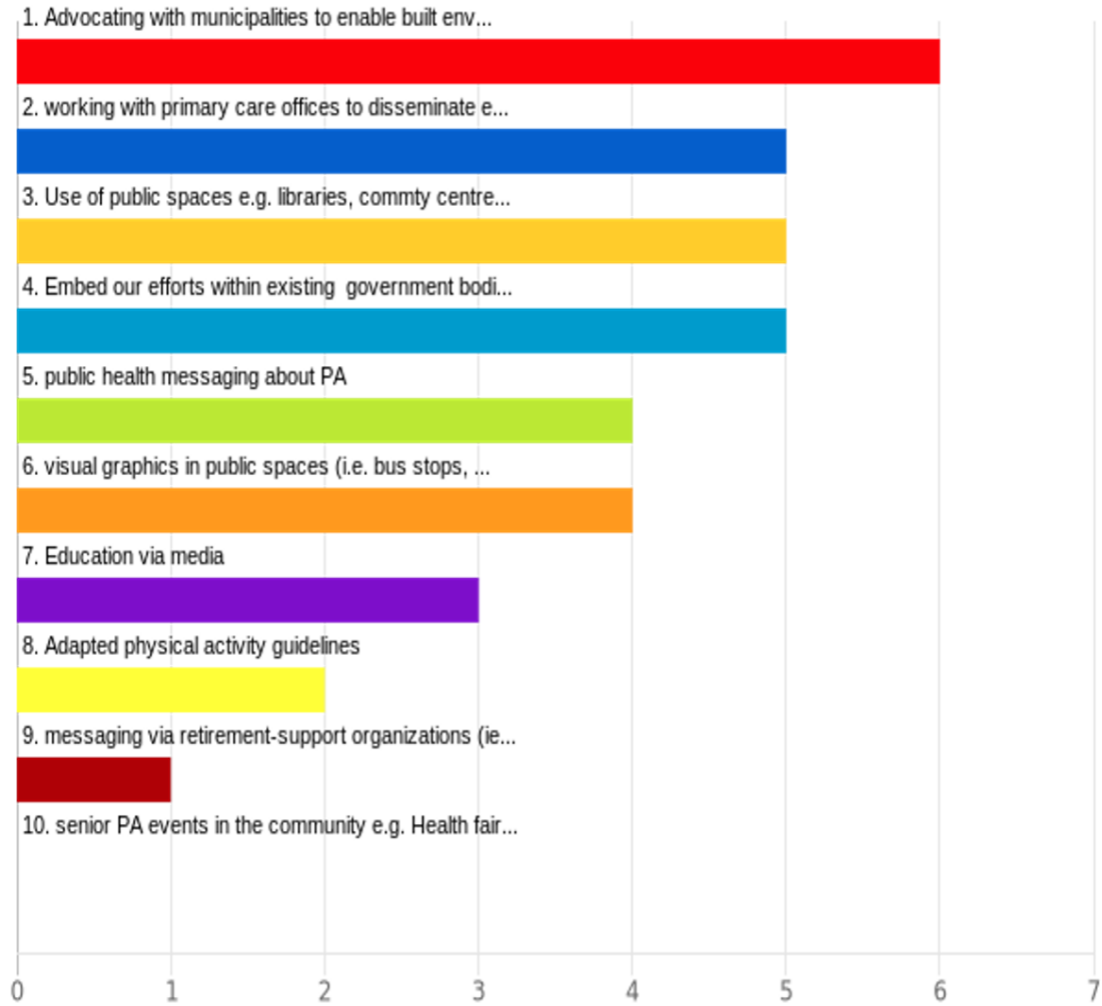
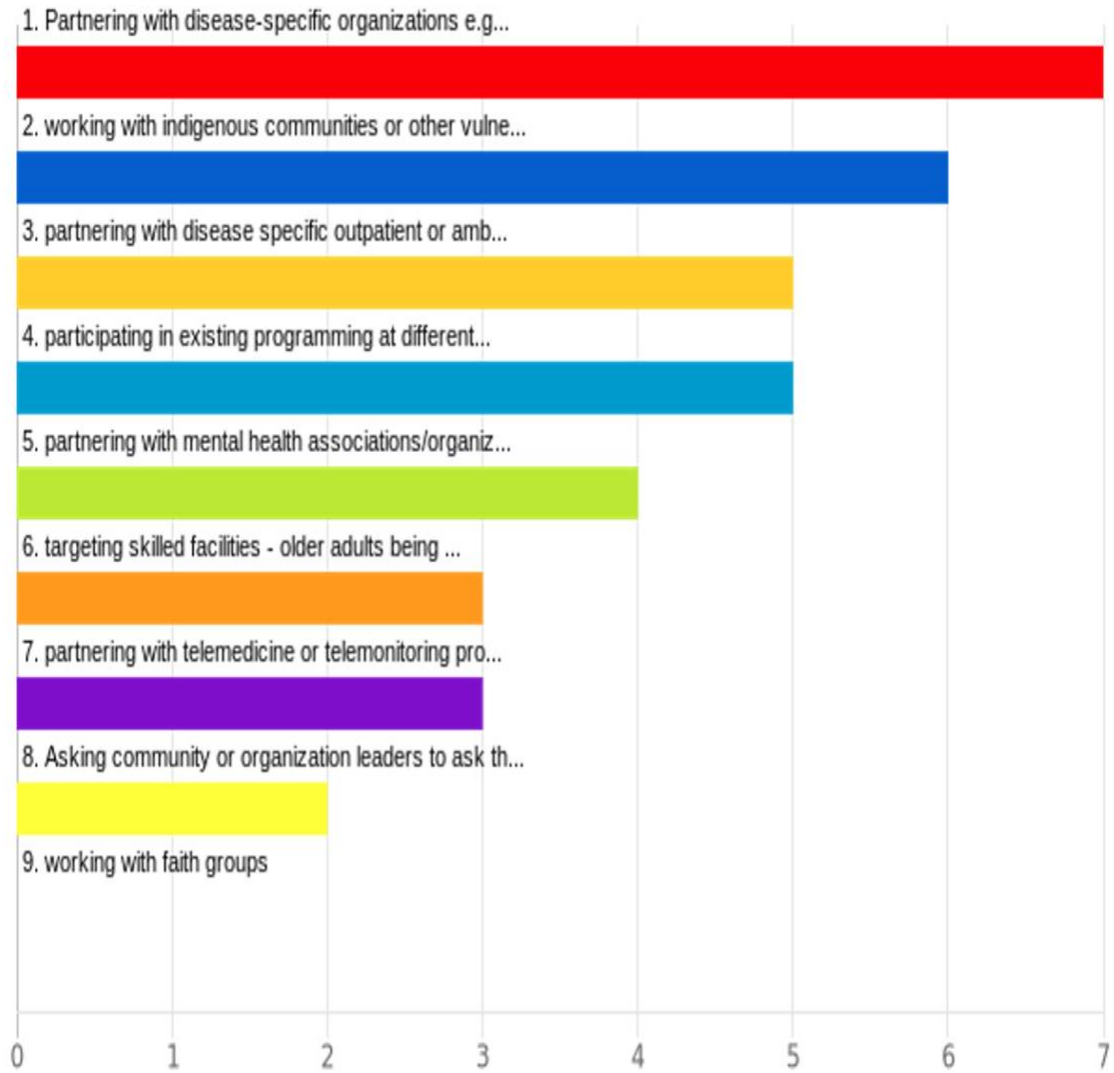


Figure 6. Targeted dissemination approaches



Supplementary Material 1

Consensus study participants Pre-reading

**Improving Physical Literacy for Adults with Multiple Chronic Conditions:
A Population Health Perspective**

Background

The prevalence of multimorbidity, defined as having 2 or more chronic conditions continues to rise among individuals of all ages.¹ Currently over 44% of adults (20-64 years) and 80% of older adults (≥ 65 years) report having one or more chronic condition.⁴⁵ Chronic conditions such as diabetes, heart disease, stroke and cancer are the leading cause of death in Canada.⁴ Older adults with multimorbidity have higher rates of healthcare utilization and poorer health status, including decreased mobility and physical function compared to individuals with no or fewer conditions.⁴⁶ Risk factors for chronic conditions have been directly linked to un-healthy behaviours, such as a sedentary lifestyle and tobacco use and indirectly linked to underlying social determinants of health, such as physical environments and literacy.⁴⁷ There is a wealth of evidence demonstrating that the negative health effects associated with multimorbidity can be improved with prevention approaches to address risk factors such as inactivity however, only 11% of adults between 60 and 79 years meet the physical activity guidelines.⁴⁸ Older adults report several barriers to engaging in and sustaining physical activity, including fear of injury or pain, decreased confidence and/or enjoyment with physical activities, and poor access to exercise resources.⁴⁹ With over 1.3 million Canadians reporting a mobility limitation there is a need for public health efforts and community resources to address the complex needs and movement barriers of adults living with multimorbidity.¹²

Adults are now living longer, however, they are living with more mobility and functional impairments. If adults with multimorbidity are to improve their function and mobility through movement activities and rehabilitation strategies, they require a level of **physical literacy**.

Defining Physical literacy

Over the last 30 years, the term physical literacy has gained popularity, specifically within sport and education fields as a result of the work of Whitehead.^{15,16} Whitehead describes physical literacy as a philosophical and multi-dimensional construct that embodies a holistic approach to the mind and body.¹⁷ She explains physical literacy as a journey and lived embodiment to a better quality of life.¹⁷ There are varying definitions in the literature, however Whitehead’s definition of physical literacy as “the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life” is widely accepted and is supported by the International Physical Literacy Association.^{18,19} Common terms used to describe physical literacy in the literature include physical activity, physically educated and physically able.⁵⁰

The Physical Literacy Journey for Adults

According to Whitehead, physical literacy is meant to be a lifelong journey that encompasses an individual’s physical (movement competence), affect (motivation and confidence) and cognitive (knowledge and understanding) dimensions.¹⁹ As individuals age and adjust to chronic conditions, their competence with motor tasks and confidence with movement may decline, and their knowledge and understanding of how to move and maintain mobility may change. As older adults acquire or re-acquire physical literacy, the set of skills necessary will increasingly focus on maintaining adequate function and mobility to ensure physical independence.

Framing Physical Literacy for adults through a Rehabilitation Lens

We propose improving physical literacy in adults as a potential strategy to tackle the ongoing challenges of multimorbidity. Older adults with the ability and confidence to participate in a variety of physical activities are more likely to engage in life-long, healthy, sustained physical activity opportunities.²⁷ Research indicates a positive relationship between physical literacy and healthy aging, therefore it is important to develop and implement population health programs that focus on improving physical literacy for aging adults who are living with multimorbidity as

a means to lessen the burden on our healthcare system.¹⁴ Before we can design physical literacy programs, we must first define and frame physical literacy for adults through a rehabilitation lens, incorporating all the important constructs that embody a physically literate adult. The current physical literacy definition uses constructs such as: motivation, confidence, physical competence, knowledge, understanding and physical activity.¹⁵ Some of these constructs may be applied to adults living with chronic conditions, however further work is needed to identify the rehabilitation needs of aging adults. It is important to look beyond the sports and physical activity realm to include physical literacy constructs within the physical, affective and cognitive domains that will improve the important outcomes related to rehabilitation.

1. Physical Domain of Physical Literacy for Adults

The physical domain of physical literacy refers to an individual's physical competence with developing or relearning important functional movement skills and patterns. Jones et al (2019) describe physical competence for older adults as the ability to engage in acquired movement skills and or relearn new movements despite chronic conditions and age related changes.⁵¹

2. Affective Domain of Physical Literacy for Adults

The affective domain of physical literacy refers to one's motivation, confidence and self-esteem with movement or physical activity.^{19,51} Maintaining independence becomes a key motivator for participation in physical activities for adults who are living with multimorbidity. Confidence and self-esteem can foster resiliency, competency and physical adaptability for adults despite health-related setbacks.

3. Cognitive Domain of Physical Literacy for Adults

The cognitive domain of physical literacy refers to one's knowledge and understanding of how to engage in safe and effective physical activities that will promote healthy aging. Body and kinesthetic awareness regarding the changes associated with aging and chronic conditions will improve mobility. Older adults with multimorbidity who can self-monitor changes in function, and employ rehabilitation strategies to address functional decline will be better able to maintain their independence. This, in turn, could have an impact on population indicators of disability.

Integrating Rehabilitation with Physical Literacy and Public Health

Physical therapists as rehabilitation specialists have an important role to play in encouraging healthy, active living and maintaining mobility, not only among individuals but also for the overall population. Adopting population health initiatives in physiotherapy practice will help inform the development of interventions and policies that improve disparities, such as multimorbidity.³⁹ Health promotion is closely tied to prevention and refers to the process of empowering people to increase control over their health, moving beyond a focus on individuals to consider social, cultural and political environments that limit individual choice and opportunity.³⁹

An example of a population-based initiative

Community engagement through partnership and shared decisions is needed, in addition to networking with community organizations and individuals who share a common vision for the management of chronic conditions. Linking physiotherapy to existing public health programs, such as the Heart and Stroke Association or the Chronic Disease Prevention Alliance of Canada could reach a large audience in need. For example, the Heart & Stroke Association is working with the Public Health Agency of Canada (PHAC) and the MaRS Centre for Impact Investing on an innovative program called Activate. It is a free six-month wellness program to help at-risk people from developing hypertension. This program allows participants to receive access to an online health platform with curated content and trackers, support from a personal health coach and dietitians, a 2-month free membership at participating [YMCA-YWCA Health & Fitness Centres](#), and PC OPTIMUM points to reward healthy behaviours. Physiotherapists could be an asset to this initiative by providing rehabilitation resources and tools that participants could use to improve or develop the physical skills required to function in their daily lives and participate in physical activities they enjoy.

CHAPTER 4:

**“YOU CAN BECAUSE YOU DO AND YOU DO, BECAUSE YOU CAN”: A QUALITATIVE STUDY
EXAMINING WHAT IT MEANS TO BE A PHYSICALLY LITERATE ADULT FROM THE PERSPECTIVE
OF ADULTS LIVING WITH MULTIPLE CHRONIC CONDITIONS**

Prepared for:

Scandinavian Journal of Public Health

“You can because you do and you do, because you can”: A qualitative study examining what it means to be a physically literate adult from the perspective of adults living with multiple chronic conditions

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Abstract

Aims: Physical literacy is an emerging strategy to increase participation in movement activities for children and youth, however, little is known about how to frame physical literacy for aging adults. The purpose of this qualitative study was to explore how adults with multiple chronic conditions describe physical literacy for adults and to understand the needs, preferences, barriers, and facilitators to acquiring and maintaining physical literacy despite fluctuations in health status.

Methods: Sixteen semi-structured interviews were conducted with working and retired teachers in Ontario with varying self-identified physical activity levels and are living with 2 or more chronic conditions. A semi-structured interview guide was used to conduct the interviews. Thematic analysis was used to analyze the data.

Results: Participants identified 5 themes when describing physical literacy for adults: understanding one's body, conscious commitment to movement, access to and knowledge of rehabilitation health resources, valuable physical activities, and confident problem solver. Results indicate that when acquiring physical literacy for adults, there are important new constructs, such as self-management and the awareness of rehabilitation strategies to maintain mobility, that differ from the traditional physical literacy model.

Conclusions: To improve function and mobility outcomes for adults living with chronic conditions, programs should be guided by a physical literacy framework that addresses the needs unique to aging adults, such as understanding the changes that occur with aging, self-monitoring mobility changes and participating in rehabilitation strategies.

Keywords: Physical literacy, adults, chronic conditions, rehabilitation, public health, physical therapy, function, mobility, program development

Background

As the global population of older adults increases¹, more people are living longer with chronic health conditions². The prevalence of multiple chronic conditions (MCC), defined as having two or more chronic conditions, continues to increase worldwide, affecting one in three adults². The incidence of MCC markedly increases with age, however over the past decade, the proportion of working-age adults with MCCs has been steadily increasing³. Multiple chronic conditions result in a burden to the patient, including a decline in physical function and mobility⁴, and poor quality of life⁵. The increasing prevalence of MCC also creates a significant challenge to the healthcare system, including higher rates of healthcare utilization and medical costs⁶.

Lifestyle practices such as decreasing sedentary behaviour and increasing physical activity have demonstrated benefit with the prevention and management of chronic conditions⁷⁻⁹, however only 23% of American adults are meeting the physical activity guidelines¹⁰. Adults with MCC report many barriers to participation in physical activity, such as cost, time, physical pain and symptoms, lack of guidance from professionals and decreased access to resources¹¹⁻¹³.

Facilitators for participation in physical activity include social interaction, health professional involvement, and health coaching¹².

Rehabilitation providers, such as physical therapists, are experts in restoring function, promoting active lifestyles, coaching, and teaching self-management strategies. However, due to lack of access and affordability for these resources, less than 10% of people who could benefit from rehabilitation services receive them¹⁴. Increasing access to rehabilitation services is essential to meet the growing needs of our aging population. Innovative approaches are needed, such as

framing rehabilitation in program development and using population health strategies to target the mobility and functional needs of aging adults.

Programs designed to improve the physical literacy of aging adults and adults with MCC through health promotion and health prevention strategies at the individual, community, organizational and service level have the potential to improve important health outcomes for adults and older adults. Physical literacy, most widely defined as “the motivation, confidence, physical competence knowledge and understanding to actively participate in physical activities for life”¹⁵, is an evolving concept, and has been proposed to be a primary determinant of health through its positive influence on engagement in physical activity^{16,17}. Despite inclusiveness being foundational to physical literacy, research in physical literacy has mainly focused on physical education for children and youth and little is known about the benefits of physical literacy for aging adults and adults with chronic conditions^{16,18}. Additionally, the current physical literacy definition is conceptually framed for individuals who are developing and expanding one’s physical activity and does not account for individuals who are experiencing movement and activity constraints due to age-related changes. An integrative review examining which critical components are currently used to frame physical literacy for aging adults (≥ 45 years)¹⁸, found that physical literacy is defined differently for the older adult population than the current Whitehead definition which focuses on youth and younger adults in the education and sport sectors^{16–18}. Meaningful and/or purposeful activities, knowledge of age-related changes, social interaction and diverse activities were the top four components reported in the literature review when describing physical literacy for adults¹⁸.

Most recently, to further understand what important components should be included in a physical literacy program for adults and adults with chronic conditions, an on-line expert consensus study was completed with key rehabilitation and researchers who are experts in the field of physical literacy. Questions were designed to gain consensus on what components describe a physically literate adult, what rehabilitation principles/strategies should be included in a physical literacy program and how rehabilitation knowledge could be disseminated at a population level to improve function and mobility outcomes for adults. Group consensus resulted in the following top 5 components used to define physical literacy for adults and/or adults with chronic conditions: 1) self-efficacy with movement, 2) confidence in safety of movement, 3) motivation and commitment to physical activity, 4) the ability to self-monitor changes in physical function and 5) understanding the benefits of physical activity and what to do despite physical limitations. This expert consensus study indicates that from the perspectives of healthcare professionals and researchers, re-conceptualizing the current physical literacy definition to include the rehabilitation components required for aging may add value in the promotion of movement and optimal function with aging.

To further understand what physical literacy means to adults, research is needed on physical literacy from the perspectives of adults who are living with mobility and physical function challenges. The purpose of this qualitative study was to explore how adults with MCC describe physical literacy for aging adults and to understand the needs, preferences, barriers, and facilitators to acquiring and maintaining physical literacy despite fluctuations in health status.

Methods

We used a qualitative interpretive description (ID) approach to explore what physical literacy means to adults living with multiple chronic conditions¹⁹. An interpretive descriptive approach was chosen as the best method to provide an in-depth understanding of the evolving physical literacy concept and to generate results that will enlighten and guide the promotion of physical literacy for adults with multiple chronic conditions¹⁹. Ethical approval for this study was obtained from the Hamilton Integrated Research Ethic Board (#8062).

Sample and Recruitment

Following the guidance of interpretive description, purposive sampling was used to interview working and retired teachers. Purposive sampling involves identifying and selecting individuals that are especially knowledgeable about or experiences with a phenomenon of interest. Teachers were identified as the population for this enquiry because they have a common understanding of the novel physical literacy construct, through their experience with teaching and curriculum development. Teachers also have the knowledge and willingness to share their experience, and the ability to communicate opinions in an articulate and reflective manner that can help maximize saturation²⁰.

Participants were recruited for study by advertisement on the Retired Teachers of Ontario (RTO) website, contacting gatekeepers within local community groups (YMCA) and social media advertisement. Participant information was sent via email and interviews were arranged if volunteers met pre-screening eligibility and consent forms were signed. Eligibility for participation in the semi-structured interviews included: 1) adults 40 – 75 years, 2) currently working or have previously worked as a primary or secondary school teacher, and 3) have been diagnosed with two or more chronic conditions. Adults diagnosed with dementia and individuals

who did not speak English were excluded from the study. The sampling strategy involved teachers from 4 different categories; 1) working teachers with moderate to high physical activity (PA), 2) retired teachers with moderate to high PA, 3) working teachers with inactive to low PA, and 4) retired teachers with inactive to low PA, as determined by the International Physical Activity Questionnaire (IPAQ). The sampling strategy allowed a diverse range of teachers to share narrative stories of their experience and what it means to them. The research study is an emergent design and therefore final sample size was determined once saturation of the common themes was reached and no further information could be extracted from the narratives of participants²¹. Before taking part in the study, participants provided informed consent for collection of demographic information and agreed to audio recording of the interview over the zoom platform.

Data Collection

A semi-structured interview guide was developed by 2 authors (CP and JR) and used to lead the interviews. Following the interpretive description methodology, the interview guide was framed based on the authors rehabilitation clinical experience, recent physical literacy research and the research goals^{18,22}. Participants were read a short scenario, followed by questions examining the following five main topic areas: 1) common mobility and physical function challenges, 2) barriers and facilitators to participation in PA, 3) access to information on chronic conditions, 4) defining physical literacy for adults, and 5) how to share physical literacy knowledge with the public. (Figure 1: Interview Guide). The interview guide ensured that all relevant constructs were discussed, while preserving the necessary openness of qualitative research²³. Interviews ranged from 50 minutes to 70 minutes and were conducted in November 2021. Participants provided

informed consent to take part and have their interview recorded and their quotes used anonymously. Participants were reminded of their right to withdraw from the study at any time.

Data Analysis

All recording interviews were transcribed using Otter²⁴, an automatic transcription software for recorded audio/video files. Data was then cleaned, and analyzed using Dedoose, a web-based qualitative content analysis software²⁵. Each participant was assigned an ID number.

Transcripts were read and re-read by 2 authors (CP and JR) to ensure an understanding of the content within the context of one's lived experience. A thematic approach that reflected the participants perspective was used to guide data analysis²⁶. Relevant sections of the interviews were highlighted and coded into "parent codes", identified as initial root codes that occur frequently throughout the data. Transcripts were read again and segments of the content with similar meaning were assigned the same code. The codes were then refined into key themes. Coding occurred over 2 months and saturation was reached when no new codes were generated.

To ensure dependability and credibility of analysis initial coding of the first 2 interviews was conducted by author CP and the coding strategy was then reviewed by author JR. This allowed the researchers to discuss any differences and come to a consensus. Authors CP and JR reviewed the codes together in 2 sessions that carefully examined the data behind each code.

The categorized data were organized around two major headings: a) physical literacy constructs related to adults; and 2) facilitators and barriers to acquiring physical literacy for adults.

Differences, and similarities among working and retired teachers, were analyzed by matching the codes with participant descriptors in the Dedoose software.

Results

Demographics

A total of 16 interviews were completed virtually over ZOOM, with 4 participants from each of the 4 sampling groups. Participants in this study were all female (100%) with a mean age of 59 years (ranging from 41 – 73 years). Fifty percent (n=8) of the participants were currently working as a teacher and the other 8 participants were retired teachers. A summary of participant demographic characteristics is included in Table 1. All participants were diagnosed with 2 or more chronic conditions with osteoarthritis (OA) reported as the most common primary condition (37.5%), followed by chronic neck and/or back pain (17.5%). Five participants (31.3%) lived alone and were either widowed or divorced. Two participants disclosed that they were currently using a mobility aid, due to a recent lower extremity fracture. Four participants (3 retired teachers and 1 working teacher) reported they had joint replacements at the knee or hip in the last 5 years. Thirteen participants reported they had experience with rehabilitation professionals in the past, to address an acute or chronic condition(s). Five main themes emerged from the data related to describing physical literacy for adults: 1) understanding one's body, 2) conscious commitment to movement, 3) access and knowledge of rehabilitation health resources, 4) valuable physical activities, and 5) confident problem solver.

Physical literacy constructs related to aging adults

Understanding one's body

As depicted by Table 2, the theme of understanding one's body was influenced by four subthemes that centered on having knowledge and awareness around one's physical and mental health and the changes that occur with aging and chronic conditions. All participants felt that a key component to maintaining or becoming physically literate as an adult is having the

knowledge around how physical activity can benefit one's function and mobility with age and fluctuations in health. Participants explained that it was important have an understanding around what movements may benefit and/or impair their current health condition. Participants explained that having an awareness around the changes that occur with aging and chronic conditions, such as pain, weakness, loss of balance and being able to self-identify these changes and then knowing what steps to take to remediate function and mobility issues was a key component in acquiring physical literacy for adults.

“I think knowing what my issues are, what aches I have and what's causing them and knowing how to approach them to improve whatever the condition is and getting advice from experts is important. I think just being aware of what your body needs, and staying on top of things is better, as opposed to just saying, No, I'm too old to do that. Make yourself aware of what you need to do to keep going”. (ID#1, retired 72-year-old woman).

“I think, being really aware of your conditions and, your situation. You know, maybe you can walk in and do all the things now, but you need to understand that if you don't continue to do that, there might come a day where you can't do it.” (ID#6, retired 71-year-old woman).

Participants frequently reported that acknowledging one's physical deficits was a reason for taking up health related activities and movements, despite not participating in activities earlier in life. However, others reported a fear of not being able to keep up with the same activities or causing further injury or pain with participation in exercise and sport.

Conscious commitment to movement

Participants overwhelmingly felt that physically literacy for adults has a direct association with an increased commitment to movement. Four sub-themes, including an active participation in physical activity, continually regulating movement activities, setting physical health goals, and understanding one's motivation to move, guided the main conscious commitment to movement

theme. Many participants talked about how “any movement was good movement” and this did not need to involve vigorous physical activity or prescribed exercise. This included staying committed to bettering one’s physical health through setting physical health goals and participating in daily movement activities, even when barriers arise.

“Being physically literate goes back to what my mom said, **you can because you do and you do, because you can.** This will dictate the quality of my life. And, you know, if I’m not physical and aware of what I can do, and I’m not doing it, then I’m going to have to accept the consequences. And they may not be things I want to accept, you know, knee pains, boredom, weight gain.” (ID #6, retired 72-year-old woman)

Participants discussed the need to understand individual and environmental moderators for movement, such as personality traits, beliefs about physical activity and socioeconomic factors, such as access to exercise options. Motivation was reported as a critical factor in supporting the conscious commitment and participants cited the importance of having awareness about what are one’s motivators to move.

“I think it is important you understand what your motivation to move is. My motivation is to keep moving so that things don’t get worse or actually help some of my chronic issues. Also, I notice I have better posture when I exercise and that is an extrinsic motivator. But my main motivation is the social fun I have when out hiking with the group”. (ID #3, retired 63-year-old woman)

As people age, motives that indicate pragmatic or mobility concerns, such as maintaining one’s independence, appear to override motives that are more personally uplifting, such appearance²⁷.

Access and knowledge of rehabilitation health resources

The main theme of access and knowledge of rehabilitation health resources was identified from the following four sub-themes; access to a functional health coach, understanding how to recover from health setbacks, knowledge of where to go to find physical health information, and public health support. The study participants cited that having a trusted expert, or coach in the field of

physical activity or rehabilitation was a key component to becoming physically literate as an adult.

“The most important thing is knowing where you can reach or to whom you can reach for some help when things go wrong.” (ID #6, retired 71-year-old woman)

“I take an anti-inflammatory, and that might help, and ice and heat. I certainly learned in physiotherapy the ice and heat thing. So, I do that a lot. If you do these things every day, then it just becomes part of your everyday life. It's just common sense”. (ID#4, retired 65-year-old woman)

Many participants talked about their experience with allied health professionals, such as physiotherapists, chiropractors, and massage therapists and how the most important take away from their time with these professionals was the rehabilitation knowledge gained and the increased confidence in having control over their condition. This health coaching appears to support the needed continuation along the physical literacy journey for aging adults.

Valuable physical activities

Through qualitative analysis, the main theme, “valuable physical activity” was identified from the following four sub-themes: social support, confidence with participation in a variety of safe exercises, participation in meaningful movements and environmental awareness with physical activity. Participants agreed that a key component to acquiring physical literacy is having an awareness around what meaningful and safe exercises/activities are available for adults who are living with chronic conditions or mobility challenges. Participants reported that they often had to seek out information from friends, family, health professionals and the internet to understand what other adults, with similar conditions are doing to stay active. Even though all participants cited that physical activity was beneficial for aging and chronic conditions, many adults reported that it is important to know what activities are safe for one’s body/condition and to avoid

repeating movements that may aggravate pre-existing conditions. Participants explained that it was important to have the confidence to try new activities and challenge oneself in new environments to expand one's physical abilities. Many participants cited that having an awareness around what exercises and movements bring value and joy to one's life is an important contributor to building physical literacy as an adult. For example, participants reported it was important to understand if social activities or independent activities bring more enjoyment and create an encouraging environment for facilitating one's physical literacy.

“It's important to recognize what motivates you – for example winning motivates my husband with racquetball – I don't care about that – I enjoy being social with my friends and how my body feels after I move.” (ID #3, retired 63-year-old woman)

Confident problem solver

We found that the following four sub-themes were associated with the confident problem solver theme; ability to overcome movement barriers, ability to try new activities, ability to adapt to the environment and building resilience with health setbacks. Participants cited that having confidence to make and sustain feasible changes and overcome barriers, are key factors in becoming a physically literate adult. Given the episodic nature of many chronic conditions, having the self-efficacy to adapt and persevere with movement goals, despite environmental and interpersonal barriers, appears to be integral to building physical literacy for adults.

“I really liked Yoga but after the stroke I didn't have the balancing abilities. So, what I had to do is find something that gives me the same results, which is flexibility, while being safe. That's why I went into Pilates. Having said that, doing a plank is not a possibility for me because you have to go on your toes. So, I modify, and that's what I look for in physical activities. Like if I can't do everything, I can modify it and still be part of the group” (ID #6, retired 71-year-old woman)

Participants commonly expressed their hesitation with pushing beyond their physical comfort zone, due to a fear of re-injury, falling or increasing pain symptoms. However, there was

agreement from the majority, that to maintain physical literacy it is important to “own your abilities” and focus on all you “can do” and what strategies you can use to overcome movement barriers.

Facilitators for Acquiring Physical Literacy

The most frequently cited facilitator for acquiring physical literacy was having social networks and participating in enjoyable activities with friends and family.

“Yeah, I think group programs are really important because you get the social aspect, and especially when you're retired, and you live alone, you need that social aspect. And it kind of motivates you to do more and share information with one another”. (ID#1, retired 72-year-old woman)

Other facilitators for physical literacy that emerged included, having access to activities and programs that one enjoys, such as age-appropriate community exercise classes, hiking clubs, pickle ball teams and movement programs that support adults with varying health conditions and abilities. Participants also reported that a strong facilitator for one’s continuing physical literacy journey, despite fluctuations in health, was having credible sources for health information. The McMaster University Optimal Aging Portal was referenced by 4 participants as a trusted online health resource that is actively used to learn about health aging²⁸. Participants stated that having a reliable health advocate or coach was important, as they could address changes in health and mobility proactively and start rehabilitation strategies in a timely manner to offset further functional limitations.

“I’m a nosy type, ask questions person, you know, I want to know about everything about my health, but not everybody knows enough to ask the questions. People need to be told some of the information without having to ask the questions” (ID#2, retired 73-year-old woman)

Participants reported that previous beliefs from childhood about the importance of exercise was a facilitator for physical literacy, however, only 9/16 participants reported being physically active as a child. Participants agreed that acquiring physical literacy could be commenced at any age and only 5/16 participants stated they have been active and physically literate throughout all stages of their life.

Barriers for Acquiring Physical Literacy

The most frequently reported environmental and social barriers included lack of time, lack of social support and climate changes

“I'm basically alone most of time. So, I'm not going to put myself in a situation that is probably going to get me hurt” (ID# 5, retired 64-year-old woman).

“I had been prone to pneumonia and bronchitis, so I just don't go out in the cold. That's why I go south, so that I don't have to cope with the winter.” (ID#2, retired 73-year-old woman)

One's beliefs about consequences of movement or fear of falling was also reported. Even though all participants agreed that physical activity was beneficial for chronic conditions, many adults expressed concern with doing the wrong activity or too much activity, that would then result in previously experienced negative consequences.

“I'm leery but I want to go skiing downhill. But there's a part of me that's afraid because if I fall again.... The Dr said, you're going to be fine. Yeah, but it's still there. You know, it's just a reminder from that fall.” (ID # 8, retired 73-year-old woman)

Competing health information and lack of health resources was also reported as a barrier to acquiring physical literacy. Some participants stated they received opposing health information from health specialists and on-line health resources, which resulted in a lack of trust and decreased one's motivation to follow activity guidelines and recommendations. Participants

stated they were less likely to participate in movements without access and support from a trusted coach or health professional.

“The one thing I'm worried about, though, is not having somebody with me, who has the knowledge to correct when I'm doing something incorrectly, because I worry about injuring myself more. By either overdoing it or not doing it correctly”. (ID#1, retired 72-year-old woman)

Participants also reported a lack of community programs available for adults experiencing multiple health conditions. For example, participants reported that they did not “fit in” to the traditional disease specific programs offered (e.g., falls programs, knee osteoarthritis exercise groups), because they were often experiencing competing health issues (e.g., fatigue from cancer treatment) that decreased their confidence in their abilities and the safety of the program. Other participants stated that the disease- specific programs were too focused on the conditions, and they were looking for something more holistic, that could challenge them in all areas of mobility and movement.

Similarities and differences based on working status

Similarities and differences between working teachers (n=8) and retired teachers (n=8) were analyzed with the Dedoose software to understand how each represented subgroup describes the barriers and facilitators for acquiring physical literacy. When examining the facilitators for acquiring physical literacy, there were similarities between the working teachers and retired teachers, such as having knowledge of the movement options available and how they add value to the management of one’s condition, as well as continued participation in activities that one enjoys. However, retired teachers reported additional key facilitators, such as having a health coach available to support the journey of physical literacy while navigating multiple

chronic conditions and having a social support from family or friends. Working teachers reported lack of time and difficulty with navigating multiple conditions as the barriers to acquiring physical literacy. Retired teachers reported barriers such as limited access to physical activity options that met needs and preferences, as well as low confidence with activity and the management of one's condition. Fear of re-injury, exacerbation of symptoms and fear of falling were commonly reported as barriers to acquiring physical literacy for both working teachers and retired teachers. Refer to Table 3 for a full list of facilitators and barriers for acquiring physical literacy.

Discussion

This qualitative study had two purposes: first to explore the constructs associated with physical literacy for adults and older adults with chronic conditions and second, to examine the facilitators and barriers for acquiring physical literacy as an aging adult. The semi-structured interview analysis was primarily guided by interpretive description of working teachers and retired teachers' perceptions of what constructs depict a physically literate adult.

Findings from this qualitative study demonstrated that the constructs associated with physical literacy for aging differ from those associated with the current Whitehead definition of physical literacy. Participants described physical literacy as owning an awareness and understanding of one's body and obtaining access and knowledge of rehabilitation health resources to acquire the skills needed to confidently problem solve changes in functional health to maintain a conscious commitment to movement and participation in valuable physical activities. Interestingly, common components of the Whitehead definition of physical literacy were identified, such as

confidence, knowledge, understanding and engagement in physical activities. However, additional identified key components focused on understanding the changes that occur with one's functional health, as this relates to aging and chronic conditions, as well as accessing rehabilitation health specialists and coaches to support the physical literacy journey. Lastly, an identified new theme around "problem solving" demonstrates the need to learn skills related to self-efficacy, self-regulation and resiliency with aging that can foster physical literacy with aging, despite health setbacks.

When children and younger adults are acquiring physical literacy, they are continually learning physical competency skills taught from teachers, parents, and sport coaches, that match and complement their growing and functionally evolving bodies. However, when adults age and one's physical functional health becomes more constrained due to age related changes, there is a need for coaches who are experts in the field of rehabilitation and functional adaptation to support and encourage new learning and re-learning of physical literacy skills. Current physical literacy models describe a pathway from birth to childhood where physical literacy skills are developed as a child and then maintained into adulthood. However, this current model may not apply to older adults who are living with age-related or chronic conditions, who likely need support with building new rehabilitation focused physical literacy skills, as opposed to regaining past sports-focused skills. As a promising health promotion strategy to improve function and mobility for aging adults, physical literacy, framed through a rehabilitation lens with the constructs identified in this qualitative study could be a meaningful approach to sustaining positive health behaviours, specifically with adults who are living with multiple chronic conditions. Findings also indicated that an important aspect in promoting physical literacy

programming for adults relates to access of quality leaders associated with motivating adults and older adults to increase their participation in movement activities and self-management and leading the programs within the public health environment.

As in younger populations, confidence related to physical literacy is shaped by past experiences. Therefore, it is important to gain insight into an adult's physical literacy journey; including understanding which physical activity skills they learned and the context in which they were learned, which skills they may want and need to re-learn, or skills they are confronting for the first time. Previous adverse events such as a fall or fear of exacerbating health conditions during physical activities are barriers that can be mitigated, for example, through learning how to self-monitor one's balance by participating in balance exercises. By affecting social and cultural norms related to physical activity for chronic conditions and overcoming individual level barriers to organized programs and services that support learning new rehabilitation skills that promote participation in lifelong meaningful activity, we will be able to facilitate a deeper understanding of physical literacy for adults.

Strength and Limitations

Strengths of this study include the interpretive descriptive design in which knowledge was co-created by using semi-structured interviews to collect rich data from participants who expanded on their understanding of physical literacy as it relates to their experience with aging and chronic conditions. Additionally, triangulation and member checking ensured the credibility of the study. However, study was subject to certain limitations. Purposeful recruitment of working adults and retired older adults, from the same profession, teaching allowed for maximal data saturation for a novel and emerging construct. Teachers have lived experience with the physical

literacy construct through their exposure with the school curriculum. Both working and retired teachers were able to thoroughly communicate their ideas in a reflective manner, which added to the value of research. However, this homogenous group of teachers represents a middle to higher socioeconomic group who have access to resources such as private health benefits and therefore are familiar/acquainted with issues such as rehabilitation concepts, that many other adults do not. Additionally, the group was comprised of all women, and therefore did not the views of men were not represented and there was limited cultural diversity in the sample and results are not representative of the adult and older adult population,

The small numbers in each group working teachers (n=8), and retired teachers (n=8) did not allow for the exploration of sub-group analysis, such as examining different levels of physical activity participation with physical literacy from a more granular perspective. Selection bias may have occurred as a result of purposive sampling by work status. Additionally, those not expressing interest, or those expressing interest who were not interviewed, may have differed from those who were interviewed for the study.

Implications for Practice and Policy

Publicly funded programs grounded in the emerging physical literacy framework for adults may add value in addressing the mobility and functional health needs of aging adults. Additionally, programs that include middle-aged adults (40 – 50 years) will provide individuals with an opportunity to consider all the changes that occur with aging and initiate preventative plans to address these changes. Community programs should be tailored to improving physical literacy, as defined by the key constructs identified in this study; understanding the role of PA with aging, how to self-monitor mobility, setting functional health goals, learning how to access a health coach, creating confidence with meaningful activities, and understanding how to overcome

movement barriers. Improving communication between primary, secondary, and tertiary care as this relates to the role of rehabilitation and physical literacy is needed, along with the continued education of health professionals about promoting physical literacy for aging. Lastly, targeting hard to reach populations and individuals who are most in need by providing access to government funded physical literacy programs will make a large impact. Re-branding promotional material from the traditional exercise recommendations to physical literacy material will increase awareness and increase motivation for individuals who may not have been successful with physical activity in the past. Increasing awareness and knowledge of how to be a physically literate adult and older adult through media outlets, and creating collaborations and partnerships with health, education, employment, sport, and public health organizations who share common health outcomes will help to disseminate the new physical literacy narrative.

Conclusion

Physical literacy is an emerging strategy to support the management of function and mobility changes associated with aging and chronic conditions. Results from our qualitative interview study with adults who are living with chronic conditions demonstrate that acquiring physical literacy for adults involves the following key components; owning an awareness and understanding of one's body, obtaining access and knowledge of rehabilitation health resources, acquiring the skills needed to confidently problem solve changes in functional health, maintaining a conscious commitment to movement and participation in valuable physical activities. Further research is needed to understand how integrating the above key components into physical literacy frameworks that support the development of publicly funded programs for

adults and adults with chronic conditions will affect the functional and mobility challenges that many aging adults are living with today.

Declarations of Conflicting Interest

Conflict of Interest: The Authors (CP, JR, JM, MW) declare that there is no conflict of interest.

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References

1. World Population Aging 2019 Highlights. United Nations.
<https://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2019-Highlights.pdf>. Published 2019. Accessed February 9, 2022.
2. Roberts K, Rao D, Bennett T, Loukine L, Jayaraman G. Prevalence and patterns of chronic disease multimorbidity and associated determinants in Canada. *Heal Promot Chronic Dis Prev Canada*. 2015;35(6):87-94. doi:doi: 10.24095/hpcdp.35.6.01. PMID: 26302227; PMCID:
3. CMS. Multiple chronic conditions. https://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/Chronic-Conditions/MCC_Main. Accessed February 9, 2022.
4. Ryan A, Wallace E, O'Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes*. 2015;13(1):168. doi:10.1186/s12955-015-0355-9
5. Barnett K, Mercer S, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet*. 2012;380(9836):37-43. doi:10.1016/S0140-6736(12)60240-2.
6. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: A systematic review of the literature. *Ageing Res Rev*. 2011;10(4):430-439.
doi:<https://doi.org/10.1016/j.arr.2011.03.003>
7. Dhalwani N, O'Donovan G, Zaccardi F, et al. Long terms trends of multimorbidity and association with physical activity in older English population. *Int J Behav Nutr Phys Act*. 2016;19(13):8. doi:10.1186/s12966-016-0330-9. PMID:

26785753; PMID: PMC4717631

8. Kastner M, Cardoso R, Lai Y, et al. Effectiveness of interventions for managing multiple high-burden chronic diseases in older adults: a systematic review and meta-analysis. *Can Med Assoc J*. 2018;190(34):E1004-E1012. doi:10.1503/cmaj.171391
9. de Vries NM, van Ravensberg CD, Hobbelen JSM, Olde Rikkert MGM, Staal JB, Nijhuis-van der Sanden MWG. Effects of physical exercise therapy on mobility, physical functioning, physical activity and quality of life in community-dwelling older adults with impaired mobility, physical disability and/or multi-morbidity: A meta-analysis. *Ageing Res Rev*. 2012;11(1):136-149. doi:10.1016/j.arr.2011.11.002
10. *Statistics Canada. Tracking Physical Activity Levels of Canadians, 2016 - 2019.*; 2019. <https://www150.statcan.gc.ca/n1/daily-quotidien/190417/dq190417g-eng.htm>.
11. Desveaux L, Goldstein R, Mathur S, Brooks D. Barriers to Physical Activity Following Rehabilitation: Perspectives of Older Adults with Chronic Disease. *J Aging Phys Act*. 2016;24(2):223-233. doi:10.1123/japa.2015-0018
12. Jansons P, Robins L, Haines T, O'Brien L. Barriers and enablers to ongoing exercise for people with chronic health conditions: Participants' perspectives following a randomized controlled trial of two interventions. *Arch Gerontol Geriatr*. 2018;76(92-99). doi:10.1016/j.archger.2018.02.010
13. Collado-Mateo D, Lavín-Pérez AM, Peñacoba C, et al. Key Factors Associated with Adherence to Physical Exercise in Patients with Chronic Diseases and Older Adults: An Umbrella Review. *Int J Environ Res Public Health*. 2021;18(4):2023. doi:10.3390/ijerph18042023
14. Bright T, Wallace S, Kuper H. A Systematic Review of Access to Rehabilitation for

- People with Disabilities in Low- and Middle-Income Countries. *Int J Environ Res Public Health*. 2018;15(10):2165. doi:10.3390/ijerph15102165
15. Whitehead M. The concept of physical literacy. *Eur J Phys Educ*. 2001;6:127-138.
 16. Dudley D, Cairney J, Wainwright N, Kriellaars D. Critical Considerations for Physical Literacy Policy in Public Health, Recreation, Sport and Education Agencies. *Quest*. 2017;69(4):436-452. doi:10.1080/00336297.2016.1268967
 17. Cairney J, Dudley D, Kwan M, Bulten R, Kriellaars D. Physical Literacy , Physical Activity and Health : Toward an Evidence - Informed Conceptual Model. *Sport Med*. 2019;49(3):371-383. doi:10.1007/s40279-019-01063-3
 18. Petrusevski C, Morgan A, MacDermid J, Wilson M, Richardson J. Framing physical literacy for aging adults: an integrative review. *Disabil Rehabil*. December 2021:1-12. doi:10.1080/09638288.2021.2012841
 19. Thorne S. *Interpretive Description*. Walnut Creek: Left Coast Press; 2008.
 20. Palinkas LA, Horwitz SM, Green CA, Wisdom JP, Duan N, Hoagwood K. Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Adm Policy Ment Health*. 2015;42(5):533-544. doi:10.1007/s10488-013-0528-y
 21. Creswell J, Plano Clark V. *Designing and Conducting Mixed Methods Research*. Thousand Oaks, CA: SAGE Publications. 2nd ed. : SAGE Publications; 2011.
 22. Petrusevski C, Richardson J, MacDermid J, Wilson M. *Framing Physical Literacy for Adults through a Rehabilitation Lens: An Expert Consensus Study.*; 2021.
 23. Flick U. *An Introduction to Qualitative Research*. SAGE Publications; 2009.
 24. Otter Voice Meeting Notes. <https://otter.ai/home>. Published 2016.
 25. Dedoose Version 9.0.17, web application for managing, analyzing, and presenting

qualitative and mixed method research data (2021). Los Angeles, CA: SocioCultural Research Consultants, LLC www.dedoose.com.

26. Nowell LS, Norris JM, White DE, Moules NJ. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *Int J Qual Methods*. 2017;16(1):1609406917733847. doi:10.1177/1609406917733847
27. Trujillo KM, Brougham RR, Walsh DA. Age differences in reasons for exercising. *Curr Psychol*. 2004;22(4):348-367. doi:10.1007/s12144-004-1040-z
28. Labarge Optimal Aging Initiative. McMaster Optimal Aging Portal. <https://www.mcmasteroptimalaging.org/>. Accessed March 20, 2022.

Figure 1: Interview Guide

Figure 1: Interview Guide

“Thank you for agreeing to participate in our research study, “A Multi-phased Physical Literacy Program Targeting Adults with Multiple Chronic Conditions: A knowledge translation project. I have some background information on physical literacy and a short scenario that I will present to you that relates to an individual living with multiple chronic conditions. After reading this scenario, I have 10 short questions that I will be asking you about your perspectives on physical literacy and adults. Before beginning the interview, I need to get informed consent (present consent form and review). I will be recording each interview and the recordings will be transcribed. Please feel free to stop me at any point to ask questions or clarify”.

Scenario

Physical literacy is a term that health professionals believe is an important component in maintaining and improving the overall the health of adults. One way to think about physical literacy is that it means that we stay active for life because we understand the importance of movement and we want to be active. We also know how to be active in a safe and purposeful way.

We, as health professionals believe that communicating movement strategies and rehabilitation techniques to adults at a population level will have a positive impact on adults with chronic conditions as they age.

For example, if you were to have knee pain, there are many rehabilitation steps you could take to manage this pain such as:

- 1) stretching
- 2) strengthening
- 3) using heat/cold/anti-inflammatories
- 4) interpreting and understanding what the pain means
- 5) avoiding aggravating activities (i.e. sitting too long)
- 6) improving your posture and walking pattern
- 7) reaching out to community resources and health professionals

Identifying the best rehabilitation strategies from the list above at the right time can have a significant impact on managing knee pain. Since almost 50% of Canadian adults are living with a chronic condition, we feel it is important to broadly communicate our physiotherapy-based strategies to improve population health.

Adults living with chronic conditions will experience fluctuations in their health which will affect how they move and function. Not all individuals will be aware of the most appropriate steps to take to manage their symptoms in order to provide the best care and maintain optimal quality of life. It is also important for adults to have awareness around the movement changes that can occur with aging and chronic conditions, compare their movement to normative values and have the confidence to use rehabilitation strategies to improve and maintain functional status.

Questions:

1. What sort of movement and physical function issues or challenges have you encountered or continue to encounter?
2. Would you describe these issues/challenges you experience as having a large impact or a small impact on your overall health?
3. On a scale of 0 – 10 (with 0 being not confident at all and 10 being very confident), how confident do you feel about being able to participate in physical activities yourself?
4. What are the reasons you feel may limit your participation in these activities?
5. Is there anything you feel **you** could do to improve your participation in these activities?
6. Where would you go to get information on how to manage your mobility and functional impairments?
7. What does the term physical literacy mean to you?
8. Do you feel that being more physically literate would benefit your condition and/or your overall health?
9. How do you think we, as a society can best promote physical literacy for adults with chronic conditions?
10. What factors do you feel are most important for you to maintain or become physically literate?

Table 1: Demographic characteristics of interview participants

Characteristic categories	N%
Gender	
Female	16 (100%)
Male	0 (0%)
Age	
40 – 44	2 (12.5%)
45 – 49	2 (12.5%)
50 – 54	2 (12.5%)
55 – 59	2 (12.5%)
60 – 64	2 (12.5%)
65 – 69	1
70 – 74	5 (31.25%)
Work status	8 (50%)
Working	8 (50%)
Retired	
Marital Status	11 (69%)
Married	5 (31.3%)
Single	
Stated primary chronic condition	
OA	6 (37.5%)
RA	2 (12.5%)
Cancer	2 (12.5%)
Cardiovascular Disease	1 (6.3%)
Chronic neck/back pain	3 (17.75%)
Fibromyalgia	1 (6.3%)
Neurological condition	1 (6.3%)
Stated secondary condition	
OA	6 (37.5%)
Cancer	1 (6.3%)
Cardiovascular disease	1 (6.3%)
Chronic neck/back pain	4 (25%)
Diabetes	1 (6.3%)
Falls	2 (12.5%)
Pulmonary condition	1 (6.3%)
Self-evaluated PA level	
Inactive - Low	8 (50%)
Moderate – high	8 (50%)

Table 2: Main themes and sub-themes of acquiring physical literacy as an adult

Themes	Sub-themes
Understanding one's body	<ul style="list-style-type: none"> • Staying educated on one's condition(s) and health status • Self-monitoring functional changes • Reporting/addressing mobility changes • Understanding the impact of PA and nutrition on wellbeing
Conscious commitment to movement	<ul style="list-style-type: none"> • Active participation in PA along the journey of health • Regulating movement activities with age and illness • Physical health goals • Understanding one's motivation to move
Access and knowledge of rehabilitation health resources	<ul style="list-style-type: none"> • Functional health coach • Understanding how to remediate and recover from physical health setbacks • Knowledge of where to go to find physical health information • Public health support
Valuable physical activities	<ul style="list-style-type: none"> • Social support • Confidence with participating in a variety of safe exercises • Participation in meaningful movements • Environmental awareness with PA
Confident problem solving	<ul style="list-style-type: none"> • Ability to overcome movement barriers • Ability to try new activities • Ability to adapt to the environment • Resilience with health setbacks

Table 3: Facilitators and barriers for acquiring physical literacy for working and retired adults

Working Teachers	
Facilitators	<ul style="list-style-type: none"> • Knowledge of movement options available and how they add value to the management of one’s condition • Participating in activities one enjoys • Knowledge and access to resources help overcome movement barriers • Knowledge of when and where to ask questions
Barriers	<ul style="list-style-type: none"> • Lack of Time • Navigating diagnosis of new conditions and what is safe • Fear of exacerbating condition
Retired Teachers	
Facilitators	<ul style="list-style-type: none"> • Knowledge of movement options available and how they add value to the management of one’s condition • Health coach available to support PL journey • Social support • Participating in activities one enjoys
Barriers	<ul style="list-style-type: none"> • Unsure where to go to ask questions • Limited physical activity options available that suit needs • Have tried and failed before – low confidence • Fear of falling

CHAPTER 5:

**ENHANCING PHYSICAL LITERACY FOR ADULTS AND ADULTS WITH
MULTIMORBIDITY USING MULTIPLE KNOWLEDGE TRANSLATION
STRATEGIES: A PRE-POST INTERVENTION STUDY**

Prepared for:

Physical Therapy

Enhancing physical literacy for adults and adults with multimorbidity using multiple knowledge translation strategies: A pre-post intervention study

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Abstract

Introduction: Physical literacy is emerging as a strategy to increase lifelong participation in physical activities for all ages. However, there is limited research exploring how physical literacy can be framed for aging adults and adults with chronic conditions to support optimal physical function and mobility, associated with chronic conditions. We investigated the effect of a novel knowledge translation physical literacy intervention among adults living with chronic conditions.

Methods: A pre-post study was conducted. Twenty adults with 2 or more chronic conditions participated in a rehabilitation framed physical literacy program for 5 weeks. Physical function, mobility, self-management, physical literacy awareness and overall health behaviour change were measured pre and post intervention.

Results: Significant improvements were found for physical function ($p < 0.001$; Cohen's $d = 0.90$), as measured by the patient specific functional scale (PSFS), mobility with the 4-meter walk test at self-selected speed ($p = 0.03$; Cohen's $d = 0.53$) and all 3 physical literacy awareness questions ($p = 0.001$; Cohen's $d = 0.86$, $p < 0.001$; Cohen's $d = 1.12$, $p = 0.001$; Cohen's $d = 1.33$). No significant changes were reported for self-management or mobility when measured with the 4-meter walk test at one's fastest speed.

Conclusion: The results of this study can inform future public health interventions aimed at improving function and mobility for adults with chronic conditions. This was the first program designed for adults that integrated rehabilitation principles into the physical literacy framework. Further research is needed to determine validated physical literacy outcome measures and physiotherapy-led program effectiveness within the public health arena.

Introduction

Addressing chronic conditions, continues to be a major challenge for our healthcare system around the world^{1,2}. Over 50% of older adults (>65 years) are living with multimorbidity (co-existence of 2 or more chronic conditions), creating greater healthcare utilization and adverse health outcomes³. Functional decline is reported as a major consequence of living with multimorbidity¹. Successful interventions for chronic conditions include self-management support with daily physical activity included in a healthy lifestyle,⁴ however, only 30% of adults and 10 – 13% of older adults report engaging in regular physical activity, as recommended by the physical activity guidelines^{5,6}. The Canadian 24-Hour Movement Guidelines were recently published in October 2020, and provide evidence-based recommendations for physical activity, sedentary behaviour and sleep, however these guidelines lack information regarding strategies to maintain physical activity with aging or strategies to motivate adults to start a physical activity program⁷.

Physical literacy, defined as “having the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activities for life”, has been described as the gateway to increasing participation in physical activity for individuals of all ages^{8,9}. The promotion of physical literacy is emerging as a promising health strategy within the school curriculum and youth sport development. However, little is known about how physical literacy for adults and older adults can support successful aging and the management of chronic conditions.

When examining the current physical literacy definition, the components are framed for children and youth and are rooted in the development of physical abilities as a person grows, becomes stronger and more physically competent. This physical literacy definition does not

address constructs related to retention, re-learning and acquiring new skills at later stages of life as one experiences age-related physiological decline, or pain and loss of self-efficacy with movement, as a result of aging and chronic conditions. For example, a key component to becoming more physically literate for older adults living with osteoarthritis of the knee may be understanding the importance of correct knee alignment and learning to maintain the kinesthetic position while re-learning or learning new functional skills, such moving from sitting to standing¹⁰. Other physical literacy strategies might include the use of heat and ice in the management of inflammation and gait training to increase speed and efficiency with walking¹¹. Learning how to retain skipping and jumping may not be as relevant to adults with lower extremity functional limitations as learning how to maintain leg power or manage joint swelling with rehabilitation strategies. In addition, knowledge and understanding of physical literacy may go beyond learning the benefits of physical activity to also include learning an awareness of one's body and the changes that occur with aging and gaining knowledge on how to maintain participation in physical activity, despite health setbacks. Before developing programs to improve physical literacy for adults and adults with chronic conditions, it is important to first develop a framework of physical literacy in the context of the physical function and mobility needs of the aging population.

A recent consensus study was completed with a group of researchers and physiotherapists with expertise in physical literacy, health promotion and successful aging¹². An on-line face to face working group meeting with a Nominal Group Technique was utilized to achieve consensus¹³ of the physical literacy constructs important to adults who are living with chronic conditions¹⁴. Confidence with movement, safety with movements, motivation and commitment to physical activity, the ability to self-monitor changes in physical function and understanding

the benefits of physical activity were reported as the top five components when defining physical literacy for adults, from the perspectives of rehabilitation leaders¹². To further evaluate physical literacy and aging, a second qualitative study was completed which explored how adults with multiple chronic conditions describe physical literacy for aging adults and what are the needs, preferences, barriers, and facilitators to acquiring and maintaining physical literacy, despite fluctuations in health status¹⁵. Five key physical literacy themes emerged from the data, including 1) understanding one's body, 2) conscious commitment to movement, 3) access to and knowledge of rehabilitation health resources, 4) valuable physical activities, and 5) confident problem solver¹⁵. Similar findings emerged from both qualitative studies, indicating that when acquiring physical literacy for adults, there are important new constructs, such as self-management and the awareness of rehabilitation strategies, that differ from the traditional Whitehead physical literacy definition stated above⁸. A new physical literacy framework encapsulating the key components identified in the consensus study, semi-structured interviews and a recent integrative review¹⁶ on physical literacy and adults was developed. (Refer to Figure 1.)

The development of the **Physical Literacy** framework for **Adults and Adults with Chronic Conditions (PLACC)** was guided by the International Classification of Functioning Disability and Health (ICF) framework. The ICF is a useful model for contemporary management of functional and mobility challenges related to chronic conditions and aging using a population approach to lifelong health for all individuals across all settings. The ICF classifies information related to health, disability and functioning according to how the health condition(s) are affected by environmental and personal factors¹⁷. The PLACC framework development begins with a goal of improving physical literacy for adults with all functional abilities. A population approach

is undertaken by first addressing the barriers related to multimorbidity and aging (body function and structure, activity, and participation), as well as environmental and personal factors¹⁷. The physical literacy program components are structured around 4 key themes identified in the previous research work: improving knowledge of PA and aging, understanding of one's mobility and functional level, access to rehabilitation resources and mobility support within the community and public health^{12,15,18}. An important aspect included in this framework is the need for public engagement to facilitate and enable normative behaviours, such as participating in regular physical activity, decreasing sedentary behaviour, and utilizing rehabilitation strategies to address mobility concerns when they occur. Therefore, common physical literacy principles will need to be addressed through various program delivery approaches within clinical services (i.e., physiotherapy and rehabilitation practices), community targeted services (i.e., falls prevention programs, knee osteoarthritis (OA) exercise programs, diabetes self-management programs), and universal services (community-based health promotion initiatives, workplace wellness programs, mass media campaigns) to communicate the physical literacy message. Physical literacy programs designed and delivered by physiotherapists will aim to positively affect key measurable outcomes, including, function, mobility, and quality of life for adults using a population health approach. With recent epigenetic and epigenomic advances and the multimorbidity public health crisis, there has never been a better time for physiotherapists to move beyond individualistic approaches and embrace a population health lens with public health programming^{19,20}.

The purpose of this novel project was to develop, implement and evaluate a physical literacy intervention for adults with multiple chronic conditions that is grounded in a rehabilitation focused physical literacy model, framed to address changes with aging and the

management of chronic conditions. It was hypothesized that adults participating in a physical literacy program will demonstrate improvements with function, mobility, self-management skills and awareness around the importance of becoming physically literate with aging.

Intervention: Theoretical Background

The physical literacy intervention was developed by researchers and registered physiotherapists in the field of aging and the management of chronic conditions. The intervention was guided by the following theoretical areas:

1) **Michie's Behaviour Change Wheel**²¹ was used to guide the development of the PL intervention. After defining target behaviours that need to change, intervention functions and appropriate behaviour change strategies were selected from Michie's Behaviour change taxonomy²² with the goal of improving motivation and confidence with mobility and functional tasks that can then translate to long-term adherence with physical activity and self-management. The behaviour change strategies included feedback, goal setting, action planning, self-monitoring and information on health consequences^{22,23}.

2) **The Expanded Chronic Care Model: Integrating Population Health Promotion**²⁴, was used to guide the self-management support components for adults with chronic conditions within the community and health system, while considering the social determinants of health^{4,19}.

Improving one's self-management skills for the management of chronic conditions, such as learning rehabilitation strategies, understanding the benefits of physical activity and the consequences of sedentary behaviour and learning how to monitor one's own functional status were key components to the program.

3) Previous **physical literacy research**, including a recent integrative review¹⁸, an expert consensus study¹² and a qualitative interview study with adults who are living with chronic conditions¹⁵ was used to develop the Physical Literacy framework for aging Adults and adults with Chronic Conditions (PLACC) (Figure 1). This framework guided the physical literacy program components and the delivery methods

4) **Multi-modal knowledge translation (KT)** strategies, including sharing a podcast with physical literacy information, group virtual education sessions and access to web-based modules on healthy aging and goal setting were used to share information with participants. Research has demonstrated that sharing evidence-based, reliable and relevant information with a combination of educational material, decision support tools, small group sessions and opinion leaders are most effective when aiming to change behaviours for adults and older adults²⁵

The study was conducted virtually over zoom and consisted of a one week of asynchronous learning (i.e., podcast) and four continuous weeks of 1-hour group education sessions, delivered by a physiotherapist. A virtual delivery of the program was chosen to ensure the safety of participants during the COVID 19 pandemic and adhere to the public health guidelines. A virtual delivery of the program also allowed for a wider reach of participants outside of the Hamilton area, including individuals who may not have transportation or access to a local facility. Refer to Table 1 for a description of the intervention components and the guiding theoretical frameworks.

Physical Literacy Intervention

Participants were emailed an introduction to the study with a link to a 25-minute podcast discussing the meaning of physical literacy to adults and current research on the link between

physical literacy and healthy aging. The podcast was developed by authors (CP and JR), registered physiotherapists and researchers in the field of physical literacy and chronic conditions (https://mcmasteru365-my.sharepoint.com/personal/popelac_mcmaster_ca/Documents/Attachments/Physical%20literacy%20podcast_001.mp3). The podcast was specifically developed for the intervention and included evidence-based information and discussions on the association between physical literacy and aging and how to be a physically literate adult. Participants were instructed to listen to the podcast on their own before the first group session the following week. The second week involved a group education session on self-management, self-monitoring, pain, and physical activity. Participants were assigned “walk and talk” homework, in which they were asked to share the knowledge they learned in the group session with a friend or family member during an outdoor walk. “Walk and talk” was implemented as a teach back method to assist participants with retaining the physical literacy information they learned in the program²⁶. Studies have shown that less than half the information that is provided to patients by health professionals is recalled by patients²⁷. Teach back involves having the patient repeat back to the health professional (in their own words) what they just learned. For the purpose of this study, participants were asked to “teach” a friend or a family member what they learned in the session. Sharing new information through teach-back methods has demonstrated effectiveness across a wide range of settings, populations and outcome measures²⁶. By adding the component of a social walk, participants were motivated to apply the physical activity component that was discussed in the material. Additionally, this physical literacy intervention was designed for all adults and therefore sharing of the knowledge learned in the program was encouraged.

The third week introduced goal setting and action planning through a web-based self-management tool (www.iamable.ca), in which participants could make their own goals based on self-identified functional challenges. This web-based self-management tool was previously developed by rehabilitation experts with user center design principles, with the goal of providing primary care patients access to rehabilitation self-management strategies²⁸. The IAMABLE website also provided access to educational modules on exercise, fall prevention, fatigue management, pain management, physical activity and stress management²⁸. The fourth week continued to build on goal setting and involved a group education session on how to become a physically literate adult. Participants were then assigned “walk and talk” homework to share with a friend or family member what they learned over the 4 weeks. Refer to Figure 2 for an overview of the 4-week intervention.

Methods

Study Design

A single group pretest posttest intervention design was used to deliver a five-week period with three groups of participants from September 2021 – February 2022. For the pre post study a small effect size (0.2) is anticipated with a 80% power and two-sided 5% significance, resulting in an estimated sample size of $n=25$ ²⁹. Two data collection points were used to collect outcomes at baseline and at end of study, 5 weeks. All study procedures were undertaken by a Registered Physiotherapist (CP). Ethical approval was obtained by the Hamilton Integrated Research Ethics Board (#8062).

Procedure

Sampling and Recruitment

Eligible participants included adults between the ages of 40 to 65 years, with a self-reported diagnosis of 2 or more chronic conditions, ability to speak and understand English and access and willingness to join via laptop computer over the Zoom platform.

Recruitment of participants started in July 2021 and continued throughout the intervention until January 2022, when the third participant group was confirmed. Recruitment methods included posting study information flyers in community organizations, such as the YMCA and community social clubs in, the greater Toronto Area, Oakville, Burlington, and Hamilton. Information flyers were also placed at the Oakville Trafalgar Memorial Hospital and Hamilton Health Sciences Hospital. Social media posts on Facebook and Instagram were used to share information about the study and recruit a wide variety of participants throughout Ontario. Snowball sampling occurred with the recruitment, as 4 participants recommended a friend or family member for future participant groups. Interested participants were pre-screened by phone to ensure they matched the eligibility criteria.

Data Collection

Data were collected from three groups of participants over a 5-month period, between October 2021 and February 2022. At baseline (Time 1; T1) after eligibility screening, a registered physiotherapist contacted all participants via Zoom and completed self-report questionnaires and a mobility outcome measure. Baseline questionnaires included demographic information (age, gender, marital status, work status, living arrangement, use of gait aid, self-report physical activity level, pain rating, number and type of chronic conditions and disability level).

Assessments

Outcome measures were categorized into primary and secondary outcome measures. Adults with multimorbidity are at greater risk for poor physical functioning, disability and hospitalization, therefore function, as measured by the patient-specific functional scale was chosen as the primary outcome of interest³⁰. Mobility, self-management, and awareness of the importance of physical literacy in the healthy aging were chosen as secondary measures for the intervention. The measurements were selected to capture changes in the key physical literacy components (knowledge of the role of physical activity with aging, understanding how to monitor functional changes, awareness of rehabilitation strategies and confidence with participating in functional exercises), as identified in the Physical Literacy framework for Adults and adults with Chronic Conditions (PLACC).

Primary outcome measure

Function

The primary outcome measure was functional activity assessed using the Patient Specific Functional Scale (PSFS)³¹. The PSFS is a valid and reliable tool for adults with acute and chronic conditions that allows patients to identify up to 3 different activities that are difficult for them to perform at baseline³². The participants were then asked to rate each of their identified activities on an 11-point numerical scale, ranging from “0 = unable to perform the activity” to “10 =able to perform the activity at the same level as before injury or problem”. Higher scores represent greater function. After the 4-week intervention, the participants were again asked to rate their same activities that they identified at baseline. Mean scores were used for the analysis.

Secondary Outcome Measures

Mobility

Functional mobility was assessed using the 4-meter gait speed test (4MGS)³³. The 4MGS is one of the most widely used assessment tools in clinical practice to predict functional status of aging adults, specifically related to risk for falls, disability and mortality³⁴. Participants completed the 4MGS in their home after watching a video on how to self-administer the test and after receiving instruction from the physiotherapist assessor over zoom on how to set up and complete the test. The assessor observed and manually timed the participants complete 2 walk tests at a self-selected average speed and 2 walk tests at their fastest walking speed. A one-minute resting period occurred in-between the two walking tests. Timing started at the first foot movement and ended when a foot completely crossed the marked finish line. The participant used a cane or walker if they used this equipment in their daily life. An average was recorded of the normal walking speed and of the fastest walking speed and used for analysis.

Self-management

Self-management skills for people with chronic conditions was assessed using the self-report Health Education Impact Questionnaire (heiQ)³⁵. The heiQ assesses eight independent variables related to self-management skills for individuals with chronic conditions³⁵. The eight sub-skills include positive and active engagement in life, health-directed activities, technique acquisition, constructive attitudes and approaches, self-monitoring and insight, health services navigation, social integration and support and emotional distress³⁵. A 4-point scale (“strongly disagree” to “strongly agree” is used to measure each domain of the heiQ. The heiQ has robust psychometric properties and is a valid assessment of self-management skills in adults and older adults with chronic conditions³⁶.

Awareness of the role of physical literacy in the management of chronic conditions

Three awareness questions were emailed to participants to assess one's knowledge, attitudes, and beliefs about the relationship between physical literacy and the management of chronic conditions and aging. When evaluating individual-level health promotion and disease prevention programs, it is important to accurately measure health knowledge (i.e., risk factors for chronic conditions), and current health behaviours and perceived risk and understanding (understanding the importance of changing the health behaviour, as it relates to optimal aging)^{37,38}. Currently, there is not a valid or reliable tool that is context-specific to older adults and adults with chronic conditions that measures physical literacy awareness. Many health-related questionnaires are focused on one specific health behaviour^{39,40} or they are long surveys examining overall general health⁴¹. Therefore, we designed 3 awareness questions that were specific to physical literacy awareness for adults. For the first awareness question, participants were asked over zoom to use their current knowledge to state as many physical and/or mobility changes that they are aware of can occur with aging and chronic conditions. Participants were asked to answer this question within 2 minutes and the total number of correct answers were collected for data analysis. The second question expanded on the previous and participants were asked "from your current knowledge, please list as many things as possible you can do to help manage or prevent the functional and mobility changes that occur with aging and chronic conditions." Participants were given 2 minutes to answer this question and the total number of correct answers were recorded. For the third question, participants read the following statement: "I believe that physical literacy is important to my health". Participants were then asked to circle the number on a 10-point numerical scale that best represented their level of agreement with 1 representing that they 'strongly disagree' with the statement, 5 indicating that they were 'neutral'

and 10 indicating that they ‘strongly agree’ with the statement. Awareness questions and evidence-based correct answers are available in Supplementary Table 2.

Overall Change in Daily Life

The impact of the physical literacy intervention on the participants overall health was assessed with 7-point Global Rating of improved Change score and was collected 1-week after the intervention, 5 weeks post baseline (T2). Global rating of change (GRC) scales are commonly used in research and in clinical practice to determine change in patient status or the effect of a treatment intervention⁴². The magnitude of difference between a patient’s original health status to their current health status (after the intervention) is typically recorded in a numeric or visual analogue scale. The GRC is a quick and valuable instrument, specifically for complex subjective construct, that has demonstrated adequate reproducibility and sensitivity to change⁴³⁻⁴⁵. The GRC questions can be tailored⁴³⁻⁴⁵ to meet the patient needs and the intervention goals⁴². For the current study, participants were asked the following GRC question: “To what extent have you made changes in your daily life to help manage your chronic conditions and age-related changes because of this intervention?” Participants were then asked to score their answer from 1 -7 with 1 = “no change” and 7 = “significant change (have implemented ≥ 5 strategies)”.

Statistical Analysis

Descriptive statistics of demographic information was expressed using mean and standard deviations (SD) for continuous variables and categorical variables are presented as number and percentage (%). The Shapiro-Wilk test was used to check normality of the data. Paired t-tests were used to determine significance between the before and after physical literacy intervention outcome measures. The effect size of pre and post treatment was determined using the Cohen

‘d’ value. A small treatment effect size was considered a d value of 0.2 – 0.49, a medium treatment effect size was considered a d value of 0.5 – 0.79 and a large treatment effect size was considered a d value of 0.8 or greater. All statistical analysis were performed using MAC SPSS Version 22.

Results

A total of 20 adults were included in the intervention. All participants completed the initial outcomes and intervention; however, 1 participant did not complete the follow up assessments due to an acute illness. Thus 19 participants are included in the analysis, resulting in a large effect size of 0.90 for the primary outcome. Post-hoc power calculation resulted in 87% power with a sample size of $n=19$ ⁴⁶.

Baseline Characteristics

Table 2 displays the demographic and baseline characteristics of a total sample of 20 participants. Ninety five percent ($n=19$) of the sample were women. Participants had a mean age of 59 years ($SD = 6.15$; range = 45 – 65). All participants were community dwelling adults and living either in a house (75%, $n=15$), condominium (15%, $n= 3$) or apartment (10%, $n=2$). Most adults were retired (70%, $n= 14$) and married (70%, $n=14$). Twelve participants (60%) self-reported that they were not currently meeting the physical activity guidelines, defined as participating in 150 minutes of moderate to vigorous physical activity a week⁴⁷. Ten participants (50%) scored low on the International Physical Activity Questionnaire (IPAQ), 9 adults (45%) scored moderate on the IPAQ and 1 adult (5%) scored high on the IPAQ. Only seven participants (35%) self-reported as having no disability, as reported on the Manty Preclinical

Disability Scale. Chronic low back pain was the most reported chronic condition (25%), followed by osteoarthritis (20%).

Functional outcome measure

Table 3 shows the mean differences in mobility, function, and awareness outcomes after the physical literacy intervention. After the 4-week intervention analysis showed an improvement in function, as measured by the PSFS. A significant improvement in PSFS scores were reported ($p < 0.001$, Cohen's $d = 0.9$). However, the minimally clinically important difference (MCID) for the PSFS is 2, which was not achieved at study endpoint.

Mobility outcome measure

At follow up, participants walked faster, as measured by the 4MGS test at both normal walking speed and at fastest walking speed. Average gait velocity for the 4MGS at normal walking speed was 4.90 seconds before the intervention and it significantly decreased to 4.71 seconds after the intervention ($p = 0.03$, Cohen's $d = 0.53$). No significant decrease in the average gait velocity for the 4MGS at fastest walking speed was observed ($p = 0.64$, Cohen's $d = 0.11$).

Self-management

Out of the 8 domains of the Health Education Impact Questionnaire (heiQ) used to measure self-management, only 2 demonstrated a significant improvement. The self-directed behaviour domain improved on average from 2.76 to 3.05, on a 4-point scale ($p = 0.025$, large effect) and the emotional wellbeing domain, using a reverse 4-point scale, improved from 1.77 to 1.42 ($p = 0.002$, large effect). The changes observed for the domains of positive engagement ($p = 0.135$), self-management skills ($p = 0.157$), constructive attitudes ($p = 0.772$), self-monitoring ($p = 0.904$), health navigation ($p = 0.695$) and social integration ($p = 0.758$) were not significant.

Awareness of the role of physical literacy with healthy aging

Participant awareness around what physical literacy is and the role of physical literacy in the management of chronic conditions and aging significantly improved for each of the 3 questions. Identifying functional changes that occur with aging improved from an average of 5.37 points to 6.47 points ($p=0.001$, cohen's $d=0.86$). Identifying strategies that one can do to prevent and/or improve the changes that occur with aging and chronic conditions improved from an average of 4.47 points to 6.21 points ($p<0.001$; cohen's $d=1.12$). Participants reported belief that physical literacy is important to one's health, when measured on a 10-point scale, increased from 7.16 at the start of the intervention to 9.00 at the end of the intervention ($p<0.001$, cohen's $d=1.33$).

Perceived Change

The global rating of change (GRC) scale was used to assess overall perceived change in self-management and movement behaviour, because of the intervention. All but one participant (18/19) reported a positive change. Average GRC score at T2 was 4.53 (SD=1.17), indicating a moderate improved change. Refer to Table 4.

Discussion

The aim of this study was to develop and evaluate a novel intervention, grounded in a rehabilitation focused physical literacy framework for adults and adults with chronic conditions. The physical literacy for adults with chronic conditions group intervention was designed to address the mobility and functional needs of individuals experiencing functional changes associated with aging or chronic conditions by promoting movement self-awareness and safe physical activities, while sharing key rehabilitation-based knowledge to encourage movement despite physical limitations. Key findings of the study demonstrated significant improvements in

physical function and one's awareness of physical literacy. Improvements were also found for outcomes measuring mobility and self-management skills.

The mean PSFS scores increased from baseline to 5-weeks (4.56 – 5.87, $p < 0.001$), representing a statistically significant improvement and a large effect size. Our physical literacy study participants improved their PSFS scores by an average of 1.31 points. Literature examining the psychometric properties of the PSFS^{48,49} for adults with chronic conditions has reported the minimal clinically important difference (MCID) and the Minimal Detectable Change (MDC), as 2 points. Additionally, a recent systematic review and meta-analysis on the psychometric properties of the PSFS for patients with low back pathology found that changes ranging from 1.34 to 2.3 points can be considered clinically important deteriorations or improvements³². Our study participants demonstrated a significant improvement in PSFS over the 5-week period and had an average change of 1.3 points, which remains 0.1 – 1.0 points short of a clinically significant change. This may be due to the short duration of the intervention and follow up (5-weeks) and the variation of participants included in the intervention (i.e., type and number of chronic conditions, and length of time since diagnosis of chronic conditions). Most patients were able to complete the PSFS outcome measures with little instruction, however some patients may have chosen goals that could not be achieved in the study timeline, affecting PSFS scores. The PSFS overall was a useful outcome measure for the evaluator and the participant, as it helps adults with chronic conditions focus on positive aspects of functional recovery (i.e., meaningful activities that they are currently having difficulty completing but would like to return to) rather than concentrating on levels of pain (i.e., numeric pain rating scale). This PSFS evaluation approach also helped facilitate the goal setting and action planning component on the self-management website (www.iamable.ca) used during week 3 and 4 of the intervention²⁸.

Significant improvements were seen in mobility, as measured by the 4MGS at normal, self-selected speed ($p=0.03$; cohen's $d=0.53$), however no significant improvements were observed for the 4MGS at the fastest speed ($p=0.64$; cohen's $d=0.11$). This may be a result of the short intervention and timeline between the pre and post outcome measures. A longer follow up time (i.e., ≥ 6 weeks) may have resulted in a clinically meaningful change for function (PSFS) and mobility (4MGS fastest speed) by allowing participants to action the information (i.e., practice increasing gait speed) that was shared in the intervention over a longer time-period.

An important result of the study was that awareness of the role of physical literacy in the management of chronic conditions significantly increased after 5 weeks for all 3 questions. Participants were able to identify more functional changes that occur because of aging and chronic conditions as well as record more actions they could take to prevent and improve the changes that occur with aging and chronic conditions. Participants also increased their belief that physical literacy was important to their overall health. A key component to obtaining physical literacy as an adult is having the capacity to obtain, process and understand important physical health information and services needed to make appropriate health decisions. Lifelong educational and learning practices, (i.e., accessing e-health resources) are important enablers for positive health behaviours in the future^{50,51}, and has even greater priority with the effects of infectious disease, in addition to chronic conditions and aging¹⁹. The multi-modal knowledge translation methods, with use of the podcast, group education sessions, web-based education modules and goal setting, along with the sharing of information on “walk and talks”, all likely contributed to the retainment and action of physical literacy information shared⁵². The intervention did not result in reported improvements for self-management skills, as measured by the heiQ. This heiQ questionnaire focused on 8 domains of self-management. Within the 5-week

intervention, not all domain components were fully explored in the group session, such as constructive attitudes and health navigation, which may explain why a significant change was not observed for the overall self-management component. Additionally behaviour change is a complex process and requires time to build self-efficacy and measure change²². Overall, 90% of participants reported a moderate to significant change in their behaviour as a result of the intervention. This demonstrates that a 5-week physical literacy intervention, with the key program components identified in the PLACC framework and delivered with a population health approach, virtually, at a low cost, can positively influence important health behaviours for adults with chronic conditions.

Currently there is no standardized outcome tool used to measure physical literacy for adults. The Perceived Physical Literacy Instrument (PPLI) has been used by some researchers⁵³ to measure perceived physical literacy through 3 self-report subscales, however this scale was developed for use with adolescents and does not address the needs of adults and older adults⁵⁴. Similar to our study, other physical literacy intervention studies used a combination of objective and subjective measures that correlated with the healthy aging and key physical function and mobility outcomes for aging⁵⁵. As identified in our physical literacy framework for adults and adults with chronic conditions (PLACC), future physical literacy assessments should consider including components that measure one's knowledge of the role of physical activity (PA) with aging and key rehabilitation strategies to support continued participation in movement activities, one's ability to self-monitor physical function and one's confidence with participation in mobility activities.

A recent cross-sectional study by Huang (2022) found that physical well-being is correlated with perceived physical literacy for older adults⁵⁶. This indicates that older adults who

reported being more informed on physical literacy components, such as the benefits of PA, the changes that occur with aging, how to manage mobility concerns and how to access to rehabilitation resources were better able to maintain a healthy quality of life and complete the important activities of daily living without undue fatigue or physical stress^{56,57}. Interestingly, the study also found that physical competence was not found to be associated with perceived physical literacy⁵⁶. This further supports our PLACC framework, describing physical literacy as a combination of attributes beyond physical competence, including self-efficacy, self-monitoring, and understanding the benefits of physical activity and rehabilitation strategies. It is critical for adults experiencing age related changes and mobility challenges because of chronic conditions to make physical adaptations to ensure they maintain their physical ability to interact with their environment. Greater knowledge and understanding of physical literacy principles should be delivered through public health programs with a population health approach, considering the needs of our aging population, such as the examples presented below which are grounded in physiotherapy theory:

- Providing physiotherapists population health data, including mobility markers to identify disparities, (and what is causing them) to develop community based physical literacy interventions (i.e., walk and talk with a physiotherapist, virtual physical literacy group education sessions or rehabilitation focused health hubs)
- Physiotherapists working with elected officials in the community to promote physical literacy for adults at community events (i.e., fairs, churches, sporting events)
- Physiotherapists leading employer based physical literacy interventions for adults

- Physiotherapists working on primary health care teams to design and deliver physical literacy programs that address the needs of broad range of adults experiencing mobility concerns
- Physiotherapists at the clinic and community level sharing multi-modal information on physical literacy (i.e., physical literacy podcast provided for all adult clients, educational material on pamphlets, access to web-based self-management and physical literacy modules)
- Physiotherapists working in clinical practice, routinely screening all adults for mobility changes, and educating on self-monitoring for lower extremity strength and gait speed
- Physiotherapists working collaboratively with chronic condition organizations (i.e., diabetes association, heart and stroke foundation, arthritis society), to share rehabilitation framed physical literacy education modules and group interventions that can be utilized congruently across a variety of health disciplines
- Physiotherapists working with policy makers to design inclusive neighborhoods that promote physically literate communities
- Physiotherapists working with public health officials and key stakeholder to change the narrative from “the promotion of exercise”, to “the promotion of physical literacy”

Strengths and Limitations

One of the main strengths of this study was the innovative and novel approach taken to the prevention and management of chronic conditions by expanding beyond traditional self-

management programs to include developing physical literacy for adults with multimorbidity.

This study used a patient-centered approach with evidence-based information to build a PL framework for adults (PLACC) that was used to guide the intervention with population-based strategies. It is important to consider some limitations of our pre-post study when interpreting the results. This was a single group, non-randomized pre post study using a small sample of adults with 2 or more chronic conditions. A preceding feasibility pilot study with a representative sample size does not exist for our physical literacy study, therefore, the generalizability of our results is limited. The voluntary nature of the participation may have resulted in sample selection bias. The majority of the participants were women, which, may influence the results. Assessor bias may have occurred, as the same registered physiotherapist carried out all aspects of the study, including screening, initial assessments, intervention, and final assessments.

The virtual delivery of the intervention is congruent with a population health approach, allowing to reach a broader group of adults from all geographical areas, however it also limits individuals who do not have access to a laptop or portable device with internet and the zoom platform or are not comfortable using technology, especially in a group setting. Even though study participants reported an overall moderate improved change because of this study, the Global Rating of Change Scale has been criticized for its reliability in how well participants can recall their previous health, or health behaviours^{42,58}. To address this concern and avoid possible over or under exaggeration with overall change, serial measurements were added to each of the change scores (Refer to Table 4). For example, a score of 4 on the 7-point scale is associated with “Moderate change: have implemented 2-3 new positive behaviours. Adapting the GRC scale to meet the needs of the study may allow participants to reflect on the changes they have made more accurately. Lastly, a validated physical literacy measurement tool for adults and

adults with chronic conditions was not available at the time of the study. Therefore, this limitation should be considered when interpreting results based on the subjective and objective measurement tools used to measure the key components of physical literacy for adults, as defined by a novel framework (PLACC).

Implications

Rehabilitation programs are often siloed by specific health conditions (GLA:D Osteoarthritis Exercise Program), which can exclude adults with multimorbidity⁵⁹. Similarly general exercise programs do not address the safety concerns and rehabilitation strategies required for 50% of the population, who are living with one or more chronic condition³. Physical literacy programs are needed for adults that focus on increasing awareness of the changes that occur with aging, improve self-management skills, teach rehabilitation strategies, promote optimal aging, and offer actionable movement solution to address the common functional limitations associated with multimorbidity. Programs designed for all individuals of all functional levels that maximize access and use of existing community, primary care, and public health resources and integrate a rehabilitation lens into physical literacy programming is required for our aging population. Further agreement is needed among researchers, health professionals, public health officials and key stakeholders regarding the definition of physical literacy for adults and adults with chronic conditions.

Obtaining physical literacy is associated with optimal aging, therefore, it is important to understand the key components of a physical literate adult⁶⁰. Sharing key rehabilitation principles, such as the management of inflammation, rehabilitation focused strengthening and stretching and monitoring/assessing one's change in functional status are all necessary

components that should be integrated into physical literacy programming for adults and delivered effectively through population health approaches. Government funding is needed to support the evolving field of physiotherapy within public health to effectively attend to the public health crisis of chronic conditions. Systematic and validated measurement tools are needed to assess physical literacy for adults and measure change with programming. Newly developed interventions should be grounded in a rehabilitation framework, such as the Physical Literacy framework for Adults and adults with Chronic Conditions (PLACC) and address functional, mobility, self-management, and educational awareness skills. Multi-knowledge translation strategies should be used in a blended and actionable step through on-line and in-person sessions that can be implemented at the clinical, primary care and public health levels. Future research should focus on the assessment of such interventions with larger and more diverse sample groups with stronger research designs.

Conclusion

A shift in public understanding of the importance of physical literacy for adults and adults with chronic conditions can positively influence key aging outcomes and help guide further program development to integrate rehabilitation strategies. Our Physical Literacy Framework for Adults and Adults with Chronic Conditions (PLACC) uses a population health approach to promote physical literacy in all aspects of one's adult life through the delivery of physical literacy programs within clinical care, targeted services (i.e., primary care) and universal services (i.e., public health programs)⁶¹. Our findings highlighted that participating in a 5-week knowledge translation physical literacy intervention and delivered in a virtual group setting is associated with improvements in self-reported function, mobility, and awareness of the

importance of physical literacy for optimal aging for adults with chronic conditions. Participants reported a moderate change in their lifestyle behaviours, as a result of the intervention. No significant changes were found concerning the domains of self-management and mobility (when measured by 4MWT at fastest gait speed). Importantly, since the association between physically literate adults and optimal aging has been suggested⁶², our study results can inform future public health activities which aim to improve important health outcomes (i.e., function and mobility) for adults with chronic conditions and provide validation for government funded physiotherapists addressing a public health crisis. Additionally, our study results can support further development of physical literacy interventions grounded in rehabilitation principles for adults and adults with chronic conditions.

Table 1: Multi-modal Physical Literacy Intervention for Adults and Theoretical Frameworks

PL Intervention Components	Description on components	Delivery of components	Guiding Frameworks	Theoretical domains
Education on what PL is and how this is linked to optimal aging	Physical literacy and aging podcast prepared by researchers and developed for study participants	Asynchronous learning Email link sent for participants to listen to on their own time before session 1	Michie’s Behaviour Change	<ul style="list-style-type: none"> • Provide information on behaviour and how this is linked to health
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Self-management support • Informed, activated patients • Population health approach
			*PLACC	<ul style="list-style-type: none"> • Sharing of PL components identified in research
Education on the importance of PA in the management of chronic conditions (self-monitoring) and optimal aging	Group education session #1 Evidence-based information slides shared didactically by registered physiotherapist and then provided in reading format	Synchronous learning Virtual 1 hour group education delivery via Zoom PDF slides emailed to participants to read for reference	Michie’s behaviour change	<ul style="list-style-type: none"> • Provide information on behaviour and how this is linked to health • Provide normative information about other’s behaviour • Self-monitoring of behaviour
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Self-management support • Informed, activated patients • Population health approach
Education on the consequences on physical inactivity and sedentary behaviour with chronic conditions and optimal aging	Group education session #2 Evidence-based information slides shared didactically by registered physiotherapist and then provided in reading format	Synchronous Learning Virtual 1 hour group education delivery via Zoom PDF slides emailed to participants to read for reference	Michie’s behaviour change	<ul style="list-style-type: none"> • Provide information on the consequences of the behaviour • Barrier identification and problem solving
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Self-management support • Informed, activated patients • Population health approach

Instruction on how to increase or maintain physical activity with chronic conditions and aging	Group education session #3 Evidence-based information slides shared didactically by registered physiotherapist and then provided in reading format	Synchronous Learning Virtual 30-minute group education delivery via Zoom PDF slides emailed to participants to read for reference	Michie’s behaviour change	<ul style="list-style-type: none"> • Provide instruction on how to perform the behaviour
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Self-management support • Informed, activated patients • Population health approach
Instruction on how to be a physically literate adult and older adult	Group education session #4 Strategies on how to be more physically literate shared didactically by registered physiotherapist and then provided in reading format	Synchronous Learning Virtual 1 hour group education delivery via Zoom PDF slides emailed to participants to read for reference	Michie’s behaviour change	<ul style="list-style-type: none"> • Provide instruction on how to perform the behaviour
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Self-management support • Informed, activated patients • Population health approach
			PLACC	<ul style="list-style-type: none"> • Sharing of PL components identified in research
Education and Instruction on how goal setting and action planning	Group instruction session during week 3 on goal setting and action plans as a self-management strategy Participants provided access to a web-based health education tool (www.iamable.ca) and instructed on how to use the website and set goals and action plans	Synchronous Learning Virtual 30-minute group education session on how to use the website www.iamable.ca to set goals/action plans and navigate self-management modules	Michie’s behaviour change Goal setting	<ul style="list-style-type: none"> • Goal Setting • Action Planning
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Clinical information systems (web-based self-management tool) • Informed, activated patients
Physical Activity Walk and Talk with a friend or neighbor	Participants asked to arrange a walk and talk with a friend or neighbour during week 2 and week 4 as part of “homework”	Asynchronous learning and sharing of information	Michie’s Behaviour Change	<ul style="list-style-type: none"> • Plan social support
			Expanded Chronic Care Model	<ul style="list-style-type: none"> • Community resources

***Physical Literacy Framework for Adults and Adults with Chronic Conditions (PLACC)**

Table 2: Baseline Demographic Profile and Chronic Conditions Characteristics

Item	Categories	n (%)
Gender	Female	19 (95)
	Male	1 (5)
Age (years)	45 – 49	2 (10)
	50 – 54	2 (10)
	55 – 59	4 (20)
	60 – 65	12 (60)
Work status	Working (full time)	6 (30)
	Retired	14 (70)
Marital Status	Married	14 (70)
	Single	5 (25)
	Widow	1 (5)
Living Arrangement	House	15 (75)
	Condominium	2 (10)
	Apartment	3 (15)
Use of gait aid	Yes	4 (20)
	No	16 (80)
Physical Activity Status (IPAQ)	Low	10 (50)
	Moderate	7 (35)
	High	3 (15)
Pain rating (Numeric Scale 1-10)	Mean = 3.25 and SD=2.12	
Disability level (Manty Preclinical Disability Scale)	No Disability	7 (35)
	Pre-Clinical Disability	3 (15)
	Minor Manifestation	8 (40)
	Major Manifestation	2 (10)
Number of Chronic conditions	2	9 (45)
	>2	11 (55)
Type of primary chronic condition	OA	4 (20)
	OP	1 (5)
	Post Stroke	1 (5)
	MS	1 (5)
	Chronic LBP	5 (25)
	Chronic neck pain	1 (5)
	RA	2 (10)
	Cancer	2 (10)
	Parkinson	1 (5)
	Muscular dystrophy	1 (5)
	Diabetes	1 (5)

Table 3: Results of Paired t-tests for Study Outcomes and Effect sizes

Outcomes	Measurements	Baseline (T1) Score Mean (SD) (n=20)	Post-intervention (T2) Score Mean (SD) (n=19)	p-value	Cohens d	Effect size
Function (Primary Outcome)	Average PSFS score of 3 self-identified activities. Scale from 0-10	4.56 (2.32)	5.87 (2.42)	<0.001	.902	large
Mobility	4-meter gait speed test: walking at normal speed (average time in seconds)	4.90 (1.13)	4.71 (1.11)	0.033	0.531	medium
	4-meter gait speed test: walking at fastest speed (average time in seconds)	3.30 (0.85)	3.26 (0.818)	0.637	0.110	small
Awareness of the role of physical literacy in the management of chronic conditions	Question 1: Name as many functional changes that occur with aging and chronic conditions: Number of correct responses in 2 minutes	5.37 (2.34)	6.47 (1.9)	0.001	0.859	large
	Question 2: What can you do to prevent and/or improve the changes that occur with aging? Number of correct responses in 2 minutes	4.47 (1.90)	6.21 (1.81)	<0.001	1.115	large
	Question 3: I believe that physical literacy is important to my health: 10-point scale with 1 = strongly disagreed and 10 = strongly agree	7.16 (2.12)	9.00 (1.3)	<0.001	1.330	large
Self-management	HEiQ positive engagement domain (4-point scale)	3.06 (0.28)	3.12 (0.28)	0.135	.359	
	HEiQ self-directed behaviour domain (4-point scale)	2.76 (0.73)	3.05 (0.37)	0.026	0.559	medium
	HEiQ skill domain (4-point scale)	3.10 (0.37)	3.21 (0.34)	0.157	0.339	small
	HEiQ constructive attitudes domain (4-point scale)	3.25 (0.31)	3.27 (0.34)	0.772	0.067	
	HEiQ self-monitoring domain (4-point scale)	3.23 (0.39)	3.24 (0.28)	0.904	0.028	
	HEiQ health navigation domain (4-point scale)	2.97 (0.43)	2.95 (0.48)	0.695	0.092	
	HEiQ social integration domain (4-point scale)	3.08 (0.57)	3.11 (0.51)	0.758	0.072	
	HEiQ emotional wellbeing domain (reversed 4-point scale)	1.77 (0.52)	1.42 (0.45)	0.002	0.822	large

PSFS = Patient Specific Functional Scale: 11-point numeric rating scale (0= “unable to perform activity” and 10 = “able to perform”

HeiQ = Health Education Impact Questionnaire: 4-point Likert scale (1 = “strongly disagree” and 4 = “strongly agree”)

Table 4: Global Rating of Change Scale (GRC)

Question: To what extent have you made changes in your daily life to help manage your chronic conditions or age-related changes because of this intervention?

Score	Description	n (%)
1	No change	1 (5)
2	Hardly any change (thinking about implementing changes)	0
3	A little change (starting to implement 1-2 strategies)	1 (5)
4	Moderate change (have implemented 2 -3 new strategies)	6 (30)
5	A good deal of change (have implemented 3-4 new strategies)	8 (40)
6	A great deal of change (have implemented 4-5 new strategies)	3 (15)
7	Significant change (have implemented \geq 5 strategies)	0

Mean = 4.53 SD = 1.172

Figure 1: Physical Literacy Framework for adults and adults with chronic conditions (PLACC)

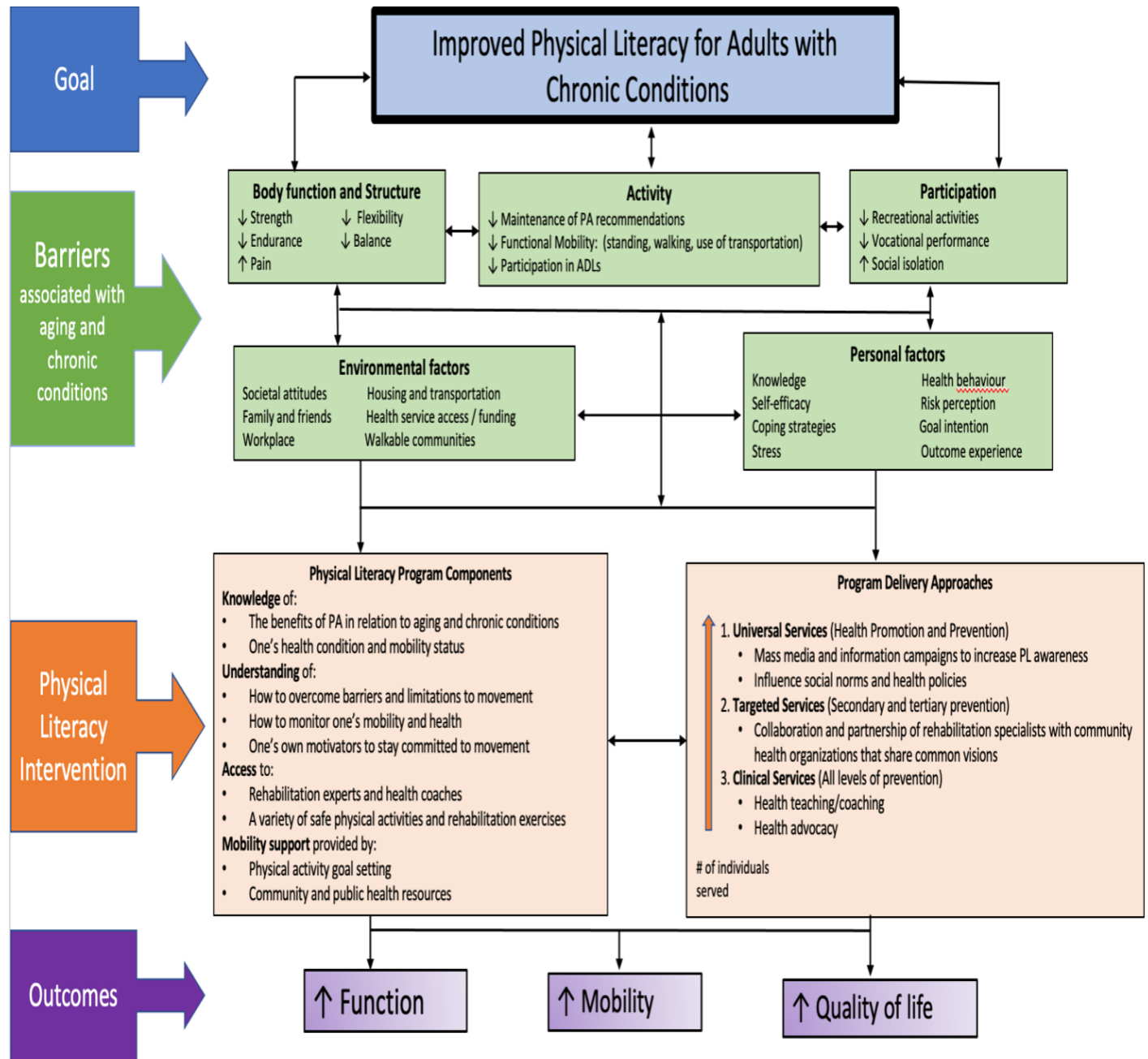


Figure 2: Physical Literacy Intervention Components

Week 1	Week 2	Week 3	Week 4
<p>Independent Prep Work</p> <ul style="list-style-type: none"> • Independent 25- minute physical literacy podcast for participants to listen to on their own time • Content: What is physical literacy? What is the current literature on physical literacy for adults? How can one become more physically literate? 	<p>Group Education Session</p> <ul style="list-style-type: none"> • 1-hour virtual presentation on self-management for aging and chronic conditions • Content: How to become an active self-manager, how to self monitor mobility and functional changes • Homework: “walk and talk” *share your knowledge with others during an outdoor walk 	<p>Group Work Session</p> <ul style="list-style-type: none"> • 1-hour virtual actionable education session on goal setting and action planning • Content: Introduction to www.iamable.ca, a web based self-management and goal setting application. Participants guided with SMART goal development and weekly action plans 	<p>Group Education Session</p> <ul style="list-style-type: none"> • 1-hour virtual education session on how to become a physically literate adult • Content: the link between optimal aging and physical literacy, rehabilitation strategies for aging and chronic conditions, how to acquire and maintain physical literacy through fluctuations in health • Homework: “walk and talk” *share your knowledge with others during an outdoor walk

References

1. Marengoni A, Angleman S, Melis R, et al. Aging with multimorbidity: A systematic review of the literature. *Ageing Res Rev.* 2011;10(4):430-439.
doi:<https://doi.org/10.1016/j.arr.2011.03.003>
2. Naghavi M, Abajobir T, Bettcher D. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980–2016: a systematic analysis for the global burden of disease study 2016. *Lancet.* 2017;(10.1016/S0140-6736(17)32152-9):1151-2110.
3. Sakib MN, Shooshtari S, St. John P, Menec V. The prevalence of multimorbidity and associations with lifestyle factors among middle-aged Canadians: an analysis of Canadian Longitudinal Study on Aging data. *BMC Public Health.* 2019;19(1):243.
doi:10.1186/s12889-019-6567-x
4. Reynolds R, Dennis S, I H. A systematic review of chronic disease management interventions in primary care. *BMC Fam Pract.* 2018;19(1):11. doi:10.1186/s12875-017-0692-3
5. Benjamin EJ, Muntner P, Alonso A, et al. Heart Disease and Stroke Statistics—2019 Update: A Report From the American Heart Association. *Circulation.* 2019;139(10):e56-e528. doi:10.1161/CIR.0000000000000659
6. Sun F, Norman IJ, While AE. Physical activity in older people: a systematic review. *BMC Public Health.* 2013;13(449). <https://doi.org/10.1186/1471-2458-13-449>.
7. Ross R, Chaput JP, Giangregorio LM, et al. Canadian 24-Hour Movement Guidelines for Adults aged 18-64 years and Adults aged 65 years or older: an integration of physical activity, sedentary behaviour, and sleep. *Appl Physiol Nutr Metab.* 2020;45(10):S57-S102.
<https://doi.org/10.1139/apnm-2020-0467>.

8. International Physical Literacy Association. <https://www.physical-literacy.org.uk/>.
Published 2014.
9. Higgs C, Cairney J, Jurbala P, Dudley D, Way R, Mitchell D. *Developing Physical Literacy: Building a New Normal for All Canadians. Physical Literacy in the Adult and Older Years.*; 2019. https://sportforlife.ca/wp-content/uploads/2019/09/DPL-2_EN_web_November_2019-1.pdf.
10. Fransen M, McConnell S, Harmer AR, Van der Esch M, Simic M, Bennell KL. Exercise for osteoarthritis of the knee: a Cochrane systematic review. *Br J Sports Med.* 2015;49(24):1554 LP - 1557. doi:10.1136/bjsports-2015-095424
11. Uritani D, Koda H, Sugita S. Effects of self-management education programmes on self-efficacy for osteoarthritis of the knee: a systematic review of randomised controlled trials. *BMC Musculoskelet Disord.* 2021;22(1):515. doi:10.1186/s12891-021-04399-y
12. Petrusevski C, Richardson J, MacDermid J, Wilson M. *Framing Physical Literacy for Adults through a Rehabilitation Lens: An Expert Consensus Study.*; 2021.
13. McMillan SS, King M, Tully MP. How to use the nominal group and Delphi techniques. *Int J Clin Pharm.* 2016;38(3):655-662. doi:10.1007/s11096-016-0257-x
14. McMillan S, King M, Tully M. How to use the nominal group and Delphi techniques. *Int J Clin Pharm.* 2016;38(3):655-662. doi:doi: 10.1007/s11096-016-0257-x. Epub 2016 Feb 5. PMID: 26846316; PMCID: PMC4909789.
15. Petrusevski C, Richardson J, MacDermid J, Wilson M. “You can because you do and you do, because you can”: A qualitative study examining what it means to be a physically literate adult from the perspective of adults living with multiple chronic conditions. 2022.
16. Petrusevski C, Morgan A, MacDermid J, Wilson M, Richardson J. Framing physical

- literacy for aging adults: an integrative review. *Disabil Rehabil*. December 2021:1-12.
doi:10.1080/09638288.2021.2012841
17. Stucki G. International Classification of Functioning, Disability, and Health (ICF): A Promising Framework and Classification for Rehabilitation Medicine. *Am J Phys Med Rehabil*. 2005;84(10).
https://journals.lww.com/ajpmr/Fulltext/2005/10000/International_Classification_of_Functioning,.2.aspx.
 18. Petrusevski C, Morgan A, MacDermid J, Wilson M, Richardson J. Framing Physical Literacy for Adults: An Integrative Review. *Disabil Rehabil (Under Rev)*. 2021.
 19. Magnusson D, Rethorn Z. Strengthening Population Health Perspectives in Physical Therapist Practice Using Epigenetics. *Phys Ther*. 2022;102(1):pzab244.
<https://doi.org/10.1093/ptj/pzab244>.
 20. Dunleavy K, Mejia-Downs A, Guerrero H, et al. Embedding Population Health in Physical Therapist Professional Education. *Phys Ther*. 2022;102(1):pzab238.
doi:10.1093/ptj/pzab238.
 21. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. *Implement Sci*. 2011;6(1):42. doi:10.1186/1748-5908-6-42
 22. Michie, S Ashford, S Sniehotta, F Dombrowski, S Bishop, A. French D. A refined taxonomy of behaviour change techniques to help people change their physical activity and healthy eating behaviours: The CALO-RE taxonomy. *Psychol Health*. 2011;26(11):1479-1498. doi:10.1080/08870446.2010.540664.
 23. Levack WMM, Weatherall M, Hay-Smith EJC, Dean SG, McPherson K, Siegert RJ. Goal

- setting and strategies to enhance goal pursuit for adults with acquired disability participating in rehabilitation. *Cochrane database Syst Rev.* 2015;2015(7):CD009727-CD009727. doi:10.1002/14651858.CD009727.pub2
24. Victoria J. Barr Brenda Marin-Link, Lisa Underhill, Anita Dotts, Darlene Ravensdale and Sandy Salivaras SR. The Expanded Chronic Care Model: An Integration of Concepts and Strategies from Population Health Promotion and the Chronic Care Model. *Healthc Q.* 2003;7(1):73-82. <http://www.longwoods.com/product/16763>.
 25. Lokker C, Gentles SJ, Ganann R, et al. Knowledge translation strategies for sharing evidence-based health information with older adults and their caregivers: findings from a persona-scenario method. *BMC Geriatr.* 2021;21(1):665. doi:10.1186/s12877-021-02588-x
 26. Talevski J, Wong Shee A, Rasmussen B, Kemp G, Beauchamp A. Teach-back: A systematic review of implementation and impacts. *PLoS One.* 2020;15(4):e0231350-e0231350. doi:10.1371/journal.pone.0231350
 27. Richard C, Glaser E, Lussier M-T. Communication and patient participation influencing patient recall of treatment discussions. *Health Expect.* 2017;20(4):760-770. doi:10.1111/hex.12515
 28. Richardson J, Letts L, Sinclair S, et al. Using a Web-Based App to Deliver Rehabilitation Strategies to Persons With Chronic Conditions: Development and Usability Study. *JMIR Rehabil Assist Technol.* 2021;8(1):e19519. <https://doi.org/10.2196/19519>.
 29. Clinical.com. Sample Size Calculator. <https://clincalc.com/Stats/SampleSize.aspx>.
 30. Ryan A, Wallace E, O'Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes.*

- 2015;13(1):168. doi:10.1186/s12955-015-0355-9
31. Horn KK, Jennings S, Richardson G, van Vliet D, Hefford C, Abbott JH. The Patient-Specific Functional Scale: Psychometrics, Clinimetrics, and Application as a Clinical Outcome Measure. *J Orthop Sport Phys Ther.* 2012;42(1):30-42.
doi:10.2519/jospt.2012.3727
 32. Nazari G, Bobos P, Lu S, Reischl S, Almeida PH, MacDermid JC. Psychometric Properties of the Patient-Specific Functional Scale in Patients with Low Back Pathology: A Systematic Review and Meta-Analysis. *Physiother Canada.* 2021;74(1):6-14.
doi:10.3138/ptc-2020-0042
 33. Bohannon R, Wang Y. Four-Meter Gait Speed: Normative Values and Reliability Determined for Adults Participating in the NIH Toolbox Study. *Arch Phys Med Rehabil.* 2019;100(3):509-513. <https://doi.org/10.1016/j.apmr.2018.06.031>.
 34. Rydwik E, Bergland A, Forsén L, Frändin K. Investigation into the reliability and validity of the measurement of elderly people's clinical walking speed: A systematic review. *Physiother Theory Pract.* 2012;28(3):238-256. doi:10.3109/09593985.2011.601804
 35. Osborne RH, Elsworth GR, Whitfield K. The Health Education Impact Questionnaire (heiQ): An outcomes and evaluation measure for patient education and self-management interventions for people with chronic conditions. *Patient Educ Couns.* 2007;66(2):192-201. doi:10.1016/j.pec.2006.12.002
 36. Pozza A, Osborne RH, Elsworth GR, Gualtieri G, Ferretti F, Coluccia A. Evaluation of the Health Education Impact Questionnaire (heiQ), a Self-Management Skill Assessment Tool, in Italian Chronic Patients. *Psychol Res Behav Manag.* 2020;13:459-471.
doi:10.2147/PRBM.S245063

37. Glasgow R, Linnan L. *Chapter 21: Evaluation of Theory-Based Interventions*. In: Glanz K, Rimer BK, Viswanath K, Editors. *Health Behaviour and Health Education: Theory, Research, and Practice*. 4. San Francisco, CA: Jossey-Bass; 2008. Pp. 487–508.
38. Public Health Ontario. Evaluating health promotion programs: introductory workbook: Public Health Ontario.
39. Traina SB, Mathias SD, Colwell HH, Crosby RD, Abraham C. The Diabetes Intention, Attitude, and Behavior Questionnaire: evaluation of a brief questionnaire to measure physical activity, dietary control, maintenance of a healthy weight, and psychological antecedents. *Patient Prefer Adherence*. 2016;10:213-222. doi:10.2147/PPA.S94878
40. Busschaert C, De Bourdeaudhuij I, Van Holle V, Chastin SFM, Cardon G, De Cocker K. Reliability and validity of three questionnaires measuring context-specific sedentary behaviour and associated correlates in adolescents, adults and older adults. *Int J Behav Nutr Phys Act*. 2015;12:117. doi:10.1186/s12966-015-0277-2
41. Statistics Canada . Canadian community health survey - annual component (CCHS): Statistics Canada. 2015.
42. Kamper SJ, Maher CG, Mackay G. Global rating of change scales: a review of strengths and weaknesses and considerations for design. *J Man Manip Ther*. 2009;17(3):163-170. doi:10.1179/jmt.2009.17.3.163
43. Middel B, Stewart R, Bouma J, Sonderen E van, Heuvel WJA van den. How to validate clinically important change in health-related functional status. Is the magnitude of the effect size consistently related to magnitude of change as indicated by a global question rating? *J Eval Clin Pract*. 2001;7(4):399-410. doi:https://doi.org/10.1046/j.1365-2753.2001.00298.x

44. Fischer D, Stewart AL, Bloch DA, Lorig K, Laurent D, Holman H. Capturing the Patient's View of Change as a Clinical Outcome Measure. *JAMA*. 1999;282(12):1157-1162. doi:10.1001/jama.282.12.1157
45. Abrams D, Davidson M, Harrick J, Harcourt P, Zylinski M, Clancy J. Monitoring the change: Current trends in outcome measure usage in physiotherapy. *Man Ther*. 2006;11(1):46-53. doi:https://doi.org/10.1016/j.math.2005.02.003
46. Clinical.com. Post-hoc power calculator.
47. Tremblay MS, Warburton DER, Janssen I, et al. New Canadian Physical Activity Guidelines. *Appl Physiol Nutr Metab*. 2011;36(1):36-46. doi:10.1139/H11-009
48. Stratford P, Gill C, Westaway M, Binkley J. Assessing Disability and Change on Individual Patients: A Report of a Patient Specific Measure. *Physiother Canada*. 1995;47(4):258-263.
49. Sterling M, Brentnall D. Patient Specific Functional Scale. *Aust J Physiother*. 2007;53(1):65. doi:10.1016/s0004-9514(07)70066-1
50. Adu M, Malabu U, Malau-Aduli A, Malau-Aduli B. Enablers and barriers to effective diabetes self-management: A multi-national investigation. *PLoS ONE [Electronic Resour]*. 2019;14(6).
51. Regmi K, Jones L. Systematic review of the factors - enablers and barriers - affecting e-learning in health sciences education. 2020 Mar 30;20(1):91. *BMC Med Educ*. 2020;20(1):91. doi: 10.1186/s12909-020-02007-6. PMID: 32228560; PMCID: PMC7106784.
52. Camden C, Shikako-Thomas K, Nguyen T, et al. Engaging stakeholders in rehabilitation research: A scoping review of strategies used in partnerships and evaluation of impacts.

- Disabil Rehabil.* 2015;37(15):1390-1400. doi:10.3109/09638288.2014.963705
53. Huang Y, Sum R, Yang Y, Yeung N. Physical Competence, Physical Well-Being, and Perceived Physical Literacy among Older Adults in Day Care Centers of Hong Kong. 2022;19(7):3851. Published 2022 Mar 24. *Int J Environ Res Public Health.* 2022;19(7):3851. doi:doi:10.3390/ijerph19073851
54. Sum R, Cheng C, Wallhead T, Kuo C, Wang F, Choi S. Perceived physical literacy instrument for adolescents: A further validation of PPLI. *J Exerc Sci Fit.* 2018;16:26-31. doi:10.1016/j.jesf.2018.03.002.
55. Huang Y, Sum K-WR, Yang Y-J, Chun-Yiu Yeung N. Measurements of Older Adults' Physical Competence under the Concept of Physical Literacy: A Scoping Review. *Int J Environ Res Public Health.* 2020;17(18):6570. doi:10.3390/ijerph17186570
56. Huang Y, Sum R, Yang Y, Yeung N. Physical Competence, Physical Well-Being, and Perceived Physical Literacy among Older Adults in Day Care Centers of Hong Kong. *Int J Environ Res Public Health.* 2022;19(7):3851. doi:10.3390/ijerph19073851
57. Cornish K, Fox G, Fyfe T, Koopmans E, Pousette A, Pelletier CA. Understanding physical literacy in the context of health: a rapid scoping review. *BMC Public Health.* 2020;20(1):1569. doi:10.1186/s12889-020-09583-8
58. Ross M. Relation of implicit theories to the construction of personal histories. *Psychol Rev.* 1989;96(2):341.
59. Zywił M, Ellis K, Veillette C, Skou S, McGlasson R. Implementation of the Good Life with osteoArthritis in Denmark (GLA:D) Program across Canada for the Management of Hip and Knee Osteoarthritis. *Healthc Q.* 2021;24(1):54-59. doi:10.12927/hcq.2021.26464
60. Whitehead M, Taplin L. Physical Literacy as a Journey. *Int Counc Sport Sci Phys Educ.*

2013;54(Bulletin Special Edition):52-60.

61. Magnusson DM, Eisenhart M, Gorman I, Kennedy VK, E. Davenport T. Adopting Population Health Frameworks in Physical Therapist Practice, Research, and Education: The Urgency of Now. *Phys Ther.* 2019;99(8):1039-1047. doi:10.1093/ptj/pzz048
62. Whitehead M. *Physical Literacy throughout Life. In Physical Literacy across the World.* Abingdon, UK: Routledge; 2019.

CHAPTER 6

DISCUSSION

DISCUSSION

The burden of multimorbidity for adults of all ages is rapidly increasing in Canada^{1,2}. Individuals living with 2 or more chronic conditions report poor quality of life and face an increased risk for functional decline and disability³⁻⁷. Estimates of the prevalence of multimorbidity vary from around 20-30% when considering the whole population and 55-98% when focusing on older adults⁸⁻¹¹. A recent analysis on the Canadian Longitudinal Study on Aging (CLSA) survey data found that multimorbidity (defined as 3 or more chronic conditions for this study) is not limited to older adults and is a very common occurrence among middle aged Canadians⁸. This study found that the prevalence of multimorbidity increased with age from 29.7% in the 45-49 year-old age group to 52% in the 60-64 year old age group, indicating the need for upstream prevention strategies, as well as innovative management strategies for chronic conditions⁸. Unfortunately there remains limited evidence to support the effectiveness of interventions for multimorbidity within primary care¹². There have been several calls to address the multimorbidity public health crisis and provide a more integrated and comprehensive approach utilizing innovative practices that can inform policy change¹³.

Physical literacy (PL), defined as “having the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility in physical activity for life”¹⁴ has emerged as an important construct in children’s health promotion to positively impact lifelong physical activity habits¹⁵. Even though PL is envisioned as a life-long journey, little is known about how to foster PL for adults and older adults^{16,17}. Developing and maintaining PL is consistent with the goal of healthy aging and provides opportunities to maintain good health throughout life. Therefore, expanding the promotion of PL for adults and older adults within public health may add value by not only increasing participation in physical

activities for this population, but also improving important health outcomes related to function and mobility.

Rehabilitation experts, such as physiotherapists work with individuals across the life span, with varying population groups and organizations. Physiotherapists are the ideal healthcare professionals to expand their role from primary providers to health promoters in the field of public health and leverage population health approaches to share key rehabilitation knowledge through PL interventions for adults with mobility and functional limitations. If increasing PL is to be accepted as a public health intervention, it is important to first conceptualize PL for adults from the perspectives of rehabilitation professionals, public health leaders, physical literacy experts and adults living with multimorbidity.

This thesis includes four manuscripts that aimed to understand how PL is framed for adults and to highlight the key components required when acquiring PL as an adult and older adult. The findings were used to guide a novel rehabilitation-based PL program that has potential to be included in the clinical, community and public health arenas as an innovative health promotion strategy to improve function and mobility outcomes for adults with multimorbidity. A mixed methods exploratory sequential design^{18,19} was used in which an integrative review, qualitative consensus study and qualitative semi-structured interview study informed the final quantitative pre-post intervention study. A summary of the findings of each manuscript, contributions of this body of work to the scientific literature, limitations in the research, and future directions are described throughout the chapter.

Summary of Findings from Each Chapter

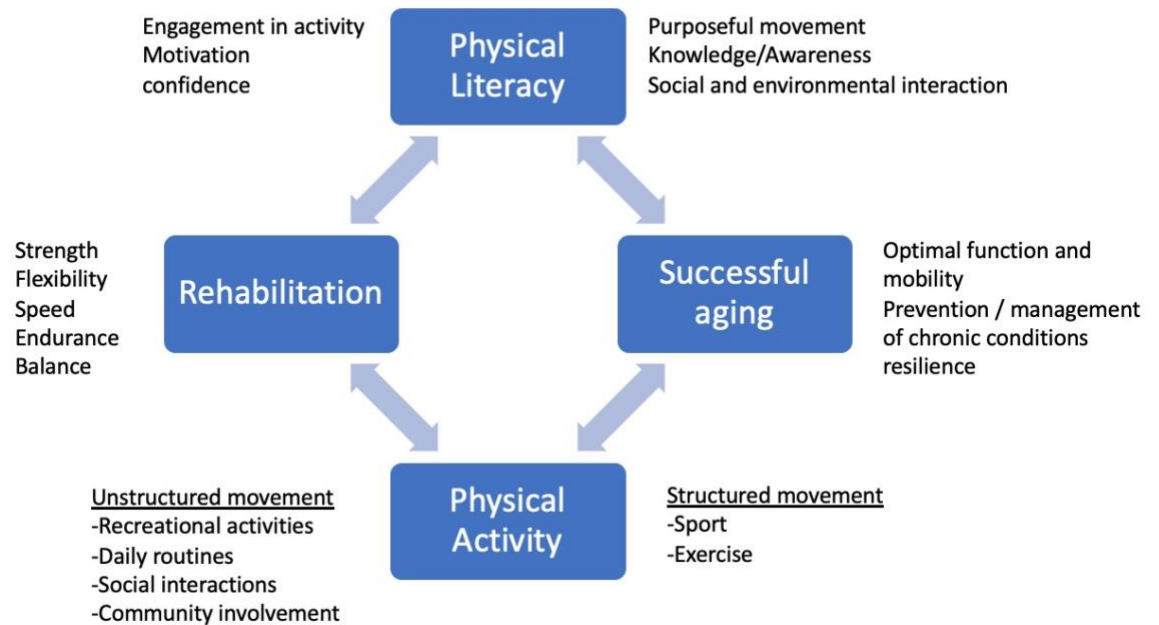
Summary of Chapter 2, “Framing Physical Literacy for Aging Adults: An Integrative Review”

The first manuscript in this thesis (Chapter 2) involved an integrative review and thematic synthesis of the literature on how PL is currently characterized for adults and older adults in the context of physical function and mobility. The primary purpose of this integrative review was to understand what critical components are used to describe physically literate adults and if these components differ from the construct used in the definition of PL put forward by Whitehead^{14,20}. This review also aimed to understand what intervention components are currently used in PL interventions for adults and older adults and examine the role of PL in successful aging. A rigorous 5-step methodology by Whitemore and Knaf²¹ was followed throughout the review which included problem identification, literature search, data evaluation, data analysis and presentation of findings. A total of 22 papers from December 2000 – March 2021 were included in the review. The Joanna Briggs Institute Appraisal Tools²² were used to assess each paper. Grey literature (conceptual models, opinion papers and literature reviews) comprised 50% of the included papers. The remaining 11 papers included 2 systematic reviews, 1 scoping review, 2 randomized controlled studies, 1 quasi experimental study, 1 pre-post study, 1 cross sectional survey, 2 mixed methods studies and 1 qualitative focus group study. When examining the PL definition for adults and older adults, 6 components were generated from the current Whitehead definition and 13 new PL components related to adults and older adults were found. All papers (100%) identified engagement in physical activity as a key PL component for adults, aligning with Whitehead’s current definition. Motivation and confidence were also commonly identified in the papers (77%). Knowledge/understanding of physical activity was included in 55% of the papers. Interestingly, the current construct of physical competence was only referenced in 4 (18%) of the papers and value of physical activity was only identified as a key

component in 2 (9%) of the papers reviewed. These findings concur with a recent cross-sectional study (Huang, 2022) involving community dwelling adults (≥ 60 years) attending day care centers in Hong Kong²³. Participants completed questionnaires and objective function and mobility outcome measures to explore the correlation between physical competence, physical well-being and perceived physical literacy among older adults. Findings indicated physical competence was not associated with perceived physical literacy ($r=0.11$, $p>0.05$), however, knowledge and understanding had a positive and moderate correlation with physical well-being ($r=0.35$, $p<0.01$)²³. Of the 13 new PL components identified in this review, meaningful (person-centered) and purposeful activities, knowledge of age-related changes, social interaction, diverse activities, and physical/age adaptation were the top 5 components referred to in the literature when describing PL for adults and older adults.

Only 4 intervention studies were identified in the integrative review and only one study measured outcomes under the concept of PL and aimed to promote PL for older adults,²⁴ demonstrating the dearth of evidence available to support PL interventions for adults. Even though there was no direct reference to the construct rehabilitation in the included papers, many components related to rehabilitation principles and strategies were discussed. Authors described physically literate adults as having optimal function, mobility, adherence to physical activity, self-management skills and participation in movement exercises such as strengthening, flexibility, balance, and endurance. Figure 1 illustrates the thematic findings of the review and demonstrates the intersection between the complex role of the four components: rehabilitation, physical literacy, successful aging, and physical activity, in the promotion of physical literacy for adults.

Figure 1: The Intersection of rehabilitation with physical literacy



Future Directions

This review is the first to explore what is known about PL as it applies to adults and older adults and connecting rehabilitation as a potential resource to becoming a physically literate adult. The traditional conceptualization of PL²⁵ coined by Whitehead does not appear to fully account for changes that occur with aging and the skills and components that are required for adults to maintain and improve function and mobility. Whitehead’s definition of PL (having the motivation, confidence physical competence, knowledge and understanding to value and take responsibility for engagement in physical activity for life) was formulated to develop youth within the sports and physical education arenas. This definition is widely used across many organizations that promote activity for children, such as the International Physical Literacy Association²⁶, Sport for Life²⁷ and ParticiP ACTION²⁸. PL is described as a person’s capacity and commitment to a physically active lifestyle²⁹, however the findings from my integrative review indicate that there are many other key constructs required when acquiring PL as an adult and

older adult. Results from the integrative review are consistent with a recent scoping review exploring PL in the context of health (Cornish, 2020) which found the empirical evidence linking PL and health outcomes is limited and the relationship remains theoretical¹⁷. For example, 50% of the papers included in my integrative review included grey literature, consisting of literature reviews, opinion papers and theoretical models. Further evidence-based studies are needed that examine the key components to acquiring PL as an adult, and specifically for older adults and persons with chronic conditions. Additionally, my integrative review found that there are currently no validated and reliable PL measurements for adults and older adults. This is consistent with findings from a recent scoping review (Huang, 2020) examining measurements of older adults' physical competence under the concept of physical literacy³⁰. Huang et al., 2020 found that scholars have adopted a wide range of self-report measures (i.e., SF-36, instrumental activities of daily living) and objective measures (gait speed, times up and go test) that are used conjunctively to measure the physical competence domain within physical literacy for older adults. The measurement of PL for adults and older adults will largely depend on how it is defined for this population. Therefore, further research is needed which examines the key components in acquiring PL as an adult. Future PL programs for adults and older adults should consider including intervention components that address the identified new components of PL that were found in this review.

Summary of Chapter 3, "Framing Physical Literacy for Adults through a Rehabilitation Lens: An Expert Consensus Study"

The second manuscript (Chapter 3) involved a qualitative expert consensus study designed to pursue a common understanding of PL constructs important to adults with multimorbidity. An on-line face to face working group meeting using Nominal Group Technique

(NGT) was utilized to achieve consensus³¹. Purposive sampling included 7 experts in the field of rehabilitation, physiotherapy, physical literacy, and knowledge translation. A two-hour facilitated consensus workshop was conducted virtually by an expert group facilitator from Queens University Execute Decision Centre at the Smith School of Business.

When asked what the most important components are for acquiring PL for adults (≥ 45 years), the following top 5 constructs were reported: 1) confidence/self-efficacy with movement, 2) confidence in safety of movement and making decisions related to activities that are safe, 3) motivation and commitment to PA, 4) the ability to self-monitor changes in physical function and 5) understanding the benefits of PA and what to do despite physical limitations. The number one response when asked “how would you describe a physically literate adult was “overcomes limitation and barriers and adapt to engage in PA”. All participants of the consensus group agreed that being physically literate is directly associated with successful aging by improving the number of years living with better functional health and independence. Consensus identified the following rehabilitation strategies that should be included in a population health PL program for adults: 1) exercise programs that promote upright balance, mobility, and speed, 2) incorporate self-efficacy and self-management strategies into public health programs, 3) exercises designed to reduce fall risk), 4) education on the importance of body mechanics/strategies to reduce injury risk in ADLs, 5) education on the importance of maintaining aerobic capacity (i.e.: walking tolerance), 6) education on the importance of maintaining strength and 7) education on how to manage symptoms common to chronic conditions (fatigue, pain, stress, etc.).

Future Directions

Findings from the consensus study of health and rehabilitation professionals demonstrates alignment with findings from the preceding integrative review¹⁶, indicating it may be beneficial

to re-conceptualize the current PL definition to include the rehabilitation needs of adults and older adults to optimize function and mobility throughout the aging process. Self-efficacy for movement, and confidence in safety of movement (and having confidence to choose safe activities) were identified as the most important components for adults when acquiring PL, from the perspectives of health professionals and researchers. This demonstrates the difference in how one may describe PL for children and youth compared to aging adults with and without chronic conditions. Safety with movement and choosing safe activities is not expressed in the current PL definition, however this appears critical for aging adults³²⁻³⁴. For adults who are experiencing changes in their function and mobility and living with challenges associated with chronic conditions, such as pain, decreased strength and loss of range of motion, it is important that they understand their functional level, by comparing to normative data (i.e., gait speed) and have the option to choose safe and physically appropriate challenges that will benefit their overall health and contribute to successful aging³⁵⁻³⁷. Developing and delivering PL programs that are grounded in the key components identified in this consensus study such as understanding the importance of PA in the management of age of related changes, how to self-monitor function and mobility changes and how to adapt to overcome limitations and barriers to movement will likely provide more opportunity for adults of all abilities to improve key health outcomes.

From the perspectives of health and research experts (community physiotherapy leaders, optimal aging researchers and knowledge translation specialists), key rehabilitation strategies should not be siloed into clinical settings or disease specific programs and instead shared at a population level utilizing targeted and non-targeted approaches with a population health lens³⁸. Evidence suggests that health promotion interventions focusing on modifying lifestyle behaviours are more effective if both targeted and non-targeted approaches are used^{39,40}.

Therefore, there is opportunity for rehabilitation professionals, such as physiotherapists to clearly define their role in health promotion and establish the scope and boundaries of its position as team members and leaders with other health promoting professionals to design and deliver PL programs that are grounded in rehabilitation principles for aging adults and adults with chronic conditions^{41,42}. Physical literacy can encompass the work from many sectors (allied health, education, public health), therefore future studies should include the perspectives of experts in the arenas of policy/advocacy, health promotion, kinesiology, and physical activity and aging.

Summary of Chapter 4, “You can because you do and you do, because you can”: A qualitative study examining what it means to be a physically literate adult from the perspective of adults living with multiple chronic conditions”

The purpose of the third study (Chapter 4) was to gather information from adults (45 – 75 years) who have personal experiences, attitudes, perceptions and beliefs related to PL, aging and multimorbidity⁴³. A qualitative interpretive description⁴⁴ with semi-structured interviews was used to explore what PL means to community-dwelling working and retired adults who are living with 2 or more chronic conditions. The findings revealed 5 themes identified as key components to acquiring PL for adults: 1) understanding one’s body, 2) conscious commitment to movement, 3) access and knowledge of rehabilitation health resources, 4) valuable physical activities, and 5) confident problem solver. The resultant 5 themes offer valuable insight and additional information to the existing literature and preceding studies (integrative review and consensus study) by demonstrating that physically literate adults with chronic conditions require an understanding of not only the benefits of PA, but the changes that occur with one’s functional health, as this relates to aging and chronic conditions. They also require access to rehabilitation health specialists and coaches to support the PL journey and require the opportunity to learn

“problem solving” skills related to fluctuations in health status, self-efficacy for movement, self-regulation and resiliency with aging that can foster successful aging, despite health setbacks.

Social networks, participating in enjoyable activities with friends and family, having access to activities and programs and having a trusted source for health information, such as a health coach were all reported as facilitators for acquiring PL. Barriers to PL included lack of time and lack of social support, as well as climate changes, negative consequences to movement (i.e., fear of falling, re-injury or flare up), competing health information from health professionals and lack of community programming for adults with multiple health conditions. Many of the facilitators and barriers to PL reported by the interview participants overlap with those that are published in the PA literature^{45,46}. However, having trusted health sources that facilitated the acquisition of PL skills and/or a health coach emerged as a new facilitator theme that should be considered in development and delivery of PL programming to increase adherence and participation.

Findings from the integrative review, consensus study and interview study support the following re-conceptualization of PL for adults: *“Physical literacy for adults and older adults includes having the motivation and confidence to engage in meaningful, safe, social and diverse activities, obtaining knowledge of age-related changes and the benefits of physical activity and understanding how to adapt and respond to mobility and functional changes through self-monitoring and utilization of rehabilitation strategies.”*

Future Directions

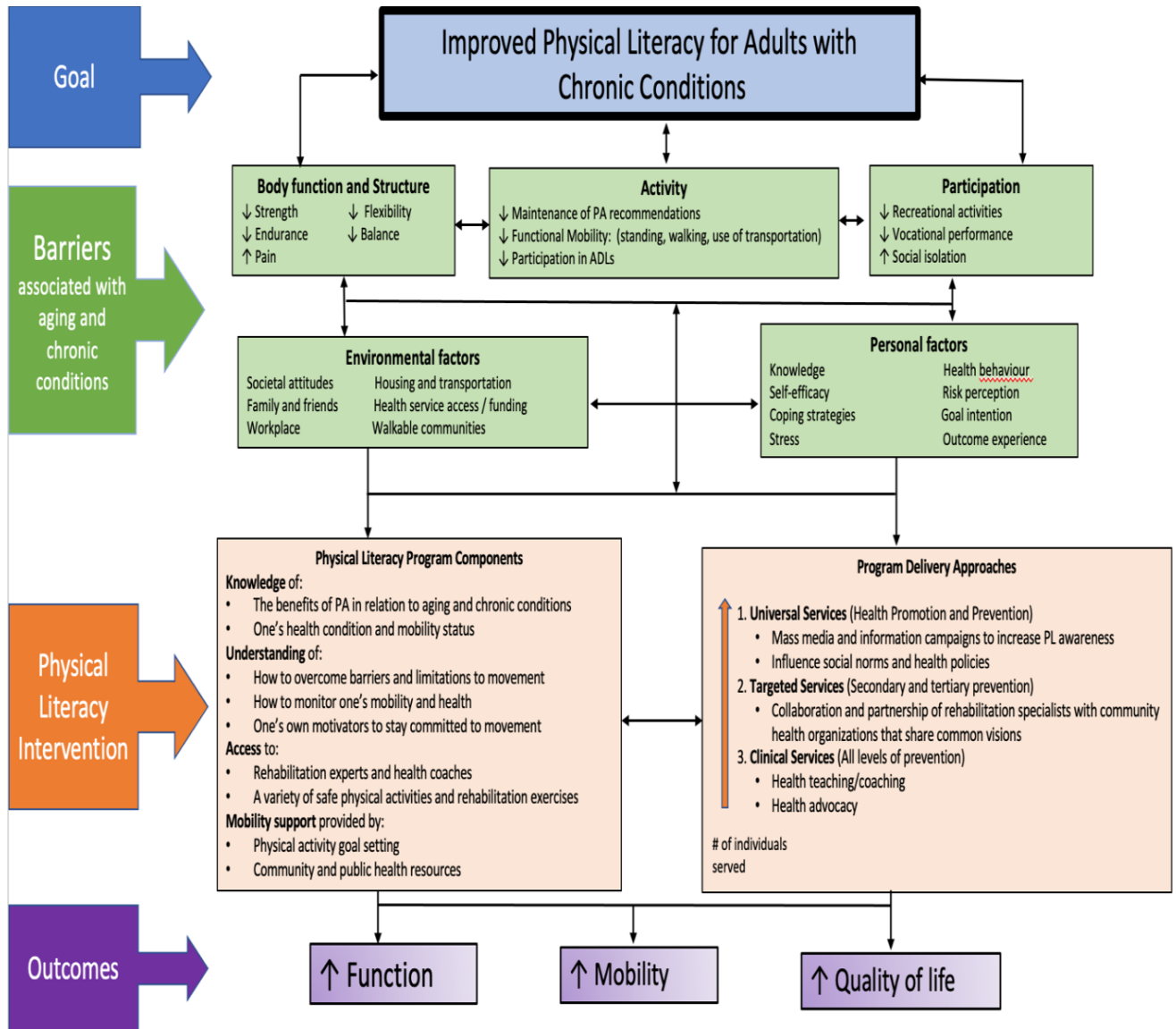
These findings have implications for understanding how adults with multimorbidity can be better represented in the promotion of PL. Including end-users as part of this participatory

research⁴⁷ has provided valuable insight into the population health approaches⁴⁸ that are needed to develop physically literate adults and older adults. If promoting PL for adults and older adults as a solution to functional decline is to be successful, there is a need to expand the intrapersonal elements of PL (motivation, confidence, physical competence, knowledge and understanding) to include organizational (user-friendly and accessible public health programming), environmental (walkable neighborhoods, and age friendly communities) and policy elements (PL mass media campaigns, national strategies to foster community engagement in movement). More research is needed to understand the perspectives of adults from various geographical locations and differing socio-economic groups. Building on current PL models^{49,50} to meet the needs of aging adults is needed. PL models that account for how movement and activity become constrained due to age related changes, as opposed to current models that are focused on expanding physical activity as one gains more movement ability^{49,51,52} has potential to affect positive health outcomes for adults with chronic conditions.

Summary of Chapter 5, “Enhancing physical literacy for aging adults and adults with multimorbidity using multiple knowledge translation strategies: A pre-post Intervention study”

The purpose of the fourth study (Chapter 5) was to build on the program of research and design and deliver a multi-component PL intervention for adults (45 – 65 years) with 2 or more chronic conditions, based on the findings from the preceding three papers (integrative review, expert consensus study and semi-structured interview study). The **Physical Literacy** framework for **Adults and adults with Chronic Conditions (PLACC)** was developed to help frame the intervention components and delivery methods (Figure 2.).

Figure 2. Physical Literacy Framework for adults and adults with chronic conditions (PLACC)



The PLACC framework was guided by the International Classification of Functioning Disability and Health (ICF) framework⁵³ and the recent evidence attained from this program of research in PL and aging^{16,38,54}. Twenty adults (95% female, 59 ± 6 years) participated in a pre-post study, utilizing multi-modal knowledge translation principles, and delivered virtually by a

registered physiotherapist. The intervention was delivered with a population health approach⁵⁵ and included behaviour change strategies (feedback, goal setting, action planning self-monitoring and information on health consequences) based on Michie's Behaviour Change Wheel⁵⁶.

After 5 weeks, significant improvements were found for physical function as measured by the patient specific functional scale (PSFS), mobility with the 4-meter walk test at self-selected speed and 3 PL awareness questions. However, no significant changes were found for mobility when measured with the 4-meter walk test at one's fastest speed or for self-management, as measured by the Health Education Impact Questionnaire. Overall, 90% of participants reported a moderate to significant change in their behaviour, that was attributed to the intervention. This demonstrates that a 5-week PL intervention, with the key program components identified in the PLACC framework and delivered virtually, at a low cost, can positively influence important health behaviours for adults with chronic conditions. However, the short duration of the study and follow up period (5 weeks) may not allow time to capture behaviour changes and make an impact with mobility outcomes (walking at fastest speed).

Future Directions

The results of this novel study can add to the paucity of PL recommendations and interventions for adults and specifically for older adults and adults with chronic conditions, while demonstrating the need for further PL studies grounded in rehabilitation strategies. Multi-modal complex interventions⁵⁷ which target patient health behaviours such as physical activity and movement are recommended for adults with multimorbidity^{58,59}. However due to the uncertainties about the effectiveness of these interventions¹² there are calls for re-orientation of

care that focuses on the treatment burden of patients, such as organizing and attending health care appointments and modifying lifestyle behaviours.

Self-management support interventions based on the traditional Chronic Disease Self-management Support Programme⁶⁰ have demonstrated modest short term effects with self-efficacy in the management of one's condition, however, there is no clear evidence that these interventions improve health-related quality of life or change healthcare use⁶¹. Therefore, there is a need to leverage the expertise of a broad range of health professionals (i.e., physiotherapists) who can address the needs that are most important to patients with multimorbidity and deliver interventions through health promotion initiatives that are applicable for large populations. Rehabilitation programs are often siloed by specific health conditions (GLA:D Osteoarthritis Exercise Program), which can exclude adults with multimorbidity⁶². Similarly general exercise programs do not address the safety concerns and rehabilitation strategies required for 50% of the population, who are living with one or more chronic condition⁸. Findings from our PL study demonstrate that programs which function as an extension to self-management programs and target a broad population of adults and older adults with multimorbidity can affect positive health outcomes over a short period of time. Programs should focus on increasing individual and population awareness of the changes that occur with aging, improve self-management skills, teach rehabilitation strategies, promote optimal aging, and offer actionable movement solution to address the common functional limitations that adults with chronic conditions are living with.

Future research is needed to determine whether the above function, mobility and awareness changes observed in our 5-week PL intervention are sustained in the long-term and across various geographical areas and socio-demographic groups. Future research should also investigate the mechanisms of action to determine whether some intervention components (i.e.,

on-line education, instruction, goal setting) had more significant impacts or if the combination of all intervention components was needed to affect change. Further studies are needed to support the PLACC framework, as well as research investigating standard PL outcome measures and assessment procedures for adults and older adults.

STRENGTHS

The integrative review (Chapter 2) offers the first synthesis of a variety of literature sources and evidence types on how PL is framed for adults and older adults. This review followed a rigorous framework⁶³ that generated a synthesis of existing literature to understand how a difficult construct, such as PL has evolved over time. The virtually delivered consensus study (Chapter 3) involved an expert panel of health professionals and researchers that allowed us to gain valuable data on the strength and agreement for each PL and aging topic discussed while opening the forum for discussion around each panelist's reasoning for their answers. Consensus forums are recognized as effective tools for determining expert consensus, specifically for novel and evolving topics such as PL and adults⁶⁴. The interview study (Chapter 4) demonstrated many strengths that continued to build and refine the findings from the previous program of research. A “realist” approach with thematic analysis⁶⁵ using semi-structured interviews to collect rich data from patient experiences was used to ensure trustworthiness in the qualitative research^{66,67}. Credibility was ensured by using triangulation and member checking⁶⁸. Maximal data saturation was achieved through purposeful recruitment of participants who have lived experiences with PL and chronic conditions.

One of the main strengths of the pre post intervention study (Chapter 5) included the novel approach to the prevention and management of chronic conditions by expanding the promotion of PL beyond the traditional sport and educational institutions to the public health

sector while considering the rehabilitation needs of adults and older adults. This intervention utilized a patient-centered approach⁶⁹ by using end-user information to build a framework (PLACC) that guided the intervention. The Joanna Briggs Institute Checklist for Quasi-Experimental Studies (non-randomized experimental studies)⁷⁰ was used to ensure quality of the pre post study research. Lastly, many interventions studies targeting multimorbidity include older adults, even when younger adults are eligible for inclusion. This study addresses the needs of middle-aged (≥ 45 years) individuals as an upstream approach and to tackle the additional issues related to multimorbidity, such as increased prevalence of chronic conditions for middle aged adults⁸, employability, and work absenteeism due to health challenges and overall quality of life¹².

LIMITATIONS

Due to the dearth of evidence available exploring the new topic of PL and adults, the extracted studies in the integrative review (Chapter 2) are limited and not homogenous in study methodology, with grey literature comprising 50% of the papers. Therefore, the findings of this review are largely based on expert opinion, literature reviews and conceptual models, and only four intervention studies examining effectiveness on health outcomes. The consensus study (Chapter 3) included 7 experts in the fields of rehabilitation and aging, however this study lacked the input from public health and policy advisors as part of the forum who may offer more insight into PL and aging. It is also possible that framing the evidence prior to the consensus meeting could influence judgements and recommendations of the panel. The interview study (Chapter 4) was subject to certain limitations, including the recruitment of a homogenous group of participants within a small geographical area (Greater Toronto Area) and from a middle to higher socioeconomic group. Working and retired teachers are likely to have access to resources such as

private health benefits and communities with exercise facilities, limiting the generalizability of the findings. Even though recruitment was open for men and women, only women volunteered to participate. Therefore, the views of men are not represented in this study.

The pre post intervention study (Chapter 5) was a single group, non-randomized trial using a small sample (n=20). This is a novel study, however there was not a pilot study completed prior to this to inform the feasibility/acceptability or provide a representative sample size. The voluntary nature of the participation in the study may result in sample selection bias. Assessor bias may have occurred, as the same registered physiotherapist carried out all aspects of the study, including screening, initial assessments, intervention, and final assessments. Additionally, the majority of the participants were women, which limits the generalizability of the results. On-line study advertisement occurred through Facebook for the intervention study and through the Retired Teacher's Union for the interview study targeting both men and women. Study flyers were also advertised at McMaster University, the YMCA and Hospitals within Hamilton and the Greater Toronto Area. It is well known that gender is an important determinant of health risk with males being more likely to participate in high risk activities, such as smoking, unhealthy eating, and physical inactivity and are less likely to participate in health promotion programs^{71,72}. Systematic reviews have found that males comprise only about 20% of health behaviour research samples,^{73,74} further contributing to the lack of evidence on how to increase health promoting behaviours for me. There was potential for self-selection bias in the studies, because the women participants may have already an interest in making behaviour changes.

The findings from this study represent changes over a short period of time (5-weeks), therefore it is unknown if these changes can be sustained over a longer period. Lastly, a validated

PL measurement tool for adults and adults with chronic conditions was not available at the time of the study and therefore the outcomes may not reflect all components of PL for adults.

OVERALL CONTRIBUTIONS

Physical literacy has been described as the gateway to physical activity⁵⁰ and the link to successful aging⁵¹, however, there remains a paucity of evidence exploring PL for adults and older adults^{16,17}. This mixed-methods program of research⁷⁵ has broadened the PL literature by providing a new perspective on how PL can be framed through a rehabilitation lens to support the function and mobility needs of adults as they age and experience health changes. My Integrative review: Framing Physical Literacy for Adults through a Rehabilitation Lens, was the first review to synthesize and critically appraise all existing literature on PL and adults. The Whitehead definition of PL²⁵ is most widely accepted within the literature, however, there remains debate over how well this definition encapsulates the full embodiment of PL throughout the lifecourse⁴⁹. The program of research has defended this view and demonstrated that new constructs should be considered when acquiring PL as an adult and older adult.

This thesis work adds to the work of Cairney⁵⁰ and Dudley⁴⁹ by linking PL with health and chronic conditions while considering individual and environmental factors. However, to my knowledge, this is the first body of work to re-conceptualize the PL definition to include constructs related to rehabilitation to promote optimal function and mobility with aging and chronic conditions. The PL constructs identified in this work, (i.e., self-monitoring function, variety of meaningful and safe physical activities and knowledge of physical changes that occur with aging), can help to inform future PL assessment measures for adults and older adults. Currently there is not a validated outcome measures to assess PL for older adults (≥ 65 years), however findings from the work can contribute to future PL measurement tools that consider

assessing outcomes such as walking speed, lower extremity function, self-management skills and knowledge of safe and meaningful activities that will promote health with aging and chronic conditions.

Additionally, this work further supports Cairney's view (2019)⁵⁰ that PL is a disposition or attitude acquired by an individual throughout a lifetime, that may start in early childhood but requires facilitation throughout life until old age^{25,50}. This thesis work is in line with Whitehead's description of PL, in that physical competence can never be a sole constituent of PL, and it is important to consider the affective and cognitive domains of PL as well²⁵. Our findings indicate that physical competence may not be as important to acquiring PL as an adults or older adult, compared to that of a child. Also, supporting the work of Huang (2020)³⁰, and Roetert (2019)⁷⁶ physical competence, under the concept of PL for older adults requires functional strength that focuses on the lower extremities, balance, flexibility, endurance and core stability associated with upright posture.

The Physical Literacy Framework for Adults and Adults with Chronic Conditions (PLACC) developed from this thesis work builds on the Lifecourse Continuum Model proposed by Jones (2018)⁷⁷. Through consensus meetings Jones used an ecological approach when considering the key components related to policy, community, organizational, interpersonal, and intrapersonal factors that contribute to physical literacy for older adults. Our PLACC model has expanded on this model by utilizing a population approach to delivery of PL programs, while maintaining optimal function and mobility within the ICF framework as the key outcomes for adults with chronic conditions.

In the context of physical education, PL has been promoted to teachers, sports agencies, and government officials to support participation in physical activities for children. However, there

has been almost no attention to the positioning of PL in the field of public health as a prevention and promotion approach to the management of chronic conditions. This thesis work is leading the way in PL research that supports optimal aging and the management of chronic conditions through a population health approach that has potential to be integrated into public health programs.

Lastly, this work can raise awareness of emerging roles for physiotherapists within the public health and health promotion sectors. Physiotherapy leaders who adopt new roles within public health can have the opportunity to support and implement best practices at a population health level. From an advocacy perspective, including physiotherapists in PL programming may improve the “physiotherapy voice” in multiple health arenas (policy, program planning and service design) and encourage collaboration across diverse health teams⁷⁸.

IMPLICATIONS FOR PRACTICE, POLICY, AND RESEARCH

Further consensus is still needed among researchers, health professionals, public health officials and key stakeholders regarding the definition of PL for adults and adults with chronic conditions. Health literacy is defined as the “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions”⁷⁹. The formulation of health literacy has been criticized in the literature because it focuses on the capacity and competency of the individual and does not consider the broad array of factors such as climate change, poverty and globalization⁷⁹. The PL components within our evolving definition for adults addresses this concern and incorporates the social, environmental, and systemic forces that contribute to poor health outcomes. Physical literacy for adults and older adults involves:

- Having knowledge of physical activity and its relation to aging and health conditions

- Understanding of how to monitor one's mobility and overcome barriers to movement
- Access to rehabilitation coaches (i.e., physiotherapists, exercise trainers, kinesiologists) and safe PA resources
- Mobility support within communities, primary care, and public health to increase participation in PA

Programs designed for all individuals of all functional levels that maximize access and use of existing community, primary care, and public health resources and integrate rehabilitation strategies into PL programming is required for our aging population. PL has demonstrated promise as a health promotion strategy for children and youth^{27,80} and now has potential to be adapted to meet the functional needs of adults, older adults and adults with chronic conditions. This program of research offers opportunities for rehabilitation professionals (i.e., physiotherapists) whom have been called to action by their governing bodies (i.e., Canadian Physiotherapy Association and American Physical Therapy Association) to expand their roles within clinical practice and employ population health approaches in primary care and public health to address the functional limitations experienced by over 50% of our population^{42,81}.

Rehabilitation researchers such as Magnusson (2019)⁴¹ have stated that physiotherapy interventions must target the social determinants of health to be effective and that clinicians must evolve and expand our roles to meet the functional and mobility needs of our population^{41,42}. Physiotherapists are trained in the assessment and diagnosis of musculoskeletal conditions, exercise prescription that considers comorbid health conditions and coaching strategies to help individuals reach their full physical capacity. They are well positioned to lead health promotion

initiatives aimed at increasing awareness around the importance of physical activity, mobility, and function in the management of chronic conditions for adults.

Persons in the lower socioeconomic groups carry a higher risk of developing multimorbidity at a younger age,⁸² therefore upstream rehabilitation approaches are needed that reach individuals who will benefit the most. Our Physical Literacy Framework for Adults and Adults with Chronic Conditions (PLACC) uses a population health approach to promote PL in all aspects of one's adult life through the delivery of PL programs within clinical care, targeted services (i.e., primary care) and universal services (i.e., public health programs)⁴¹. Sharing key rehabilitation principles, such as the management of inflammation, rehabilitation focused strengthening and stretching and monitoring/assessing one's change in functional status are all necessary components that should be integrated into PL programming for adults. Newly developed interventions should be grounded in a rehabilitation framework, and address functional, mobility, self-management, and educational awareness skills. Multi-knowledge translation strategies should be used in a blended and actionable step through on-line and in-person sessions that can be implemented at the clinical, primary care and public health levels.

CONCLUSION

Physical literacy is an emerging strategy to support the management of function and mobility changes associated with aging and multimorbidity. A shift in the public understanding of the importance of PL for adults and adults with chronic conditions can positively influence key aging outcomes and help guide further program development to integrate rehabilitation strategies. However, to date there has been limited attention given to the positioning of PL in the field of public health⁸³ Globally, health promotion is an important pillar of public health. Physiotherapists have continued to be involved with health promotion within their practices and

they now have potential to take on a leadership role in the public health sector. Physiotherapists can leverage their knowledge by creating and executing evidence-based programs and communication campaigns that translate information about the benefits of PA in the management of chronic conditions and share key rehabilitation principles with the public. Physiotherapists can be more involved in top-down approaches by influencing policy makers and sharing a strong strategic vision for health promotion activities and building partnerships with community-based agencies and other healthcare organizations. Our mixed-methods program of research offers a novel patient-centered solution to address the negative function and mobility health outcomes associated with multimorbidity. Since successful aging is associated with PL⁵², our study results can inform future public health activities which aim to improve important health outcomes for adults with multimorbidity and provide validation for government funded physiotherapists addressing a public health crisis.

References

1. Koné Pefoyo AJ, Bronskill SE, Gruneir A, et al. The increasing burden and complexity of multimorbidity. *BMC Public Health*. 2015;15(1):415. doi:10.1186/s12889-015-1733-2
2. Broemeling A-M, Watson DE, Prebtani F. Population patterns of chronic health conditions, co-morbidity and healthcare use in Canada: implications for policy and practice. *Healthc Q*. 2008;11(3):70-76. doi:10.12927/hcq.2008.19859
3. Ryan A, Wallace E, O’Hara P, Smith SM. Multimorbidity and functional decline in community-dwelling adults: a systematic review. *Health Qual Life Outcomes*. 2015;13(1):168. doi:10.1186/s12955-015-0355-9
4. Fong JH. Disability incidence and functional decline among older adults with major chronic diseases. *BMC Geriatr*. 2019;19(1):323. doi:10.1186/s12877-019-1348-z
5. McDaid O, Normand C, Kelly A, Smith S. Prevalence, patterns and healthcare burden of multimorbidity in the older irish population. 2013;182:S229. *Ir J Med Sci*. 2013;182:S229.
6. Jindai K, Nielson C, Vorderstrasse B, Quiñones A. Multimorbidity and Functional Limitations Among Adults 65 or Older, NHANES 2005-2012. *Prev Chronic Dis*. 2016;13:E151. <https://doi.org/10.5888/pcd13.160174>.
7. Barile J, Thompson W, Zack M, Krahn G, Horner-Johnson W, Bowen S. Multiple chronic medical conditions and health-related quality of life in older adults, 2004-2006. *Prev Chronic Dis*. 2013;10:E162. <https://doi.org/10.5888/pcd10.120282>.
8. Sakib MN, Shooshtari S, St. John P, Menec V. The prevalence of multimorbidity and associations with lifestyle factors among middle-aged Canadians: an analysis of Canadian Longitudinal Study on Aging data. *BMC Public Health*. 2019;19(1):243.

doi:10.1186/s12889-019-6567-x

9. Taylor AW, Price K, Gill TK, et al. Multimorbidity - not just an older person's issue. Results from an Australian biomedical study. *BMC Public Health*. 2010;10(1):718.
doi:10.1186/1471-2458-10-718
10. Britt HC, Harrison CM, Miller GC, Knox SA. Prevalence and patterns of multimorbidity in Australia. *Med J Aust*. 2008;189(2):72-77. doi:https://doi.org/10.5694/j.1326-5377.2008.tb01919.x
11. Agborsangaya C, Lau D, Lahtinen M, Cooke T, Johnson J. Multimorbidity prevalence and patterns across socioeconomic determinants: a cross-sectional survey. *BMC Public Health*. 2012;12:201. https://doi.org/10.1186/1471-2458-12-201.
12. Smith S, Wallace E, O'Dowd T, Fortin M. Interventions for improving outcomes in patients with multimorbidity in primary care and community settings. *Cochrane database Syst Rev*. 2016;3(3):CD006560. https://doi.org/10.1002/14651858.CD006560.pub3.
13. Albreht T, Dyakova M, Schellevis F, Van den Broucke S. Many diseases, one model of care? *J comorbidity*. 2016;6(1):12-20. https://doi.org/10.15256/joc.2016.6.73.
14. Whitehead 1 M. The Concept of Physical Literacy. *Eur J Phys Educ*. 2001;6(2):127-138.
doi:10.1080/1740898010060205
15. Giblin S, Collins D, Button C. Physical Literacy: Importance, Assessment and Future Directions. *Sport Med*. 2014;44:117-1184. doi:10.1007/s40279-014-0205-7
16. Petrusevski C, Morgan A, MacDermid J, Wilson M, Richardson J. Framing physical literacy for aging adults: an integrative review. *Disabil Rehabil*. December 2021:1-12.
doi:10.1080/09638288.2021.2012841

17. Cornish K, Fox G, Fyfe T, Koopmans E, Pousette A, Pelletier CA. Understanding physical literacy in the context of health: a rapid scoping review. *BMC Public Health*. 2020;20(1):1569. doi:10.1186/s12889-020-09583-8
18. National Institutes of Health Best Practices for Mixed Methods Research in the Health Sciences. August 2011. https://obssr-od-nih-gov.libaccess.lib.mcmaster.ca/wp-content/uploads/2016/02/Best_Practices_for_Mixed_Methods_Research.pdf. Accessed March 10, 2020.
19. Östlund U, Kidd L, Wengström Y, Rowa-Dewar N. Combining qualitative and quantitative research within mixed method research designs: A methodological review. *Int J Nurs Stud*. 2011;48(3):369-383. doi:10.1016/j.ijnurstu.2010.10.005
20. International Physical Literacy Association. <https://www.physical-literacy.org.uk/>. Published 2014.
21. Whitemore R, Knafl K. The integrative review: update methodology. *J Adv Nurs*. 2005;5(Broome 1993):546-553. doi:10.1111/j.1365-2648.2005.03621.x.
22. Peters, M. D. J., Godfrey, C., Mclnerney, P., Baldini Soares, C., Khalil, H., & Parker D. Methodology for JBI scoping reviews. The Joanna Briggs Institute reviewers' manual, 2015. *Adelaide, South Aust Joanna Briggs Inst*. 2015.
23. Huang Y, Sum R, Yang Y, Yeung N. Physical Competence, Physical Well-Being, and Perceived Physical Literacy among Older Adults in Day Care Centers of Hong Kong. *Int J Environ Res Public Health*. 2022;19(7):3851. doi:10.3390/ijerph19073851
24. Holler P, Jaunig J, Amort F-M, et al. Holistic physical exercise training improves physical literacy among physically inactive adults: a pilot intervention study. *BMC Public Health*.

- 2019;19(1). doi:10.1186/s12889-019-6719-z
25. Whitehead M. The concept of physical literacy. *Eur J Phys Educ.* 2001;6:127-138.
 26. International Physical Literacy Association. <https://www.physical-literacy.org.uk/>.
 27. Balyi I, Way R. No Title. *Can Sport Life Long-term Athl Dev Vancouver Centres, Can Sport.* 2005. http://sportforlife.ca/wp-content/uploads/2017/04/LTAD-2.1-EN_web.pdf?x96000.
 28. ParticipACTION. <https://www.participaction.com/en-ca>. Accessed July 22, 2022.
 29. Francis C, Longmuir P, Boyer C, Andersen L, Barnes J, Boiarskaia E. The Canadian assessment of physical literacy: development of a model of Children's capacity for a healthy, active lifestyle through a Delphi process. *J Phys Act Health.* 2016;13(2):214-222.
 30. Huang Y, Sum K-WR, Yang Y-J, Chun-Yiu Yeung N. Measurements of Older Adults' Physical Competence under the Concept of Physical Literacy: A Scoping Review. *Int J Environ Res Public Health.* 2020;17(18):6570. doi:10.3390/ijerph17186570
 31. McMillan S, King M, Tully M. How to use the nominal group and Delphi techniques. *Int J Clin Pharm.* 2016;38(3):655-662. doi:doi: 10.1007/s11096-016-0257-x. Epub 2016 Feb 5. PMID: 26846316; PMCID: PMC4909789.
 32. Desveaux L, Goldstein R, Mathur S, Brooks D. Barriers to Physical Activity Following Rehabilitation: Perspectives of Older Adults with Chronic Disease. *J Aging Phys Act.* 2016;24(2):223-233. doi:10.1123/japa.2015-0018
 33. Cress ME, Buchner DM, Prohaska T, et al. Best practices for physical activity programs and behavior counseling in older adult populations. *Eur Rev Aging Phys Act.* 2006;3(1):34-42. doi:10.1007/s11556-006-0003-9

34. Foo K, Sundram M, Legido-Quigley H. Facilitators and barriers of managing patients with multiple chronic conditions in the community: a qualitative study. *BMC Public Health*. 2020;20(1):273. <https://doi.org/10.1186/s12889-020-8375-8>.
35. Fragala MS, Cadore EL, Dorgo S, et al. Resistance Training for Older Adults: Position Statement From the National Strength and Conditioning Association. *J Strength Cond Res*. 2019;33(8). https://journals.lww.com/nsca-jscr/Fulltext/2019/08000/Resistance_Training_for_Older_Adults__Position.1.aspx.
36. Bricca A, Harris LK, Jäger M, Smith SM, Juhl CB, Skou ST. Benefits and harms of exercise therapy in people with multimorbidity: A systematic review and meta-analysis of randomised controlled trials. *Ageing Res Rev*. 2020;63:101166. doi:<https://doi.org/10.1016/j.arr.2020.101166>
37. Nicolson PJA, Bennell KL, Dobson FL, Van Ginckel A, Holden MA, Hinman RS. Interventions to increase adherence to therapeutic exercise in older adults with low back pain and/or hip/knee osteoarthritis: a systematic review and meta-analysis. *Br J Sports Med*. 2017;51(10):791 LP - 799. doi:10.1136/bjsports-2016-096458
38. Petrusevski C, Richardson J, MacDermid J, Wilson M. *Framing Physical Literacy for Adults through a Rehabilitation Lens: An Expert Consensus Study.*; 2021.
39. *National Collaborating Centre for Determinants of Health. (2013). Let's Talk: Universal and Targeted Approaches to Health Equity. Antigonish, NS: National Collaborating Centre for Determinants of Health, St. Francis Xavier University.*; 2013.
40. King K, Meader N, Wright K, et al. Characteristics of Interventions Targeting Multiple Lifestyle Risk Behaviours in Adult Populations: A Systematic Scoping Review. *PLoS One*.

- 2015;10(1). doi:e0117015. <https://doi.org/10.1371/journal.pone.0117015>
41. Magnusson DM, Eisenhart M, Gorman I, Kennedy VK, E. Davenport T. Adopting Population Health Frameworks in Physical Therapist Practice, Research, and Education: The Urgency of Now. *Phys Ther.* 2019;99(8):1039-1047. doi:10.1093/ptj/pzz048
 42. Dunleavy K, Mejia-Downs A, Guerrero H, et al. Embedding Population Health in Physical Therapist Professional Education. *Phys Ther.* 2022;102(1):pzab238. doi:10.1093/ptj/pzab238.
 43. DeJonckheere M, Vaughn L. Semistructured interviewing in primary care research: a balance of relationship and rigour. *Fam Med community Heal.* 2019;7(2):e000057. <https://doi.org/10.1136/fmch-2018-000057>.
 44. Thorne S. *Interpretive Description*. Walnut Creek: Left Coast Press; 2008.
 45. Collado-Mateo D, Lavín-Pérez AM, Peñacoba C, et al. Key Factors Associated with Adherence to Physical Exercise in Patients with Chronic Diseases and Older Adults: An Umbrella Review. *Int J Environ Res Public Health.* 2021;18(4):2023. doi:10.3390/ijerph18042023
 46. Schmidt L, Rempel G, Murray T, McHugh T, Vallance J. Exploring beliefs around physical activity among older adults in rural Canada. *Int J Qual Stud Health Well-being.* 2016;11:32914. <https://doi.org/10.3402/qhw.v11.32914>.
 47. Jull J, Giles A, Graham ID. Community-based participatory research and integrated knowledge translation: Advancing the co-creation of knowledge. *Implement Sci.* 2017;12(1):1-9. doi:10.1186/s13012-017-0696-3
 48. Kornas LR and K. Putting a Population Health Lens to Multimorbidity in Ontario. *Healthc*

- Q. 2018;21(3):8-11. <https://www.longwoods.com/product/25709>.
49. Dudley D, Cairney J, Wainwright N, Kriellaars D. Critical Considerations for Physical Literacy Policy in Public Health, Recreation, Sport and Education Agencies. *Quest*. 2017;69(4):436-452. doi:10.1080/00336297.2016.1268967
50. Cairney J, Dudley D, Kwan M, Bulten R, Kriellaars D. Physical Literacy , Physical Activity and Health : Toward an Evidence - Informed Conceptual Model. *Sport Med*. 2019;49(3):371-383. doi:10.1007/s40279-019-01063-3
51. Higgs C, Cairney J, Jurbala P, Dudley D, Way R, Mitchell D. *Developing Physical Literacy: Building a New Normal for All Canadians. Physical Literacy in the Adult and Older Years.*; 2019. https://sportforlife.ca/wp-content/uploads/2019/09/DPL-2_EN_web_November_2019-1.pdf.
52. Whitehead M. *Physical Literacy throughout Life. In Physical Literacy across the World*. Abingdon, UK: Routledge; 2019.
53. Stucki G. International Classification of Functioning, Disability, and Health (ICF): A Promising Framework and Classification for Rehabilitation Medicine. *Am J Phys Med Rehabil*. 2005;84(10). https://journals.lww.com/ajpmr/Fulltext/2005/10000/International_Classification_of_Functioning,.2.aspx.
54. Petrusevski C, Richardson J, MacDermid J, Wilson M. “You can because you do and you do, because you can”: A qualitative study examining what it means to be a physically literate adult from the perspective of adults living with multiple chronic conditions. 2022.
55. Wagner EH, Austin BT, Von Korff M. Organizing Care for Patients with Chronic Illness.

- Milbank Q.* 1996;74(4):511-544. doi:10.2307/3350391
56. Michie S, Stralen MM Van, West R. The behaviour change wheel : A new method for characterising and designing behaviour change interventions The behaviour change wheel : A new method for characterising and designing behaviour change interventions. *Implement Sci.* 2011;6(1):42. doi:10.1186/1748-5908-6-42
57. Craig P, Dieppe P, Macintyre S, Michie S, Nazareth I, Petticrew M. Developing and evaluating complex interventions: the new Medical Research Council guidance. *BMJ.* 2008;337:a1655. doi:10.1136/bmj.a1655
58. Kastner M, Cardoso R, Lai Y, et al. Effectiveness of interventions for managing multiple high-burden chronic diseases in older adults: a systematic review and meta-analysis. *Can Med Assoc J.* 2018;190(34):E1004-E1012. doi:10.1503/cmaj.171391
59. Smith, SM Soubhi, H Fortin, M Hudon, C O'Dowd T. Interventions for improving outcomes in patients with multimorbidity in primary care and community settings. *Cochrane Database Syst Rev.* 2012;4.
60. O'Connell S, Mc Carthy VJC, Savage E. Frameworks for self-management support for chronic disease: a cross-country comparative document analysis. *BMC Health Serv Res.* 2018;18(1):583. doi:10.1186/s12913-018-3387-0
61. Foster G, Taylor S, Eldridge S, Ramsay J, Griffiths C. Self-management education programmes by lay leaders for people with chronic conditions. *Cochrane Database Syst Rev.* 2007;4. <https://doi.org/10.1002/14651858.CD005108.pub2>.
62. Zywił M, Ellis K, Veillette C, Skou S, McGlasson R. Implementation of the Good Life with osteoArthritis in Denmark (GLA:D) Program across Canada for the Management of Hip

- and Knee Osteoarthritis. *Healthc Q*. 2021;24(1):54-59. doi:10.12927/hcq.2021.26464
63. Whittemore R, Knafl K. The integrative review: updated methodology. *J Adv Nurs*. 2005;52(5):546-553. doi:doi: 10.1111/j.1365-2648.2005.03621.x. PMID: 16268861.
64. Nair R, Aggarwal R, Khanna D. Methods of formal consensus in classification/diagnostic criteria and guideline development. *Semin Arthritis Rheum*. 2011;41(2):95-105. doi:doi: 10.1016/j.semarthrit.2010.12.001. Epub 2011 Mar 21. PMID: 21420149; PMCID: PMC3131416.
65. Nowell LS, Norris JM, White DE, Moules NJ. Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *Int J Qual Methods*. 2017;16(1):1609406917733847. doi:10.1177/1609406917733847
66. Cohen D, Crabtree B. Evaluative criteria for qualitative research in health care: controversies and recommendations. *Ann Fam Med*. 2008;6(4):331-339. <https://doi.org/10.1370/afm.818>.
67. Kitto S, Chesters J, Grbich C. Quality in qualitative research. *Med J Aust*. 2008;188(4):243-246. <https://doi.org/10.5694/j.1326-5377.2008.tb01595.x>.
68. Thomas J, Harden A. Methods for the thematic synthesis of qualitative research in systematic reviews. *BMC Med Res Methodol*. 2008;8(1):45. doi:10.1186/1471-2288-8-45
69. McMillan SS, Kendall E, Sav A, et al. Patient-Centered Approaches to Health Care: A Systematic Review of Randomized Controlled Trials. *Med Care Res Rev*. 2013;70(6):567-596. doi:10.1177/1077558713496318
70. The Joanna Briggs Institute Critical Appraisal Tools: Checklist for Quasi-Experimental Studies. https://jbi.global/sites/default/files/2019-05/JBI_Quasi-

Experimental_Appraisal_Tool2017_0.pdf. Accessed July 5, 2022.

71. Mahalik JR, Burns SM, Syzdek M. Masculinity and perceived normative health behaviors as predictors of men's health behaviors. *Soc Sci Med*. 2007;64(11):2201-2209.
doi:<https://doi.org/10.1016/j.socscimed.2007.02.035>
72. Rongen A, Robroek SJW, van Lenthe FJ, Burdorf A. Workplace Health Promotion: A Meta-Analysis of Effectiveness. *Am J Prev Med*. 2013;44(4):406-415.
doi:<https://doi.org/10.1016/j.amepre.2012.12.007>
73. Maher CA, Lewis LK, Ferrar K, Marshall S, De Bourdeaudhuij I, Vandelandotte C. Are Health Behavior Change Interventions That Use Online Social Networks Effective? A Systematic Review. *J Med Internet Res*. 2014;16(2):e40. doi:10.2196/jmir.2952
74. Robertson LM, Douglas F, Ludbrook A, Reid G, van Teijlingen E. What works with men? A systematic review of health promoting interventions targeting men. *BMC Health Serv Res*. 2008;8(1):141. doi:10.1186/1472-6963-8-141
75. Sandelowski M. Using Qualitative Research. *Qual Health Res*. 2004;14(10):1366-1386.
doi:10.1177/1049732304269672
76. Roetert EP, Ortega C. Physical Literacy for the Older Adult. *Strength Cond J*. 2019;41(2):889-899. doi:10.1519/SSC.0000000000000430
77. Jones GR, Stathokostas L, Young BW, et al. Development of a physical literacy model for older adults -- a consensus process by the collaborative working group on physical literacy for older Canadians. *BMC Geriatr*. 2018;18(1):13. doi:10.1186/s12877-017-0687-x
78. Magnusson D, Rethorn Z. Strengthening Population Health Perspectives in Physical

- Therapist Practice Using Epigenetics. *Phys Ther.* 2022;102(1):pzab244.
<https://doi.org/10.1093/ptj/pzab244>.
79. Freedman D, Bess K, Tucker H, Boyd D, Tuchman A, Wallston K. Public health literacy defined. *Am J Prev Med.* 2009;36(5):446-451.
<https://doi.org/10.1016/j.amepre.2009.02.001>.
80. Durden-Myers E, Green N, Whitehead M. Implications for Promoting Physical Literacy. *J Teach Phys Educ.* 2018;37:1-10. doi:10.1123/jtpe.2018-0131
81. Canadian Physiotherapy Association: Primary Health Care. Position Statement Population Health. https://physiotherapy.ca/sites/default/files/positionstatements/population-health_en.pdf. Accessed July 23, 2022.
82. Barnett K, Mercer S, Norbury M, Watt G, Wyke S, Guthrie B. Epidemiology of multimorbidity and implications for health care, research, and medical education: a cross-sectional study. *Lancet.* 2012;380(9836):37-43. doi:10.1016/S0140-6736(12)60240-2.
83. Sum K, Li M, Choi S, Huang Y, Ma R. In/Visible Physical Education and the Public Health Agenda of Physical Literacy Development in Hong Kong. *Int J Environ Res Public Health.* 2020;17(9):3304. <https://doi.org/10.3390/ijerph17093304>.