

Evidence *in* Context

Issue: Exercise in Long-Term Care
Released: November 2017

Health research — synthesized and contextualized for use in Newfoundland & Labrador

Exercise Interventions for Long-Term Care *in* Newfoundland & Labrador

Isabelle J. Dionne, PhD., David Diamond, Stephen Bornstein, PhD., David Speed, PhD., Pablo Navarro

Newfoundland & Labrador Centre for

**APPLIED
HEALTH
RESEARCH**

www.nlcahr.mun.ca



*Celebrating the 10th Anniversary of the
Contextualized Health Research Synthesis Program*

Find CHRSP Reports Online

All reports of the Contextualized Health Research Synthesis program are available online:

www.nlcahr.mun.ca/chrsp/

This contextualized health research synthesis report was prepared by the Newfoundland & Labrador Centre for Applied Health Research (NLCAHR), Memorial University. It was developed through the analysis, interpretation and synthesis of scientific research and/or health technology assessments conducted by other parties. It also incorporates selected information provided by experts in the subject areas and synthesis methodologies. This document may not fully reflect all the scientific evidence available at the time this report was prepared. Other relevant scientific findings may have been reported since completion of this synthesis report.

Memorial University, NLCAHR, and the CHRSP project team make no warranty, express or implied, nor assume any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, data, product, or process disclosed in this report. Conclusions drawn from, or actions undertaken on the basis of, information included in this report are the sole responsibility of the user.

This report is the property of the Newfoundland & Labrador Centre for Applied Health Research (NLCAHR). Reproduction of this document for non-commercial purposes is permitted provided proper credit is given to NLCAHR.

For further information please contact: nlcahr@mun.ca

Cite as: Dionne, Isabelle J., PhD., Diamond, David, Bornstein, Stephen, PhD., Speed, David, PhD. , Navarro, Pablo (2017). Exercise Interventions for Long-Term Care in Newfoundland & Labrador. St. John's, NL: Newfoundland & Labrador Centre for Applied Health Research, Memorial University

ISBN: 978-0-88901-483-1

Table of Contents

THE RESEARCH TEAM	5
ACRONYMS	6
GLOSSARY	7
THE RESEARCH QUESTION	8
KEY MESSAGES FROM THIS REPORT	8
HOW TO NAVIGATE THIS REPORT	9
BACKGROUND	9
METHODOLOGY	10
SEARCH RESULTS	12
SYNTHESIS FINDINGS	15
DISCUSSION	20
THE NEWFOUNDLAND & LABRADOR CONTEXT	21
IMPLICATIONS FOR DECISION MAKERS	26
REFERENCES.....	28
APPENDICES.....	30

About This Report

About NLCAHR

The Newfoundland & Labrador Centre for Applied Health Research, established in 1999, contributes to the effectiveness of the health and community services system of the province and the physical, social, and psychological well-being of the population. NLCAHR accomplishes this mandate by building capacity in applied health research, supporting high-quality research, and fostering more effective use of research evidence by decision makers and policy makers in the province's health system.

About the Contextualized Health Research Synthesis Program

In 2007, NLCAHR launched the Contextualized Health Research Synthesis Program (CHRSP) to provide research evidence that would help guide decision makers in the provincial health system on issues of pressing interest to Newfoundland & Labrador. Instead of conducting original research, CHRSP analyzes findings from high-level research already conducted in the subject area, such as systematic reviews, meta-analyses and health technology assessments. Findings are then synthesized and subjected to a systematic process of contextualization: they are analyzed in terms of their applicability to the conditions and capacities of the unique context of Newfoundland & Labrador. Our contextual analysis includes assessing the specific forms an issue may take in this province as well as the applicability of any proposed solutions and methods to

locally available resources, infrastructure, human resources, cultural conditions, and financial capacities. CHRSP uses a combination of external experts and local networks to carry out and contextualize the research synthesis and to facilitate the uptake of the results by research users. CHRSP focuses on three types of projects: health services/ health policy projects, health technology assessment (HTA) projects, and projects that combine the two to examine processes for the organization or delivery of care involving a health technology.

Who Should Read This Report?

This report provides a synthesis of the relevant research-based evidence on the role of exercise programs in maintaining functionality and encouraging activity in the frail elderly in long-term care facilities in Newfoundland & Labrador. This report is intended to support decision makers in Newfoundland & Labrador's four Regional Health Authorities, its Department of Health and Community Services, and its Department of Children, Seniors, and Social Development. The findings of our synthesis are based on an international search of the literature and may also be applicable to other jurisdictions in Canada and elsewhere, but are specifically interpreted for the context of Newfoundland & Labrador. The report includes explanations of research terms and technical language so that there is no need to have a specialized medical or health background in order to understand its content.

The Research Team

Exercise Interventions in Long-Term Care *in* Newfoundland & Labrador

Report Authors:

Isabelle J. Dionne, PhD.

Professor, Université de Sherbrooke
Canada Research Chair in Exercise
Recommendations for Healthy Aging
Faculty of Physical Activity Sciences
(Subject Expert)

David Diamond

Chief Executive Officer, Eastern Health
(Health System Leader)

Stephen Bornstein, PhD.

Director, NL Centre for Applied Health Research
(CHRSP Program Director)

David Speed, PhD.

Research Officer, NL Centre for Applied
Health Research (CHRSP Project Coordinator)

Pablo Navarro

Senior CHRSP Research Officer
NL Centre for Applied Health Research

Project Team:

Maureen Ashe, PhD.

Associate Professor, University of British Columbia
Canada Research Chair in Community Mobility

Danielle Bennett, B. Rec., CTRS

Recreation Development Specialist
St. Patrick's Mercy Home, Eastern Health

Heather Brown

Vice President, Rural Health, Long-Term Care and
Community Supports, Central Health

Carla Butt

Physiotherapist, Long-Term Care Division
Eastern Health

Jeanette Byrne, PhD.

Associate Professor, School of Human Kinetics and
Recreation, Memorial University

Janice Dalton

Regional Manager, Long-Term Care,
Eastern Health

Jennifer Fahey

Occupational Therapist, Eastern Health

Clara Fitzgerald

Director, Canadian Centre for Activity and Aging

Bev Griffiths

Director, Acute Care Health Services
Department of Health and Community Services
Government of Newfoundland & Labrador

Melissa Miller

Special Projects Manager, Clinical Information
Specialist-MDS, Information Management and
Technology Department, Central Health

Deborah Noseworthy

Physiotherapist, Long-Term Care Division
Eastern Health

Kelli O'Brien

Vice President, Long-Term Care, Rural Health,
and Quality, Western Health

Judy O'Keefe

Regional Director
Long-Term Care Program, Eastern Health

Sean Pardy

Regional Manager, Allied Health, Eastern Health

Jennifer Shears

Clinical Leader for Physiotherapy, Eastern Health

Michelle Whittle, RN, NP

Nurse Practitioner
Long-Term Care, Eastern Health

External Reviewer:

Susan Slaughter, PhD, RN, GNC(C)

Associate Professor, Faculty of Nursing
Edmonton Clinic Health Academy (ECHA)
University of Alberta

Acronyms

ADL	Activities of Daily Living
AMSTAR	Assessing the Methodological Quality of Systematic Reviews
CERS	CHRSP Evidence Rating System
CHRSP	Contextualized Health Research Synthesis Program
CINAHL	Cumulative Index to Nursing and Allied Health Literature
FIM	Functional Independence Measure
I/O	Intervention – Outcome combination
LTC	Long-Term Care
NL	Newfoundland & Labrador
QoL	Quality of Life
TUG	Timed up-and-go
RCT	Randomized Controlled Trial
RHA	Regional Health Authority
SR	Systematic Review

Glossary

ADL Barthel	An ordinal scale used to measure performance in activities of daily living
ADL FIM	A measure of the amount of support needed to care for an individual to carry out activities of daily living
Balance - Berg	A measure of balance among older people with impairment in balance function which is conducted by assessing performance of functional tasks
Balance – Reach	A measure of balance which is conducted by having the subject stand alongside a wall and stretch forward as far as possible without taking a step
Balance – Single Leg	A measure of balance which is conducted by having the subject stand unassisted on one leg, with eyes open and arms held down at the sides
Gait	The full-body manner of walking
Falls Rate	Number of falls for a defined population over time
Frailty	The condition of being physically and/or mentally weak and/or delicate
Mobility	The ability, agility, and speed by which an individual may locomote
Physical Rehabilitation	Interventions that aim to maintain or improve physical function of an individual. In a care-home setting, this typically involves increasing the physical exertions of an individual (active), although passive rehabilitation involving external stimulation (e.g., whole body vibration) is also in use. The focus of this review is active rehabilitation, which may be in the form of specific exercises or physical activity as a part of some other purposeful or leisure activity either provided in a group format or individually; generic or tailored; and delivered by rehabilitation professionals (e.g. physiotherapist), care staff, or self-directed.
Relative Risk	The ratio of the probability of an event occurring in an exposed group to the probability of the event occurring in a comparison, non-exposed group
Risk of Falls	A measure of the likelihood that an individual will fall
Step Training	Training of single or multiple volitional or reactive steps in an upright (standing or walking) position in response to an environmental challenge (e.g., stepping onto a target, avoiding an obstacle, or responding to a perturbation). Regular locomotive (e.g., walking), rhythmic (e.g., dancing) and multimodal (e.g., Tai Chi) exercises that do not exclusively train stepping in response to an environmental challenge <i>are not</i> included in this definition.
Timed up-and-go	A test of mobility and balance, where an individual rises from a chair, walks three meters, turns around, walks back to the chair, and sits down

The Research Question

“What exercise-based interventions have been shown to be effective in improving the day-to-day functioning of physically frail elderly in long-term care (LTC) facilities?”



Key Messages from this Report

The following key messages summarize the most relevant evidence synthesis findings in this report and reflect the state of the available research:

1. The research evidence addressing exercise interventions for residents of long-term care facilities is limited in both quantity and quality. The only bodies of evidence strong enough to draw conclusions pertain to **non-frail elderly**. Unfortunately, findings for the physically **frail elderly** are not strong enough to support reliable conclusions.
2. A strong body of evidence indicates that step training is effective to reduce the rate of falls among **non-frail elderly** living either in Long-Term Care (LTC) or in the community.
3. Step training may also be effective to reduce the risk of falls among **non-frail elderly**; however, additional evidence is required in order to draw any firm conclusions.
4. The evidence for physical rehabilitation to improve Activities of Daily Living (ADL) is inconsistent, likely as a result of the wide range of interventions that are considered to be “physical rehabilitation.” Some specific types of physical rehabilitation may improve ADL for non-frail elderly populations, while others may not, and the evidence is not clear about which types of rehabilitation are effective/ineffective.
5. Moderate bodies of evidence indicate that, for non-frail populations, physical rehabilitation does not make consistent or significant improvements to timed-up-and-go or to walking speed.
6. The evidence does not indicate whether or not volunteers can effectively deliver exercise-based interventions for LTC residents, either frail or non-frail, to improve day-to-day functioning. In the literature, the most commonly-reported individuals delivering exercise interventions in LTC are health professionals, such as physiotherapists.

How to Navigate this Report

- The section entitled **Synthesis Findings** provides supporting detail about each of the foregoing key messages. This section of the report provides readers with a comprehensive overview of the scientific evidence that was examined for this study.
- Local contextual variables that may have an impact on how decision makers apply the evidence in Newfoundland & Labrador are detailed in this report under the section: **The Newfoundland & Labrador Context**.
- The synthesis findings are then considered in light of the contextualization findings to come up with the list of **Implications for Decision Makers**. Please note that CHRSP prefers to use the term “implications” rather than “recommendations” because we recognize that evidence is one of several inputs that health system decision makers need to consider. CHRSP reports present the issues decision makers should *consider* rather than asserting which options they should *choose*.

Background

In 2016, the Contextualized Health Research Synthesis Program (CHRSP) solicited topics from its health partners. Both Central Health and Western Health submitted requests for CHRSP to evaluate the evidence for models, strategies, and best practices to support physical activity and exercise programs in Long-Term Care (LTC) facilities. In October 2016, CHRSP assembled a team for what became the Exercise in Long-Term Care Project.

The report’s Subject Matter Expert was Isabelle J. Dionne, PhD., a Canada Research Chair in Exercise Recommendations for Healthy Aging at the Université de Sherbrooke. The Health System Leader for the project was Mr. David Diamond, Chief Executive Officer of Eastern Health. The project team included representatives from Eastern Health, Central Health, Western Health, Memorial University, the provincial Department of Children, Seniors, and Social Development, and the provincial Department of Health and Community Services.

Given that the initial research question was very broad in scope, the Project Team met to clarify the parameters of the project in terms of which populations, interventions, and outcomes would be eligible for inclusion. At its first meeting, the Project Team achieved consensus on the following research question to guide the project:

What exercise-based interventions have been shown to be effective in improving the day-to-day functioning of physically frail elderly in long-term care facilities? Only the following interventions will be eligible for consideration: interventions that require no

equipment or minimal equipment; interventions that can be carried out on site in a long-term care facility; and interventions that would not specifically exclude persons with dementia from participating.

This document reports on the results of our project. It briefly describes the CHRSP methodology, presents a summary of our search results and knowledge synthesis, and describes the results of our contextualization interviews. Finally, we have developed a series of implications from our findings that health system decision makers in Newfoundland & Labrador may wish to consider when applying the results.

Methodology

What evidence did we look for?

In collaboration with librarians at Memorial University Libraries and our Subject Matter Expert, CHRSP staff developed several search strategies to identify relevant research literature (see Appendix A for details). These search strategies were then applied to periodical indices (e.g., PubMed and CINAHL) as well as to repositories of other published research (i.e., grey literature).

For a research study to be included in the current synthesis, it had to:

- be a systematic review or a meta-analysis covering at least two studies **or** a very recent, high-quality primary study;
- include both male and female participants;
- include a comparator group;
- study an intervention that was exclusively exercise-based or exclusively based on physical conditioning;
- measure an outcome related to activities of daily living (ADL), functional decline, or physical quality of life (QOL);
- have a population that was not limited to any specific acute or chronic condition(s);
- either have $\geq 75\%$ of its respondents reside in a long-term care facility **or** distinguish between LTC and non-LTC participants in its analysis; and
- be available in English.



The CHRSP Evidence Rating System

Our synthesis of the evidence was designed to combine *comparable* research results to arrive at a **finding**. In practice, this meant that the synthesis was carried out at the level of combining the evidence that showed how a particular Intervention affected a specific Outcome (i.e., an I/O combination) for a given Population, in a given Setting, compared to a given Comparison Group. As an example, such a finding could be: the combined evidence for the impact of physical rehabilitation (Intervention) on improving Activities of Daily Living (ADL) (Outcome) for older persons (Population) living in LTC (Setting) compared to “usual care” (Comparator).

The synthesis of evidence also assessed **the body of evidence** for any finding. We used a CHRSP Evidence Rating System (CERS) that had been designed, tested, and implemented for this purpose. The CERS measures the strength of a body of evidence arriving at five categories: Very Strong, Strong, Moderate, Weak or Very Weak.

The body of evidence measure is a compound measure that indicates the degree to which the evidence for a finding can be trusted. The strength of the body of evidence takes into account: the number and methodological quality of the included systematic reviews; the consistency of results between these reviews and any relevant primary literature; and the number of unique primary research studies that underpin the review results.

The strength of the body of evidence for a finding is **independent of the favourability of the finding** in question. That is to say, the strength (or weakness) of the body of evidence is independent of whether or not the evidence actually favours (or does not favour) the intervention over the control group (see Table 1 below). The finding that a given intervention *does not* improve a specified outcome can still come from a strong body of evidence.

Body of Evidence ↓	Favourability of Finding		
	Favouring (evidence that an intervention is effective)	No effect (evidence that an intervention has no effect)	Conflicting or Against (evidence not consistent or against using an intervention)
Very strong	✓✓✓	✓✓✓	✗
Strong	✓✓	✓✓	✗
Moderate	✓	✓	✗
Weak or Very Weak	~	~	✗

Table 1: Evidence Rating Legend

To return to the example used above, the body of evidence for physical rehabilitation to improve measures of ADL in older persons is moderate because there is a modest amount of high-quality evidence, all of which points in the same direction. In this particular case, it favors the intervention. At

the same time, and for the same reasons, an equally moderate body of evidence exists for whether physical rehabilitation has an effect on walking speed; however, in this particular case, the evidence indicates that physical rehabilitation *does not make a difference* in walking speed (i.e., it does not favour the intervention). The CERS is implemented using a programmed Excel spreadsheet that integrates critical appraisal scores, data extraction results, primary research analysis and an algorithmic scoring system.

Search Results

Over 2,500 articles were screened on the basis of title and abstract, yielding 105 systematic reviews identified for full text review (see Figure 1 below). CHRSP staff examined these reviews to determine if they met the inclusion criteria for this project. From the 105 systematic reviews, 92 were deemed ineligible for reasons having to do with the populations studied. Five articles were excluded because they studied ineligible types of interventions and four were excluded for not having measured any of the outcomes of interest. This left 13 potentially-eligible systematic reviews.

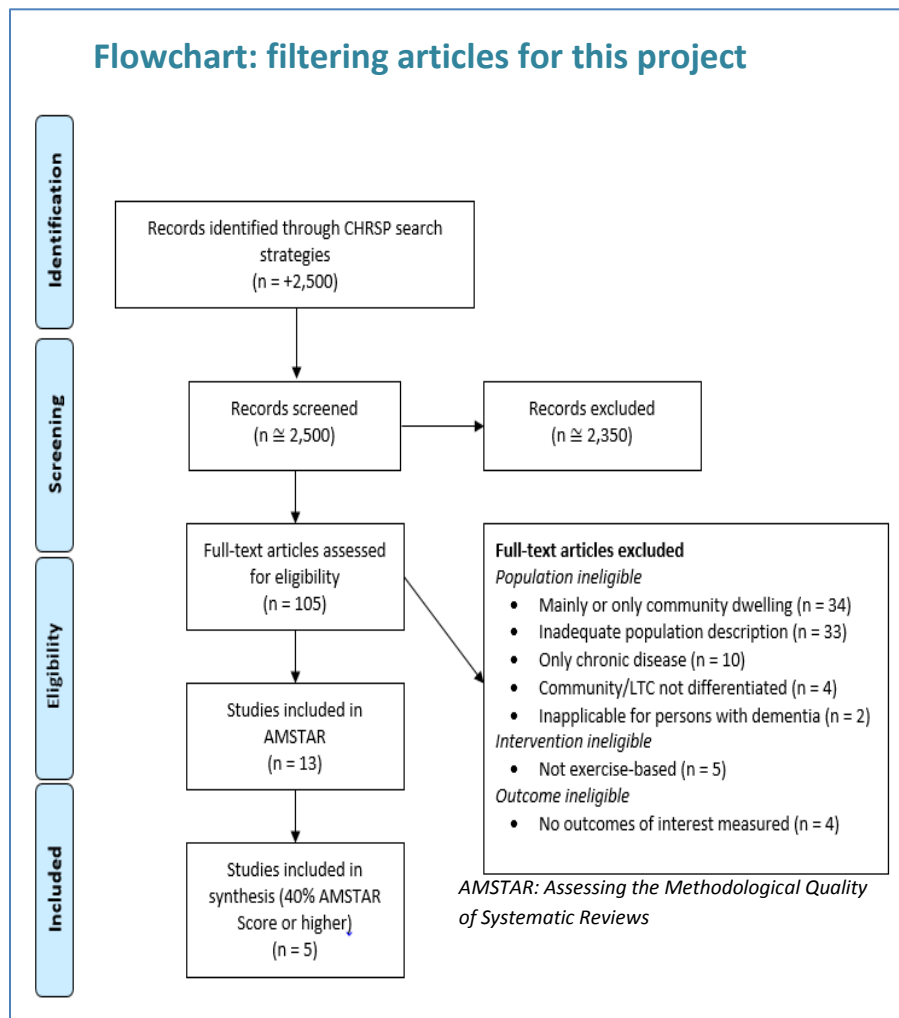


Figure 1: Flowchart showing how articles were filtered for inclusion in this project

Critical Appraisal

Two CHRSP research staff used the AMSTAR tool (A Measuring Tool to Assess Systematic Reviews) to assess the methodological quality of the included systematic reviews (1). AMSTAR consists of a set of 11 of Yes/No questions, each of which assesses a key component of systematic review methodology: comprehensiveness of literature search, whether funding sources were noted, whether conclusions reached were reasonable, etc. Only systematic reviews that scored 40% (5 out of 11) or higher on AMSTAR were included for the current study. There was a high degree of agreement between CHRSP researchers in their AMSTAR scoring of the systematic reviews with an average Kappa of 0.95, i.e., “very good” (2).

Eight of the fourteen studies (3–10) were excluded because they did not reach the AMSTAR cut-off point of 40%. Ultimately, five systematic reviews were included in the current study:

- Cameron (2012) (11)
- Chin (2008) (12)
- Chou (2012) (13)
- Crocker (2013) (14) and
- Okubo(2016) (15).

The average AMSTAR score for these systematic reviews was quite strong, with all but one rated as “High Quality” (12).

Interventions / Outcomes and Populations

The inclusion criteria for this project allowed for a broad range of Intervention/Outcome combinations (I/O) to be considered. Taken together, the included studies examined four interventions:

- Multifactorial Interventions
- Physical Rehabilitation
- Step Training, and
- Tai-Chi

The included studies addressed seven outcomes:

- Activities of Daily Living
- Balance
- Falls
- Gait
- Mobility
- Timed-Up-and-Go, and
- Walking Speed.

In total, 17 different I/O combinations were studied (See Table 2).

There was virtually no overlap in reported I/O combinations in the included studies. This lack of overlap had critical consequences for our analysis, as it reduced our capacity to *combine* findings from different systematic reviews and meant that we could draw only limited conclusions from the evidence.

The following table summarizes the Intervention/Outcome combinations examined in this report and shows which of the studies reported on frail-only populations.

Outcome		Intervention			
		Multifactorial Interventions	Physical Rehabilitation	Step Training	Tai-Chi
ADL	Barthel		Crocker 2013		
	FIM		Crocker 2013		
Balance	Undefined				Chin 2008*
	Berg			Okubo 2015	
	Reach			Okubo 2015	
	Single Leg			Okubo 2015	
Falls	Rate	Cameron 2012		Cameron 2012, Okubo 2015	
	Risk of	Cameron 2012		Cameron 2012, Okubo 2015	
Gait		Chou 2012*			Chin 2008*
Mobility			Crocker 2013		
TUG			Crocker 2013	Okubo 2015	
Walking Speed			Crocker 2013	Okubo 2015	
*Study indicated frail-only populations; all other studies indicated exclusively or primarily non-frail populations.					

Table 2: Summary of included studies and studied I/O combinations

Our Project Team had hoped to identify a substantial body of literature addressing frail LTC residents.

On close examination, it became apparent that the included studies lacked consistent definitions of the terms 'frail' and 'frailty.' There were many competing operational definitions for frailty, (e.g., the Edmonton Frail Scale vs. Speechley-Tinetti criteria). Some studies described their participants as being 'frail' in a generic sense, without providing any definition. In order to move forward with the project, we defined the terms 'frail' and 'frailty' in this report as referring to a weakened and delicate physical state.

Two studies did claim to address frail LTC residents (12,13), while three assessed populations of non-frail LTC residents exclusively or primarily (11,14,15). Likewise, most I/O analyses across all studies assessed non-frail LTC clients as either the majority or the entirety of the study population.

On close examination, however, it became apparent that the included studies lacked consistent definitions of the terms 'frail' and 'frailty' (12). There were many competing operational definitions for frailty, (e.g., the Edmonton Frail Scale vs. Speechley-Tinetti criteria) (13). Some studies described their participants as being 'frail' in a generic sense, without providing any definition (11,14,15). In order to move forward with the project, we defined the terms 'frail' and 'frailty' in this report as referring to a weakened and delicate physical state.

Synthesis Findings

Only *four* of the studied I/O combinations had bodies of evidence strong enough to draw conclusions. These combinations are **highlighted in bold** in Table 3 below and are summarized as follows:

- Physical Rehabilitation for ADL Barthel (14)
- Physical Rehabilitation for Timed Up-and-Go (14)
- Physical Rehabilitation for Walking Speed, and (14)
- Step Training for Falls Rate (11,15)

It is very important to note that each of the four I/O combinations with strong enough evidence studied exclusively or primarily *non-frail populations* (11,14,15).

INTERVENTION/OUTCOME		STRENGTH OF EVIDENCE	FINDING
Multifactorial	<i>Gait</i>	Weak ~	<i>Favours Intervention</i>
	Falls Rate	Weak ~	No Difference
	Risk of Falls	Weak ~	No Difference
Physical Rehabilitation	ADL Barthel	Moderate ✓	Favours Intervention
	ADL FIM	Weak ~	No Difference
	Mobility	Weak ~	Favours Intervention
	TUG	Moderate ✓	No Difference
	Walking Speed	Moderate ✓	No Difference
Step Training	Balance - Berg	Weak ~	No Difference
	Balance – Reach	Weak ~	No Difference
	Balance – Single Leg	Weak ~	Favours Intervention
	Falls Rate	Strong ✓✓	Favours Intervention
	Risk of Falls	Very weak ~	Favours Intervention
	TUG	Weak ~	Favours Intervention
	Walking Speed	Weak ~	No Difference
Tai-Chi	<i>Balance & Gait</i>	Weak ~	<i>No Difference</i>
• Entries in BOLD have bodies of evidence that are strong enough to draw conclusions • <i>Italicized entries indicate frail-only populations</i> • Regular font indicates exclusively or primarily non-frail populations.			

Table 3: Summary of Intervention / Outcome synthesis results

Key Message #1

The research evidence addressing exercise interventions for residents of long-term care facilities is limited in both quantity and quality. The only bodies of evidence strong enough to draw conclusions pertain to *non-frail elderly*. Unfortunately, findings for the *physically frail elderly* are not strong enough to support reliable conclusions.



Step Training

Two studies addressed “step-training interventions,” delivered in one-on-one sessions as well as in group environments (11,15). In both cases, non-frail elderly persons were the subjects of the study. Step-training interventions were defined as:

...training of single or multiple volitional or reactive steps in an upright (standing or walking) position in response to an environmental challenge (e.g., stepping onto a target, avoiding an obstacle, or responding to a perturbation). Regular locomotive (e.g., walking), rhythmic (e.g., dancing) and multimodal (e.g., Tai Chi) exercises that do not exclusively train stepping in response to an environmental challenge were excluded. (15)

One could think of step-training interventions as a specific form of balance exercise. For this reason, step-training interventions always include a focus on falls-related outcomes.

Two studies assessed step training and whether it resulted in a lower falls rate, i.e., the number of falls expected to happen over a period of time in non-frail elderly populations (11,15). Step training was in either a volitional format (participants stepped in a specific pattern or on a specific target) or in a reactive format (participants were perturbed while walking and had to recover). Analyses suggested that volitional and reactive approaches were comparably effective.

Unique among the included studies, Okubo et al. (15) tested whether living status (community-dwelling or LTC) influenced the efficacy of the step-training intervention. Results indicated that living status did not substantially influence the relationship between the intervention and the outcome, which allowed Okubo et al. to pool the results. An analysis of those seven primary studies revealed that step training was associated with a statistically significant decrease in falls rate ($z = 4.83, p < 0.001$). The finding, a relative risk (RR) = 0.48 (95% CI [.36, .65]), indicates that persons in step-training programs were 52% less likely to fall compared to the control group. Okubo et al. concluded that the evidence for the effectiveness of step training was reasonably robust and that this type of intervention could be applied in both community and institutional settings. In a similar vein, Cameron et al. (11) found that, in the two studies they assessed, step training was associated with a similarly lower falls rate, where RR = 0.45 (95% CI [.24, .85]). Overall, the body of evidence for step training and its association with a lower falls rate was evaluated as “Strong”.

Key Message #2

A strong body of evidence indicates that Step Training is effective to reduce the rate of falls among non-frail persons living in LTC or in the community.



Cameron et al. (11) and Okubo et al. (15) reach different conclusions with regard to the *risk* of falls. The risk of falls is the likelihood that an individual person may fall (whereas falls *rate* is an estimate of the number of falls per person over time). Cameron et al. found no difference between step training and control groups in their synthesis (RR = .72, 95% CI [.43, 1.19]). In contrast, a synthesis of seven studies by Okubo et al. found that the intervention group did have a significantly lower risk of falls, with RR = .51 (95% CI [.38, .68]; $z = 4.55, p < 0.001$). We rated this evidence as “very weak” because of the conflicting findings.

CHRSR researchers suspect that the disagreement over significance between these findings likely results from the difference in the number of research participants studied in each of the systematic reviews. Cameron et al. estimated an effect size using a total sample of 53 participants (35 experimental and 18 control) whereas Okubo et al. based their estimate on 660 participants (330 experimental and 330 control) pooled from several primary research studies. The smaller sample size and its resulting lack of statistical power likely account for Cameron et al. not finding a significant effect.

Key Message #3

Step training may also be effective to reduce the risk of falls among non-frail elderly; however, additional evidence is required in order to draw any firm conclusions.



Physical Rehabilitation

Physical rehabilitation was included as an intervention because it was consistent with the notion of exercise (14):

Physical rehabilitation is defined as those interventions that aim to maintain or improve physical function of an individual. In a [long-term care] setting, this typically involves increasing the physical exertions of an individual (active), although passive rehabilitation involving external stimulation (e.g., whole body vibration) is also in use. The focus of this review is active rehabilitation, which may be in the form of specific exercises or physical activity as a part of some other purposeful or leisure activity. It may be provided in a group format or individually; generic or tailored; and delivered by rehabilitation professionals (e.g. physiotherapist), care staff, or self-directed.

Crocker et al. (14) assessed physical rehabilitation as an intervention to influence Activities of Daily Living (ADL) as measured by the Barthel Index. In an assessment of seven studies, they found that persons undertaking physical rehabilitation activities reported a better score on the Barthel Index than the control group. The difference was statistically significant ($M_{diff} = 6.38$, 95% CI [1.63, 11.12], $z = 2.64, p = 0.008$).

However, Crocker et al. urge caution in interpreting these findings. Only one of the seven included studies found a statistically significant difference. Their caution is consistent with a subsequent review by the same authors, measuring ADL with a different measure—the Functional Independence Measure (FIM). In this analysis, four primary research studies were synthesized. The evidence indicated that physical rehabilitation was not associated with better ADL scores ($M_{diff} = 4.98$, 95% CI [-1.55, 11.51], $z = 1.49$, $p = 0.140$).

Crocker et al. reported a high degree of heterogeneity within their study. This may have been the product of the broad definition of physical rehabilitation that was used. Physical rehabilitation covers a wide variety of interventions, which means that the utility of this specific finding is questionable. Overall, while the evidence for physical rehabilitation is classed as “moderate,” this finding is tempered by the difficulty of regarding “physical rehabilitation” as a single type of intervention.

Key Message #4

The evidence for physical rehabilitation to improve Activities of Daily Living (ADL) is inconsistent, likely as a result of the wide range of interventions that are considered to be “physical rehabilitation.” Some specific types of physical rehabilitation may improve ADL for non-frail elderly populations, while others may not, and the evidence is not clear about which types of rehabilitation are effective/ineffective.



Crocker et al. (14) also examined whether physical rehabilitation improved performance (i.e., lower scores) on the Timed-Up-and-Go (TUG) test. Overall, physical rehabilitation did not improve TUG. However, there were specific instances where it was associated with better scores. Crocker et al. (14) found that physical rehabilitation interventions with shorter duration (< 6 months), resulted in better, lower TUG scores for the intervention group compared to the control group ($M_{diff} = -7.34$, 95% CI [-13.93, -.75], $z = 2.18$, $p = 0.029$). In this review, studies with better, lower median TUG baseline scores reported more improvements than the control group ($M_{diff} = -7.34$, 95% CI [-13.93, -.75]). In other words, populations with greater mobility may be more likely to benefit from physical rehabilitation than populations with lower mobility.

Crocker et al. (14) also assessed the relationship between physical rehabilitation and walking speed. In an assessment of nine studies, they found that physical rehabilitation and control groups did not differ with regard to how fast they were able to walk ($M_{diff} = .03$, 95% CI [-.01, .07], $z = 1.59$, $p = 0.110$). Unlike Crocker et al.’s assessment of physical rehabilitation and TUG scores, there tended to be consistent null effects when assessing sub-populations within these studies. Overall, results would suggest that physical rehabilitation is not associated with significant improvements in walking speed for the non-frail populations studied.

Key Message #5

Moderate bodies of evidence indicate that, for non-frail populations, physical rehabilitation does not make consistent or significant improvements to timed-up-and-go or walking speed.



Other Studied Interventions

Twelve of the sixteen Intervention/Outcome (I/O) combinations had “weak” or “very weak” bodies of evidence, including I/O combinations for Tai Chi and Multifactorial Interventions for the frail elderly. However, it should be noted that interventions with these bodies of evidence may not *necessarily* be ineffective. Rather, the problem may be that too few studies address this specific I/O. It may be the case that an I/O with “weak” evidence may ultimately be deemed stronger as more research accumulates.

Evidence from Primary Research Literature

In addition to our search for systematic reviews, we also looked for primary research literature (e.g., articles on randomized controlled trials or case-control trials) conducted too recently to have been included in systematic reviews. Such evidence can sometimes challenge the prevailing consensus from the review literature.

When we searched for primary literature that addressed step training however, we could not find any recent primary studies that fit our inclusion criteria for this project. Much of the recent research literature studied the use of video games that included a physical component, such as dancing or shadow boxing for community-dwelling adults; other studies looked at specific diagnoses or conditions (e.g., Parkinson’s disease or paralysis). The lack of recent primary literature on our topic was not wholly

surprising, given the fragmented nature of the existing literature in this area and the rarity with which primary literature will re-examine previously established interventions.

...the literature rarely indicated how interventions were delivered. When this information was provided, it overwhelmingly indicated that health professionals (e.g., physiotherapists) were responsible for delivering the intervention. While volunteers may very well be able to deliver exercise interventions effectively and safely, there is nothing to support this approach in the literature examined in this study.

Who can deliver exercise interventions?

Some members of our Project Team were interested in finding out about the possibility of exercise interventions being delivered by volunteers in LTC. They wanted to know what the evidence indicated as to whether volunteers could effectively provide exercise training that had been shown to improve the well-being of LTC residents. Unfortunately, the literature rarely indicated how the interventions were delivered. When this information was provided, it overwhelmingly indicated that health professionals (e.g., physiotherapists) were responsible for delivering the intervention. While volunteers *may* very well be able to deliver exercise interventions effectively and safely, there is

nothing to support this approach in the literature examined in this study.

Key Message #6

The evidence does not indicate whether or not volunteers can effectively deliver exercise-based interventions for LTC residents, either frail or non-frail, to improve day-to-day functioning. In the literature, the most commonly-reported individuals delivering exercise interventions in LTC are health professionals, such as physiotherapists.



Discussion

The overall body of evidence for exercise-based interventions for *frail populations* in LTC was weak (13,16). However, for non-frail LTC populations, our synthesis suggests that step training, either volitional or reactive, is associated with a reduced rate of falls (15). Physical rehabilitation was also statistically associated with improved ADL in non-frail populations (14), but the authors suggested caution in interpreting this result. Physical rehabilitation has been shown to have possible, but not conclusive, positive effects on TUG scores in non-frail populations (14). Finally, physical rehabilitation had a non-significant relationship with improved walking speed in non-frail populations (14).

The highly-fragmented nature of the research literature is a significant problem when considering exercise interventions for people in long-term care:

- Because the available systematic reviews studied similar, but not identical, Intervention/Outcome (I/O) combinations, attempting to synthesize the findings was highly problematic. For example, Crocker et al. (14) analyzed both FIM and Barthel measures for ADL and found that physical rehabilitation improved Barthel scores but not FIM scores.
- A fragmented literature also meant that recent primary research studies were too few in number to provide findings that would allow us to reach more definitive conclusions regarding frail populations.
- Although the literature was less fragmented for non-frail populations, it was still heterogeneous enough to limit confidence in drawing conclusions.

Another key concern with the evidence is that much of the literature treats frail and non-frail seniors as similar populations that can be combined. This concern became evident in articles that did not even specify whether the studied population was frail, non-frail, or mixed. This pooling of diverse populations is particularly troubling when one considers that the effect of exercise on well-being is so often contingent on level of frailty, as these examples from the literature demonstrate:

These analyses suggest that participants with greater disability might be less likely to benefit from exercise interventions... It may be that exercise programmes increase falls in frail residents and reduce falls in less frail residents. (11)

Physical rehabilitation for long-term care residents may be effective, reducing disability with few adverse events, but effects appear quite small and may not be applicable to all residents. (14)

It should be noted that muscle weakness is a strong fall risk factor among frail institutionalised older adults, in whom most falls occur in the absence of overt external hazards. (15)

Five of these studies seem to be performed in a highly frail population, suggesting that the degree of frailty might be critical in the effectiveness of exercise programmes. (12)

As a result, the large body of literature that combines frail and non-frail populations is of limited value for this study since our research question *focused on frail populations*. Readers should note that while some excluded systematic reviews claimed that exercise is beneficial for frail populations, they tended to have low AMSTAR scores and to be narrative reviews as opposed to systematic reviews or meta-analyses (3–5,9). In addition, in practice, “exercise” describes a range of interventions; consequently, some forms of exercise may be equally suitable or even more suitable for a frail group.

The Newfoundland & Labrador Context



Throughout the course of this project, we have tried to identify contextual factors unique to Newfoundland & Labrador that may influence the relevance and applicability of the research-based evidence to our province and its population. This section of the report addresses those contextual factors and is based primarily on consultations with local decision makers, administrators, clinicians and stakeholder group representatives in the province.

Contextualization Approach

In order to make this evidence synthesis as relevant as possible to our Health System Partners, the findings need to be considered in terms of the specific capacities, needs, and characteristics of the health system and the populations of Newfoundland & Labrador. The research evidence synthesized in this report was produced in settings other than Newfoundland & Labrador; thus it cannot be assumed that the results are directly applicable here. This section of the report will outline those contextual factors that could have an impact on the effectiveness, feasibility and acceptability of exercise as an intervention in LTC settings.

CHRSF staff spoke with project team members, allied health professionals, and other key informants to identify contextual factors that were deemed relevant to this project. Interviews were confidential and anonymous in order to encourage honest and frank responses. Our contextualization interviews asked about step-training exercise specifically and about exercise in general. For the most part, several

common themes emerged from these discussions (see below). For a complete list of our interview questions, please see Appendix B.

Problems with Definitions

Defining Frailty A primary issue identified in this study is the lack of uniformity in the criteria that determine who, among the elderly, is considered to be ‘frail.’ Neither the province’s health system as a whole nor any of its regional health authorities uses a standardized definition of frailty. As a result, individuals who are deemed frail within one long-term care facility may not be deemed as being frail in another, even if the facilities are operated within the same Regional Health Authority. Frailty also appears to have different connotations, depending on the context. In some cases, frailty is used to signify “physical frailty” only, while in other cases the term may also signify “mental frailty.”

Our contextualization consultants suggested that the uncertainty over frailty assessments could be addressed by adding a standardized frailty assessment to the Minimum Data Set (MDS), a clinical assessment tool that is administered to all patients on their admission to LTC. However, there was little consensus or specificity about which questions to add to the MDS tool, or how to do so. On the one hand, some consultants suggested using existing MDS items as proxies for frailty. Specifically, they suggested that items from the Changes in Health, End-Stage Disease and Signs and Symptoms (CHESS) section of the MDS instrument were germane to physical capacity. The CHESS assessment did contain several elements relevant to frailty (e.g., decline in ADL and mobility).

However, these questions were general and their suitability to accurately and consistently assess frailty is unclear. On the other hand, it was noted that several instruments that specifically measure frailty already exist and that some of these have been used in this province previously (e.g., the Rockwood Scale). The resources needed to implement these standardized measures in LTC facilities across Newfoundland & Labrador would need to be further researched and considered.

...the uncertainty over frailty assessments could be addressed by adding a standardized frailty assessment to the Minimum Data Set (MDS), a clinical assessment tool that is administered to all patients on their admission to LTC. Study.

It was noted that several instruments that specifically measure frailty already exist and that some of these have been used in this province previously (e.g., the Rockwood Scale). The resources needed to implement these standardized measures in LTC facilities across Newfoundland & Labrador would need to be further researched and considered.

Defining Long-Term Care When considering the evidence in context, the provincial definition of ‘long-term care facility’ is an additional source of potential confusion. In Newfoundland & Labrador, LTC is defined differently than it is elsewhere in Canada, or even within other countries where the research-based evidence for this report was collected. In Newfoundland & Labrador ‘long-term care’ institutions admit only Levels 3 and 4 patients/clients who need near-constant or constant care from health

professionals. Institutions that accommodate patients/clients with lower healthcare needs are called 'personal care homes' in this province and are not included in analyses of LTC facilities or populations. Outside of Newfoundland & Labrador, 'long-term care facilities' may include institutions that serve patients with lower levels of need as well as those who require constant or near-constant health professional care. Accordingly, the research in this study undertaken in LTC facilities with residents of mixed needs levels may not be easily adapted in LTC facilities in Newfoundland & Labrador whose populations have more serious/complex healthcare needs. In the context of this project, interventions reported as safe and effective for LTC populations may be not be deemed as safe and effective here, depending on population health status parameters that often go unreported in the literature.

Health Human Resources

Currently, a pragmatic approach is used in which a range of criteria may be considered to determine who is qualified. Since leading an exercise intervention for frail seniors or mixed populations of frail and non-frail seniors could result in injuries, the absence of a formal set of criteria could expose patients to the risk of injuries; moreover, institutions and individual employees might be exposed to significant liability risk.

Capacity to deliver exercise programs in LTC

A significant factor in the consideration of exercise as an LTC intervention is service delivery. The province does not currently have specific policies on the qualifications required for leading an exercise program in LTC. Currently, a pragmatic approach is used in which a range of criteria may be considered to determine who is qualified. Since leading an exercise intervention for frail seniors or mixed populations of frail and non-frail seniors could result in injuries, the absence of a formal set of criteria could expose patients to the risk of injuries; moreover, institutions and individual employees might be exposed to significant liability risk. In the absence of explicit policies and appropriate training programs, exercise interventions would likely need to be led by allied health professionals rather than by volunteers.

Most exercise interventions in the research literature were delivered by trained therapists, typically by physiotherapists.

The literature said little or nothing about whether the responsibility for exercise programming could be delegated to other workers, whether professionally-trained or otherwise. In our consultations, we were told that recreational therapists (RT) already working in LTC facilities in the province were potential alternatives to physiotherapists, since exercise programming falls within the RT mandate. Key informants suggested using Licensed Practical Nurses or Registered Nurses as potential service providers. We were also told that kinesiologists are specifically-trained to design and deliver exercise programs for LTC populations, including the frail. Their involvement may be relevant to Newfoundland & Labrador because Memorial University offers a kinesiology program. There was a consensus that Personal Care Attendants would not be suitable for this role.

When considering the various categories of health professionals who might be capable of leading an exercise-based intervention, it was unclear from our interviews whether or not Newfoundland &

...some types of exercise programming already exist in Newfoundland & Labrador LTC facilities. Eligibility for these programs, which are led by a physiotherapist or a recreational therapist, is based on individual assessments of a resident's suitability for a specific program. In other words, exercise is not broadly prescribed to resident groups at large, but is made available to individuals who have been assessed as physically capable of the movements involved.

Labrador has sufficient numbers of such professionals to carry out regular exercise programming within its long-term care facilities. This is especially the case for publicly-funded LTC, where most LTC residents of this province are situated. Our consultants agreed that, while physiotherapists, kinesiologists, and nursing staff in this province would likely support the underlying principle of exercise programming for LTC residents, it might be challenging to add the administration and delivery of regular, even weekly, exercise programs to their current workloads. Several contextualization consultants expressed varying levels of doubt as to whether our health system has current capacity to provide adequate staffing levels to support such programming.

Existing LTC Exercise Programs

Readers should note that some types of exercise programming already exist in Newfoundland & Labrador LTC facilities. Eligibility for these programs, which are led by a physiotherapist or a recreational therapist, is based on individual assessments of a resident's suitability for a

specific program. In other words, exercise is not broadly prescribed to resident groups at large, but is made available to individuals who have been assessed as physically capable of the movements involved. Consistent with this approach, our consultants indicated that a generic exercise program, such as step-training that is not tailored to individual residents' abilities, might involve too much risk.

Logistical Capacity for Step Training

While strong evidence exists for step training as an intervention to *reduce falls rate* in non-frail elderly and contradictory evidence suggests that it *might reduce the risk of falls* among non-frail elderly, we have noted in this report that more evidence may be required in order to draw any firm conclusions about this intervention. With this caveat in mind, we did ask our informants about the province's current capacity to deliver step training in LTC in the province. The literature indicates that step-training interventions can be delivered in either group settings or in one-on-one settings. These different delivery settings were associated with different contextual issues.

Group settings

Step-training delivered in a group setting would require open space within LTC facilities, a stepping surface with symbols, and instruction. Our contextualization consultants indicated that this approach made relatively modest demands on available resources. They thought sufficient physical space could be found within most LTC facilities and stepping surfaces would be inexpensive. Group-based exercises

were also less human-resource intensive, which would reduce concerns about the availability of appropriate health professionals. However, since step training involves exposing participants to the risk of falling, each participant in a group would require safety equipment (e.g., harnesses, support ropes, etc.) and this would increase the cost.

One-on-one settings

Step training delivered in a one-on-one setting typically involves putting a participant in a specialized space or on a specialized piece of equipment (e.g., a treadmill). The participant is then exposed to the risk of a fall through a disturbance of his/her gait. A safety harness or other device prevents the participant from falling. Relatively more expensive treadmills or specialized spaces for step training would have to be purchased. Additionally, storing treadmills or having facility space permanently devoted to step training would place additional demands on resources. Finally, because one-on-one sessions require a therapist to be present for the implementation of each individual's exercise, the return-on-investment in terms of human resources would be low and the demand for trained personnel would be high.

Summary of Contextual Analysis

Implementing a uniform exercise program across the province will require developing the capacity to distinguish frail from non-frail LTC residents. The province does not currently use a standardized definition of frailty, nor does it have a tool in widespread use that could be used to measure it. Our key informants expressed some skepticism about whether there are sufficient health human resources (specifically physiotherapists, kinesiologists, recreational therapists, or nursing staff) to implement LTC exercise programs, even on a group basis. Finally, step-training for groups of non-frail seniors would be problematic from a safety standpoint because it would require a fall-arrest system. Conversely, step-training in a one-on-one setting would be feasible from a safety standpoint but challenging in terms of the human resource and equipment requirements required for implementation.

Other Suggested Approaches

Throughout the contextualization process, we heard two suggestions indirectly linked to the question at hand. The first suggestion was a widely-held view that encouraging exercise *earlier in the lifespan* would have helped LTC residents. While there are definite benefits to introducing exercise later in the lifespan, including for LTC residents, proposed programs would require safety precautions and training both to reduce possible risks and to be effective.

The second suggestion was that simply getting seniors moving more could be beneficial in enhancing ADL functionality without the risks and challenges involved in organized exercise programs.

Starting Exercise Earlier in the Lifespan

Several informants noted that exercise could have a greater impact on LTC residents if it were to be introduced earlier in their lifespan. Persons entering LTC facilities in NL generally have impaired functionality, which makes organized exercise challenging. While continued losses of functionality may

be slowed by exercise, a great deal of work may be needed to produce improvements. Starting exercise interventions earlier in the lifespan would help to mitigate these issues. CHRSP researchers noted that much of the literature on exercise interventions for the elderly examined community-dwelling seniors. A cursory examination of that literature suggests that exercise in community-based settings has been found to be effective for a variety of health outcomes. A separate study would be required to fully assess this segment of the literature and to examine its relevance to NL seniors.

Increased Movement as Distinct from Formal Exercise Programs

Several informants noted that encouraging LTC residents to engage in activities of daily living (ADL) on their own seems to be associated with enhanced function and better quality of life. These informants noted that encouraging residents to engage in individually-appropriate behaviours (e.g., standing or sitting unaided, walking to the toilet unaided, etc.) could encourage ADL preservation. This approach is often described as “function-focused care” and has been found to be associated with better health-related quality of life for residents of nursing homes (17), better ADL functionality (18,19), and slower declines in ADL functionality (19). A report by an international taskforce (20) pointed out that daily activities were beneficial to residents; the report emphasized the risks involved with having a highly-sedentary population and explicitly recognized the distinction between exercise-based interventions and a movement-based approach. Again, another CHRSP study would be required to more fully examine this approach and its suitability for this province.

Implications for Decision Makers

When considering the findings from this research evidence in the context of Newfoundland & Labrador, the following “Implications for Decision Makers” should be borne in mind:

1. The research evidence addressing exercise interventions for residents of long-term care facilities is limited in quantity and quality. The only bodies of evidence strong enough to draw conclusions pertain to ***non-frail elderly*** and not to the ***frail elderly*** who were the target population for this report. Given this situation, caution should be exercised interpreting the following implications.
2. Physical frailty is a key criterion for determining whether exercise is a suitable intervention for a person living in long-term care; however, there is no province-wide approach to assessing frailty; indeed, there may be substantial differences between populations deemed “frail” in different long-term care facilities within the province. This lack of a uniform definition presents implementation challenges for any exercise intervention.
3. Currently, some exercise activities are being supported by physiotherapists in some of our LTC facilities for some residents, but these interventions are individually-tailored. Implementing individually-tailored exercise programs, including step training (which may be effective for ***non-frail elderly***), for larger numbers of residents with sufficient frequency and duration to be

effective would require additional human resources, notably physiotherapists, recreational therapists, kinesiologists, and/or nursing staff.

4. Group delivery of step training programs, which again may be effective for *non-frail* elderly, might be less costly than one-on-one programs but this approach presents its own set of logistical challenges, including space and equipment requirements.
5. To promote healthier aging, two other kinds of programs may be worth investigating in Newfoundland & Labrador—exercise programming for seniors still living in the community and function-focused care that encourages more movement by seniors in LTC in their activities of daily life.

References

1. Shea BJ, Grimshaw JM, Wells GA, Boers M, Andersson N, Hamel C, et al. Development of AMSTAR: a measurement tool to assess the methodological quality of systematic reviews. *BMC Med Res Methodol*. 2007 Feb 15;7(1):10.
2. Landis JR, Koch GG. The Measurement of Observer Agreement for Categorical Data. *Biometrics*. 1977 Mar 1;33(1):159–74.
3. Vogel T, Brechat P-H, Leprêtre P-M, Kaltenbach G, Berthel M, Lonsdorfer J. Health benefits of physical activity in older patients: a review. *Int J Clin Pract*. 2009 Feb 1;63(2):303–20.
4. Benjamin K, Edwards N, Ploeg J, Legault F. Barriers to Physical Activity and Restorative Care for Residents in Long-Term Care: A Review of the Literature. *J Aging Phys Act*. 2014;22:154–65.
5. Gluchowski A, Harris N, Dulson D, Cronin J. Chronic Eccentric Exercise and the Older Adult. *Sports Med*. 2015 Aug 14;45(10):1413–30.
6. Guo J-L, Tsai Y-Y, Liao J-Y, Tu H-M, Huang C-M. Interventions to reduce the number of falls among older adults with/without cognitive impairment: an exploratory meta-analysis. *Int J Geriatr Psychiatry*. 2014 Jul;29(7):661–9.
7. Neyens JC, van Haastregt JC, Dijcks BP, Martens M, van den Heuvel WJ, de Witte LP, et al. Effectiveness and Implementation Aspects of Interventions for Preventing Falls in Elderly People in Long-Term Care Facilities: A Systematic Review of RCTs. *J Am Med Dir Assoc*. 2011 Jul;12(6):410–25.
8. Silva RB, Eslick GD, Duque G. Exercise for Falls and Fracture Prevention in Long Term Care Facilities: A Systematic Review and Meta-Analysis. *J Am Med Dir Assoc*. 2013 Sep;14(9):685–689.e2.
9. Weening-Dijksterhuis E, de Greef MHG, Scherder EJA, Slaets JPJ, van der Schans CP. Frail Institutionalized Older Persons: A Comprehensive Review on Physical Exercise, Physical Fitness, Activities of Daily Living, and Quality-of-Life. *Am J Phys Med Rehabil*. 2011 Feb;90(2):156–68.
10. Sherrington C, Whitney JC, Lord SR, Herbert RD, Cumming RG, Close JCT. Effective Exercise for the Prevention of Falls: A Systematic Review and Meta-Analysis. *J Am Geriatr Soc*. 2008 Dec 1;56(12):2234–43.
11. Cameron ID, Gillespie LD, Robertson MC, Murray GR, Hill KD, Cumming RG, et al. Interventions for preventing falls in older people in care facilities and hospitals. In: *Cochrane Database of Systematic Reviews* [Internet]. John Wiley & Sons, Ltd; 2012 [cited 2016 Oct 17]. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD005465.pub3/abstract>
12. Chin A Paw MJM, van Uffelen JGZ, Riphagen I, van Mechelen W. The functional effects of physical exercise training in frail older people : a systematic review. *Sports Med Auckl NZ*. 2008;38(9):781–93.

13. Chou C-H, Hwang C-L, Wu Y-T. Effect of Exercise on Physical Function, Daily Living Activities, and Quality of Life in the Frail Older Adults: A Meta-Analysis. *Arch Phys Med Rehabil*. 2012 Feb;93(2):237–44.
14. Crocker T, Forster A, Young J, Brown L, Ozer S, Smith J, et al. Physical rehabilitation for older people in long-term care. In: *Cochrane Database of Systematic Reviews* [Internet]. John Wiley & Sons, Ltd; 2013 [cited 2016 Oct 27]. Available from: <http://onlinelibrary.wiley.com/doi/10.1002/14651858.CD004294.pub3/abstract>
15. Okubo Y, Schoene D, Lord SR. Step training improves reaction time, gait and balance and reduces falls in older people: a systematic review and meta-analysis. *Br J Sports Med*. 2016 Jan 8;bjsports-2015-095452.
16. Choi YF, Wong TW, Lau CC. The diagnostic value and cost-effectiveness of creatine kinase-MB, myoglobin and cardiac troponin-T for patients with chest pain emergency department observation ward. *Hong Kong J Emerg Med*. 2004;11(2):85–90.
17. Chan CS, Slaughter SE, Jones CA, Wagg AS. Greater Independence in Activities of Daily Living is Associated with Higher Health-Related Quality of Life Scores in Nursing Home Residents with Dementia. *Healthc Basel Switz*. 2015 Jun 30;3(3):503–18.
18. Resnick B, Galik E, Vigne E, Carew AP. Dissemination and Implementation of Function Focused Care for Assisted Living. *Health Educ Behav Off Publ Soc Public Health Educ*. 2016 Jun;43(3):296–304.
19. Slaughter SE, Wagg AS, Jones CA, Schopflocher D, Ickert C, Bampton E, et al. Mobility of Vulnerable Elders study: effect of the sit-to-stand activity on mobility, function, and quality of life. *J Am Med Dir Assoc*. 2015 Feb;16(2):138–43.
20. de Souto Barreto P, Morley JE, Chodzko-Zajko W, H Pitkala K, Weening-Dijksterhuis E, Rodriguez-Mañas L, et al. Recommendations on Physical Activity and Exercise for Older Adults Living in Long-Term Care Facilities: A Taskforce Report. *J Am Med Dir Assoc*. 2016 May 1;17(5):381–92.

Appendices

Appendix A: Search Strategies

Medical Sub-Heading (MeSH). Some research repositories (e.g., PubMed) will categorize the content of research using a system of identifying terms. One of these categorization schemes is MeSH. CHRSP researchers searched through MeSH terms to identify themes or concepts that related to the ExLTC project. Below is the search string used to search for literature using MeSH terms.

1378 hits ("Activities of Daily Living"[Mesh]) OR "Muscular Atrophy"[Mesh]) OR "Quality of Life"[Mesh]) OR "Accidental Falls"[Mesh]) AND ("Physical Fitness"[Mesh] OR "Motor Activity"[Mesh]) AND ("Review"[Publication Type])

Non-MeSH. While MeSH is a useful tool, there are circumstances where research has been categorized in a way that is not captured by MeSH terms. To compensate for this, CHRSP researchers conducted a more conventional search of PubMed.

1080 hits (exercis*[Title/Abstract] OR fitness*[Title/Abstract] OR swim*[Title/Abstract] OR walk*[Title/Abstract] OR "run"[Title/Abstract] OR "running"[Title/Abstract] OR "jog"[Title/Abstract] OR "jogging"[Title/Abstract] OR calisthen*[Title/Abstract] OR "weight lift"[Title/Abstract] OR "weight lifting"[Title/Abstract] OR yoga*[Title/Abstract] OR stretch*[Title/Abstract] OR "physical activity"[Title/Abstract] OR circuit*[Title/Abstract] OR muscul*[Title/Abstract] OR "resistance training"[Title/Abstract] OR "warm-up"[Title/Abstract]) AND ("activities of daily living"[Title/Abstract] OR brush*[Title/Abstract] OR dress*[Title/Abstract] OR "quality of life"[Title/Abstract] OR toilet*[Title/Abstract] OR independ*[Title/Abstract] OR "falls"[Title/Abstract] OR "fall"[Title/Abstract] OR weak*[Title/Abstract] OR "functional declines"[Title/Abstract] OR "physical activities"[Title/Abstract] OR "physical function"[Title/Abstract] OR "physical functioning"[Title/Abstract] OR "physical capacity"[Title/Abstract] OR "physical capacities"[Title/Abstract] OR "functional status"[Title/Abstract]) AND (frail* OR elder* OR fragil* OR "old age" OR "aging") AND (review[Publication Type])

Grey Literature. Grey literature describes published materials that have not undergone peer-review. Whereas peer-reviewed literature has many large and competing repositories, grey literature is not as well organized. However, the Canadian Centre for Drugs and Technologies in Health (CADTH) allows researchers to access a word document that lists ~140 unique domain names that may contain grey literature. This so-called "Grey Matters" document was designed to allow researchers to track which grey literature repositories they visited. Unfortunately, each website had to be searched individually which was a time-consuming process.

In response, CHRSP researchers used a customizable search engine (through Google) and programmed this search engine to only use these aforementioned ~140 unique domain names. The search engine was programmed to only return results which were file extensions: bmp, doc, docm, docx, dot, dotm, dotx,

emf, gif, jpg, odp, odt, pdf, png, pot, potm, potx, ppa, ppam, pps, ppsm, ppsx, ppt, pptm, or pptx. Sites that would have been searched through the initial PubMed search were excluded from the list of potential sites, in order to reduce overlap in search results.

Because customizable search engines through Google have limits regarding the number of search terms, CHRSP researchers divided the search term into two components.

61 hits ("systematic review") AND (frail | elder | old) AND ("activities of daily living" | "quality of life" | independ | fall | function | physical) AND (exercis | swim | walk | run | jog | weight | yoga | stretch | "tai chi") -obese -COPD -child -cancer

60 hits ("meta-analysis") AND (frail | elder | old) AND ("activities of daily living" | "quality of life" | independ | fall | function | physical) AND (exercis | swim | walk | run | jog | weight | yoga | stretch | "tai chi") -obese -COPD -child -cancer

9 hits (intitle:exercise | intitle:swim | intitle:walk | intitle:weight | intitle:yoga | intitle:stretch | intitle:"tai chi") AND "review"

201 hits ("meta-analysis") AND (frail | elder | old) AND ("activities of daily living" | "quality of life" | independ | fall | function | physical) AND (exercis | swim | walk | run | jog | weight | yoga | stretch | "tai chi")

Additional search strategies. After searching PubMed and Grey Matters, CHRSP researchers used several follow-up search strategies to collect additional information.

Google Scholar: 1400 hits (but only first 1000 were accessible) (intitle:"review" | intitle:"meta-analysis") AND (frail | elderly | geriatric) AND (intitle:exercise | intitle:swim | intitle:walk | intitle:weight | intitle:yoga | intitle:stretch | intitle:"tai chi")

Cochrane Collaboration: 115 hits (frail OR elder OR old) AND ("activities of daily living" OR "quality of life" OR independ OR fall OR function OR physical) AND (exercis OR swim OR walk OR run OR jog OR weight OR yoga OR stretch OR "tai chi") in Title, Abstract, Keywords in Cochrane Reviews'

Appendix B: Contextualization Questions

Contextualization occurred between mid-May 2017 and mid-June 2017 and involved persons from the ExLTC team, as well as different persons considered germane to the overall project. The interview process was semi-structured: several core questions were asked and then the respondent was encouraged to speak about whichever topic they wanted. Due to the varying responsibilities of informants some questions were more highly discussed by some groups than by others.

Questions about the Synthesis

1. Do you have any questions, comments, or concerns about our methods?
2. What are your impressions of the evidence synthesis?
 - a. Do the results match your understanding of the topic?
 - b. Are there any unexpected findings?
 - c. Are we missing any research?
3. Do you have any questions, comments, or concerns about our findings?

Patient-Client Factors

1. How would NL's geography influence the effectiveness of the proposed intervention?
 - a. Does NL's geography offer any unique challenges to introducing and maintain the step training intervention?
2. Are there characteristics of LTC residents in NL that you think might affect the feasibility or effectiveness of step training?

Design or Site of Service Factors

1. What are design or site of service factors that you think might be relevant to step training at nursing homes in NL?
2. Do existing facilities have the space and resources to provide step training services?
 - a. If not, what alternative strategies or ideas might work?

Human Resources Factors

1. What human resources factors might be relevant to step training?
2. How is frailty currently assessed in NL LTC facilities?
3. Are there policy restrictions or requirements on who can deliver a service like step training?
 - a. Is this policy regional or provincial?
 - b. Would nursing staff be qualified and able to lead a step training program?
4. Are there adequate staff to conduct a step training program in most NL LTC facilities? Specifically, are there adequate PTs or OTs to lead a step training session?
 - a. Would PTs or OTs have adequate time to lead step training?
5. I would like to ask you about "buy-in":
 - a. Do you believe allied health personnel will support step training?
 - b. Do you think nurses and doctors would support step training?
 - c. Do you believe that LTC residents and/or their families will support step training?

- d. Other than what I've just mentioned, who else would be needed in order for step training to move forward as an intervention?

Organization of Health Services Factors

1. Are there any organizational factors in health services that will influence the effectiveness or feasibility of step training?
2. Are there any programs in NL currently that are the equivalent of step-training programs?
 - a. What is the program and where is it taking place?
3. To implement step training will there need to be support or permissions from bodies external to LTC facilities?
 - a. If so, who? Should they be included in the contextualization process?

Economic Factors

1. Are there any short-term, medium-term, or long-term economic factors that may influence the feasibility of step training as an intervention?
2. What costs would be associated with step training?
 - a. Human resource cost?
 - b. Equipment cost?
 - c. Activity trade-off cost?
3. Step training describes a range of interventions. Some of these interventions, especially ones delivered individually, require safety harnesses, walking space or treadmills, and monitoring by therapists. In contrast, group-based delivery seems to require only open space and a floor mat. Step training can be delivered to groups or to individuals. Group-based delivery seems to require fewer resources and there does not appear to be safety equipment used. Individual-based delivery seems to require more resources and requires participants wear safety harnesses to prevent falls.
 - a. Is there sufficient *existing* infrastructure at LTC facilities to have group step training program? Specifically, is there adequate space to group people together for group step-training exercises?
 - b. Is there sufficient *existing* infrastructure at LTC facilities to have individualized step training programs? Specifically, treadmills, harnesses to prevent falls when exercising, etc.
 - c. What type of work would be involved in setting up the equipment for your preferred method of step training? Please see articles for examples.

Political Factors

1. Step training interventions only apply to non-frail persons in LTC facilities. Are there any foreseeable issues with not having a corresponding program for frail persons in LTC facilities?