CO-CREATION OF A STRENGTHS-BASED APPROACH TO IMPROVE CARDIOMETABOLIC HEALTH: A COMMUNITY-BASED AND INDIGENOUS LED HEALTHY LIFESTYLE INTERVENTION

by

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Co-Creation of a Strengths-Based Approach to Improve Cardiometabolic Health: A Community-Based and Indigenous Led Healthy Lifestyle Intervention

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Abstract

Background: Finding culturally relevant and safe ways to co-create health and fitness programs that support traditional ways to be physically active are important areas of strengths-based research with Indigenous communities in Canada. Indigenous communities are returning to traditional ways of being active on the land, and colonial perceptions of health and fitness are culturally inappropriate for Indigenous communities. As such, research methodologies should focus on empowering Indigenous community leaders to be the key advocates of health behaviour change within their own communities.

Objectives: This study examined the impact of a community-based and Indigenous led healthy lifestyle intervention designed specifically to improve health-related physical fitness and healthy lifestyle behaviours (reducing sedentary activity time and increasing physical activity levels) in adults (n = 15).

Methodology: In collaboration and consultation with a rural and remote Indigenous community, we co-created a 13-week Indigenous led intervention incorporating individualized western exercise prescriptions and knowledge sharing circles in a group-based walking program. Measures of physical activity and sedentary behaviour (self-report and 7-day accelerometry), predicted maximal aerobic power (VO_2 max; 6-minute walk test), resting heart rate and blood pressure, and other health-related physical fitness measures (musculoskeletal fitness and body composition) were taken pre- and post-intervention.

Results: Significant and clinically relevant improvements in aerobic fitness, resting blood pressure, and resting heart rate were observed. Accelerometry-measured moderate-to-vigorous intensity physical activity minutes were above international recommendations (~275 min/week), and sedentary activity time in bouts of >60 min reduced significantly post-intervention. No significant changes were observed in weight, body mass index, waist circumference, percentage body fat, grip strength, and flexibility.

Conclusion: This work demonstrates how an Indigenous designed and led, community-based healthy lifestyle intervention can provide a culturally relevant strategy to increase health-related physical fitness, increase physical activity participation, and reduce sedentary behaviours.
Lay Summary

Indigenous communities in Canada are returning to traditional ways of being active on the land. Research shows that Indigenous led and culturally appropriate initiatives have a strong potential for eliciting positive health and wellness change. Building on past research, we created a wholistic healthy lifestyle program designed by and for adults living in a rural and remote Indigenous community. This 13-week study evaluated whether a community-based and Indigenous led program can improve health-related physical fitness and physical activity and sedentary behaviours among 15 adults. Unique to this program, participants used individualized exercise prescriptions in walking groups, and talked about healthy lifestyle behaviours in knowledge sharing circles. After the program, participants showed increased aerobic fitness, lowered resting heart rate, and lowered resting blood pressure. Additionally, participants demonstrated improved physical activity behaviour and reduced sedentary behaviour after the program. The findings show that a community-based and Indigenous led approach is a meaningful and beneficial method to improve health-related physical fitness and lifestyle behaviours among Indigenous adults.
Preface

Henry P. H. Lai was the primary author of this manuscript, collected data, and created the related thesis chapters. All analysis of data collected during the intervention was conducted by Henry Lai. Co-creation responses collected in the planning of the intervention were compiled for analysis by Jonathan Aitken. This project was a part of a larger series of studies conceptualized by Dr. Darren Warburton, funded by the Canadian Institutes of Health Research (grant number CIHR IA5-156528) and the Natural Sciences and Engineering Research Council of Canada (grant number NSERC RGPIN-2018-04613). Co-investigators and collaborators include Drs. Hare, Bredin, Miles, Norman, Rhodes, and Oh.

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This thesis investigation was overseen by the research committee: Dr. Warburton (Cardiovascular Physiology and Rehabilitation Laboratory; Indigenous Studies in Kinesiology), Dr. Bredin (Cognitive and Motor Learning Laboratory, Laboratory for Knowledge Mobilization; Indigenous Studies in Kinesiology), Dr. Miles (Indigenous Physical Activity and Cultural Circle; Lytton First Nation community champion; Indigenous Studies in Kinesiology), and Dr. McKenzie (Allan McGavin Exercise Physiology Laboratory). Ethics approval for this study was obtained from the UBC Clinical Research Ethics Board (Certificate H07-03187; entitled “Indigenous Community Based Health and Wellness Intervention”) and the UBC Behavioural Research Ethics Board (Certificate H18-00674; entitled “Indigenous Community Based Healthy Lifestyle Intervention”).
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To friendships and comraderies
Chapter 1. Introduction

This chapter provides an overview of current best practices in physical activity promotion and cardiometabolic disease prevention research with Indigenous communities in Canada, highlighting the rationale behind the design, implementation, and evaluation of culturally safe research methodologies. Specific aims and hypotheses are addressed in this chapter.

1.1 Introduction and Rationale

Indigenous communities are returning to traditional ways of being active on the land. As such, finding culturally relevant and safe ways to co-create health and fitness programs that support traditional ways to be physically active are important areas of strengths-based research with Indigenous communities in Canada. In particular, improving the cardiometabolic health of Indigenous peoples continues to be an important area of research. Cardiometabolic health is a broad classification of risk factors associated with metabolic syndrome including hypertension, elevated central adiposity, high blood triglycerides, high fasting blood glucose levels, and reduced high density lipoprotein levels (1). These modifiable risk factors contribute to chronic conditions such as type 2 diabetes and cardiovascular disease, and evidence has demonstrated a greater prevalence for select chronic conditions amongst Indigenous adults living in Canada (due to the impacts of colonization) in comparison to Canadians of European descent (2). However, the notions of risks, diseases and illnesses are colonial perspectives, which do not reflect the Indigenous perspectives of health and wellbeing. Despite these differences, culturally safe efforts should be made to unite (not separate) these two worldviews in building toward the common goal of achieving health and wellbeing for humanity.
This thesis investigation aimed to make a meaningful and culturally safe contribution to improve the cardiometabolic health of Indigenous peoples. The primary author of this thesis investigation is of non-Indigenous Canadian heritage, and is conducting this research project as an Ally of Indigenous peoples. All aspects of this thesis investigation were conducted under the guidance of Indigenous Elders and cultural competency experts from Lytton First Nation and the University of British Columbia.

Currently, there is strong evidence demonstrating the cardiometabolic-related benefits of increasing moderate-to-vigorous intensity physical activity (MVPA) (3) and reducing sedentary activity time (4). However, while current physical activity guidelines have been at the forefront of chronic disease management and prevention for nearly a decade, the usage and effectiveness of these generic guidelines within Indigenous communities are greatly limited due to their lack of cultural relevance and strengths-based approaches (5). In the context of doing physical activity research with Indigenous communities, generic guidelines are ineffective because their one-size-fits-all approach is incompatible with the diverse Indigenous community ways of teaching and learning. As advocated by leading experts in this field (5), further research is warranted to fill knowledge gaps in cultural safety research with Indigenous communities.

Despite the overwhelming amount of evidence in support of the health-related benefits of routine physical activity and/or exercise participation (6), these evidence-based strategies often employ a deficits-based approach that is culturally unsafe for Indigenous communities (5,7). A deficits-based approach addresses cardiometabolic health from the perspectives of diseases, risks, and illnesses as societal problems in which the solutions often include the prescription of generic physical activity guidelines for the community. For
instance, generic guidelines often include threshold-based recommendations stating that health benefits can only be gained by engaging in a specific volume and intensity of physical activity (5,7,8) and disregard current traditional physical activities that are successfully led with Indigenous leaders for Indigenous community members. Threshold-based messaging not only creates additional barriers to physical activity participation, but it often places emphasis on the individual, rather than the wellbeing of the community or family (5,9). Furthermore, western deficits-based interventions often emphasize the physical aspects of wellbeing (using conventional approaches in biomedicine), instead of integrating multi-factorial approaches that promote wholistic wellbeing (e.g., balancing spiritual, mental, emotional, and physical wellbeing) (5,9). Collectively, these western deficits-based approaches pose numerous cultural challenges in research with Indigenous communities because they undermine the family-oriented and wholistic perspectives of teaching and learning valued by diverse Indigenous communities in Canada (5,10). As such, culturally safe and relevant prevention models that target wholistic healthy lifestyle behaviours in Indigenous communities are warranted, because a one-size-fits-all (deficits-based) approach should not be applied within Indigenous communities (5) for it also ignores the impacts of colonization.

In contrast, a strengths-based approach focuses on the aspirations, goals, and assets unique to a community, and ensures that all aspects of the research are designed by and for, and led by Indigenous community members (11). This process ensures that research with Indigenous communities acknowledges, accommodates and draws upon the cultural, historical, and traditional perspectives of teaching and learning reflective of local teachings (12,13). Furthermore, these perspectives align with the current standards of culturally safe
research practices established by the Canadian Institutes of Health Research (14), and respond to the 94 Calls to Action created by the Truth and Reconciliation Commission of Canada to redress the legacy of Indian residential schools and advance the process of Canadian reconciliation with Indigenous communities (15). The Calls to Action were created in part to address the intersectionality of inequality and discrimination compounded by a myriad of factors related to the social determinants of Indigenous health and wellness (15).

A strengths-based approach is a culturally safe and appropriate strategy to address cardiometabolic health in Indigenous communities, as it recognizes and empowers the self-determination in Indigenous community leaders to be the key advocates of health behaviour change within their own community (5). As such, culturally safe physical activity promotion and cardiometabolic disease prevention research with Indigenous communities must use a strengths-based approach. As defined by the Canadian Institutes of Health Research (14), a strengths-based approach involves methodologies that are conducted by, grounded in, or engaged with, Indigenous communities pertaining to their wisdoms and perspectives of teaching and learning, such as the facilitation of knowledge sharing circles.

Sharing circles are a culturally familiar way of talking in a group setting allowing for the accommodation of Indigenous oral history and storytelling traditions unique to Indigenous communities in Canada (16,17), and are established cultural practices that create comfort and trust among participants and with the researcher (18). Through knowledge sharing circles, evidence-based best practices and Indigenous perspectives of health and wellbeing can be shared and integrated in a culturally safe manner that is consistent with the “Two-Eyed Seeing” approach commonly observed in participatory action research with
Indigenous communities (19). The “Two-Eyed Seeing” approach (e.g., reciprocal sharing of traditional Indigenous knowledge and western worldviews) can facilitate culturally relevant co-creation activities leading to the design of a healthy lifestyle intervention that fully reflects the aspirations unique to the community. These strengths-based methodologies reflect a community-based and Indigenous led approach wherein all aspects of the research are overseen and facilitated by Indigenous community members. Transferring ownership of research in this capacity empowers the self-determination in Indigenous peoples to facilitate hope and promote positive changes within their own community using strategies that resonate with their way of life.

Community-based and Indigenous led health and wellness approaches have been widely advocated by and for Indigenous peoples. However, remarkably few Indigenous designed and led interventions exist within the field, especially within rural and remote geographies. There is growing evidence supporting the need for culturally relevant and safe interventions within Indigenous communities to promote the cardiometabolic benefits of routine physical activity participation and related healthy lifestyle behaviours including sedentary behaviours (4,20-22). Unfortunately, relatively few investigations have been conducted within Indigenous communities that consider the aspirations of the community and/or include Indigenous leaders in the design and implementation of the intervention (10).

To address this knowledge gap, we co-created a 13-week healthy lifestyle intervention in collaboration and consultation with Indigenous community leaders living in Lytton First Nation, British Columbia, Canada. Situated in the interior of British Columbia northeast of the city of Vancouver, Lytton First Nation is a rural and remote Indigenous community that
is located on 14,161 acres divided into 56 reserves that are scattered along a 100 km radius on both sides of the Fraser Canyon (23).

In consultation and collaboration with Lytton First Nation, we implemented a 13-week walking and healthy lifestyle counselling program including exercise prescriptions designed specifically to improve cardiorespiratory fitness (24). Unique to this program, our healthy lifestyle intervention was created in partnership with Indigenous Elders and community members as a family-oriented and community-based activity, and implemented in a sharing circle format that is consistent with the Indigenous ways of teaching and learning in Canada (25,26). Through these sharing circles, our team was able to co-create a healthy living intervention that built upon the strengths and aspirations of Lytton First Nation community. Integrating the strengths identified by Indigenous communities with current best practices in physical activity promotion and clinical exercise rehabilitation, we co-created an integrated walking and lifestyle counselling program entitled: “With Every Step, We Grow Stronger” (27).

1.2 Aims

We aimed to:

1) Assess the impact of a community-based and Indigenous led approach in improving health-related physical fitness measures in Indigenous adults living in a rural and remote community.

2) Assess whether the changes in health-related physical fitness demonstrate a dose-response relationship between physical activity and baseline health status.
3) Assess the impact of a community-based and Indigenous led approach in reducing sedentary activity time in Indigenous adults living in a rural and remote community.

4) Assess the correlation between changes in MVPA and sedentary activity time.

1.3 Hypotheses

We hypothesized that:

1) Participants would exhibit significant and clinically relevant improvements in health-related physical fitness measures.

2) The greatest relative changes in health markers would be seen in those with the lowest physical activity and/or fitness levels at baseline.

3) Participants would exhibit significant reductions in sedentary activity time.

4) The greatest reductions in sedentary activity time would be seen in those exhibiting the greatest increase in MVPA time.
Chapter 2. Review of the Literature

The purpose of this chapter is to provide an overview of the current trends in cardiometabolic-related health status among Indigenous adults living in Canada, draw upon key examples of community-based and Indigenous led research, and identify relevant knowledge gaps to justify the methodology co-created in this thesis investigation.

2.1 Background and Terminology

The name “Aboriginal peoples” was originally chosen by the government to represent the original inhabitants of North America and their descendants. Currently, “Indigenous peoples” is the internationally recognized name. Section 35 of the Canadian Constitution Act recognizes three historically and culturally distinct groups of Indigenous peoples: Indian (First Nations), Métis, and Inuit. In consultation with cultural competency experts, this paper will use the culturally safe terms “Indigenous” instead of “Aboriginal” and “First Nations” instead of “Indian.” These terminologies are created to recognize (not define) the diverse cultural, traditional, and historical perspectives unique to each and every community. It is always important to engage in respectful and culturally safe dialogue with Indigenous communities to acknowledge how each community wishes to self-identify.

2.2 Cardiometabolic Health Status in Canadian Indigenous Populations

The research evidence presented in this chapter contains western notions of health. As such, these topics need to be carefully managed and communicated for cultural sensitivity. This thesis investigation builds upon all worldviews using strengths-based approaches.
2.2.1 Cardiorespiratory Fitness

Cardiorespiratory fitness (also referred to as aerobic capacity, maximal aerobic power (VO\textsubscript{2 max}), or maximal oxygen consumption) is a strong predictor of cardiometabolic health, premature mortality, and overall quality of life (28-30). For instance, a level of cardiorespiratory fitness that falls below a threshold for functional dependence predicts an individual’s inability to perform activities of daily living (3). Losing the capacity to perform activities of daily living leads to worsening of musculoskeletal fitness (e.g., sarcopenia), which leads to further physical inactivity and the perpetuation of this vicious cycle of functional dependence. As such, physical activity reflects an individual’s cardiorespiratory fitness, which can be used to predict cardiometabolic health.

Furthermore, there is evidence demonstrating that cardiorespiratory fitness is also declining amongst Indigenous adults living in Canada (31). However, with respect to changes in cardiorespiratory fitness over time, current evidence is only available regarding Inuit populations in Canada, as there is a lack of available literature among other Indigenous populations in Canada (First Nations and Métis) and in the United States (American Indian and Alaskan Native populations). Amongst Inuit populations, cardiorespiratory fitness has declined from approximately 51 mL/kg/min in 1970 to 38 mL/kg/min in 2000. This systematic review and meta-analysis (of 32 investigations involving 10,579 individuals) also revealed that Indigenous peoples who experienced metabolic syndrome had significantly lower maximal cardiorespiratory fitness by mass relative to Indigenous peoples with no metabolic syndrome (31). Consistent with sources from other literature (3,6,11,32), it was concluded that lower cardiorespiratory fitness was associated with obesity, metabolic syndrome, and a western lifestyle (due to the impacts of
colonization) among Indigenous adults in North America (31). As lower cardiorespiratory fitness is associated with an increased risk for several chronic medical conditions and premature mortality (3), improving cardiorespiratory fitness is an appropriate health promotion and chronic disease prevention strategy.

2.2.2 Obesity and Metabolic Syndrome

Physical activity interventions should focus on reducing obesity and metabolic syndrome. Indigenous peoples have frequently been shown to be at an increased risk for overweight, obesity, and cardiometabolic conditions (such as heart disease and diabetes) (31-35). In British Columbia, it has been demonstrated that the prevalence of overweight, obesity, and abdominal obesity was 29.4, 48.6, and 65.1%, respectively in Indigenous men and women (34). Both obesity and abdominal obesity were significantly greater in rural (e.g., Northern and Interior) regions of British Columbia in comparison to more urban centres. It is important to support traditional ways to be physically active to improve cardiorespiratory fitness and manage the prevention and reduction of chronic diseases prevalent in Indigenous communities (36).

2.2.3 Health-Related Benefits of Physical Activity: The Evidence

The health-related benefits of routine physical activity are well established for the general population and those living with chronic medical conditions (37). Current international guidelines recommend participating in 150 min (or 30 min/day) of MVPA in bouts of 10 min or greater (38,39). This dose and intensity of physical activity have been shown to elicit clinically relevant improvements in cardiometabolic health status. For
instance, in a population cohort study, this beneficial threshold was observed when individuals engaged in approximately 3 to 5 times the recommended leisure time physical activity minimum, and no excess risk was observed at 10 or more times the minimum recommended time for physical activity (40). There is strong evidence demonstrating the dose-response relationship between physical activity and health status, such that further increases in physical activity beyond the recommended dosage and intensity can generate greater improvements in health-related benefits (e.g., “more is better”).

However, more recent evidence has challenged this threshold-based messaging, arguing that health-related benefits can still be accrued from adhering to physical activity guidelines that are well below current recommendations. For instance, Hupin and colleagues showed that even a small dose of MVPA below the current recommendations (e.g., 15 min/day) could reduce mortality in older adults by 22% (29). The evidence shows that clinically relevant improvements in health-related benefits can still be gained from doing as little as half the recommended daily dose of physical activity. This claim is supported by a recent systematic review of current systematic reviews (16 systematic reviews and/or meta-analyses involving millions of participants and diverse clinical outcomes) (6), and by the American College of Sports Medicine in the most recent position stand (41). The evidence is undeniable in that there is no clear threshold for benefits in the dose-response (curvilinear) relationship between physical activity and health status (6-8). As such, the evidence points to a current shift in the way physical activity participation is promoted (e.g., away from threshold-based messaging). This shift towards strengths-based health promotion advocates for the evidence-based knowledge translation messaging that “every little bit of activity counts” (6).
The evidence demonstrates a clear need to design, implement, and evaluate culturally safe methodologies to promote and increase physical activity participation with Indigenous communities in Canada. In particular, designing culturally safe methods to improve cardiometabolic health is an important area of physical activity research with Indigenous communities, and has been advocated by numerous organizations including the Canadian Institutes of Health Research (14) and the Truth and Reconciliation Commission of Canada (15). While current evidence clearly supports the health-related benefits of routine physical activity participation (6), it is often translated using threshold-based messaging that recommends meeting 150 minutes of MVPA per week. Because many public health agencies have translated these recommendations to indicate that this volume of activity is the minimum required to gain health benefits (6), this mistranslation can create enormous barriers to physical activity participation. These barriers to physical activity participation can be removed simply by changing the way the message is shared with Indigenous communities. Effective physical activity promotion requires culturally safe knowledge translation methodologies.

2.2.4 Physical Activity and Sedentary Behaviours

Current evidence has shown that physical activity levels are declining in Indigenous populations in both Canada and the United States over the last 50 years (42). In this systematic review, Foulds and colleagues revealed that adults reported lower activity levels since 2000 (in comparison to 1990s), and that relatively few adults met international physical activity guidelines (23% via self-report; 9% via accelerometry). Additionally, findings from the recent National Report of the First Nations Regional Health Survey
(Phase 3: Volume 2) revealed that 56.6% of First Nations adults (12,137 of 282,129 individuals on-reserve or on Crown land) were considered inactive at an energy expenditure <1.5 metabolic equivalents (43). The evidence shows that due to the impacts of colonization, Indigenous adults are not sufficiently active, and more culturally safe work needs to be done in support of traditional ways to be more physically active (42).

The relationship between sedentary behaviour and cardiometabolic disease risk is also highlighted in the literature (4,20,22). Sedentary behaviour is defined as an energy expenditure of <1.5 metabolic equivalents spent in a reclined posture or during sitting-related activities, and is correlated to greater prevalence of obesity, diabetes, and physical inactivity through decreased energy expenditure (22). In fact, one meta-analysis (involving 21,393 participants over 10 studies) demonstrated enhanced odds ratio of having metabolic syndrome if individuals spent more time in sedentary behaviours (4).

Furthermore, there is growing evidence in support of physical activity and sedentary behaviour as independent variables of cardiometabolic disease risk (4,20-22). The evidence shows that even physically active individuals can exhibit high amounts of sedentary activity time. For instance, individuals who engaged in at least 30 minutes of MVPA on five or more days still exhibited high sitting time (21). Additionally, in a wellness study, cross-tabulating sitting time, physical activity, and wellness revealed significant differences (with large effect sizes) in total wellness among adults who self-reported sufficient/insufficient physical activity and high/low amount of sitting (21).

It is clear that cardiometabolic-related benefits can be gained from reducing sedentary behaviours and increasing physical activity participation. However, it is unclear whether reducing sedentary behaviour or increasing physical activity participation has a stronger
association with cardiometabolic disease prevention. Nevertheless, current evidence recommends that both healthy lifestyle behaviours are equally important.

Reducing screen time behaviour has been an active area of cardiometabolic disease prevention research over the past decade (44). While it is still unclear whether reducing MVPA or increasing screen time has a stronger association with overweight and obesity, there is preliminary evidence demonstrating that high screen time is more consistently and more strongly associated than physical activity with cardiometabolic health (e.g., overweight and obesity) (45) and self-reported quality of life (46). The evidence indicates that reducing screen time behaviour is pertinent in cardiometabolic disease prevention, as reducing screen time has been shown to improve cardiometabolic health independent of physical activity levels (47,48).

As such, community-based healthy living interventions could focus on improving select sedentary behaviours such as reducing screen time. These are relevant strategies to share with Indigenous communities. As highlighted in the National Report of the First Nations Regional Health Survey (43), approximately 51.1% of Indigenous adults (45–64 years of age) from 253 communities in Canada spent four or more hours of sedentary time per day. There is also a significant difference between sedentary activity time between groups (e.g., nearly six in ten adults ages 18–24 spent four or more hours of sedentary time compared to roughly five in ten adults ages 45–64) (43). These statistics are consistent with findings from the literature. For instance, Foulds and colleagues (49) demonstrated a greater prevalence of overweight and obesity among Indigenous adults living in British Columbia, and a convenience sampling later revealed that there was a greater prevalence of select chronic conditions among this population in comparison to European adults (2). The
convenience sampling revealed that Indigenous adults living in British Columbia (men and women; at every age and geographic region within the province) were found to have high rates of low high density lipoprotein (>33%), physical inactivity (>31%), hypertension (>16%), and ethnic-specifically defined abdominal obesity (>33%) (2). These findings indicate an increased risk of metabolic syndrome in Indigenous adults living in British Columbia. Foulds and colleagues (50) later conducted a systematic review and meta-analysis revealing the rise in screen time behaviour (>3.5 hours/day) among North American Indigenous populations, concluding that individuals who were obese/overweight reported greater screen time.

The statistics and evidence-based recommendations advocate for the need to design culturally safe healthy living interventions that are wholistic in nature. The growing relevance of sedentary behaviours in cardiometabolic disease prevention programs further highlights the importance of using strengths-based approaches and eliminating generic physical activity guidelines altogether. Using a strengths-based approach, the knowledge translation of “every little bit of activity counts” (6) becomes a more powerful and empowering slogan because it promotes the health-related benefits of routine physical activity participation below current recommendations. Since health-related benefits can be gained from doing as little as half the recommended amount of physical activity, effective knowledge translation can motivate previously sedentary individuals to do small amounts of physical activity, and reduce barriers created by threshold-based messaging that might otherwise hinder individuals living with functional limitations from achieving and/or maintaining an active lifestyle (3).
2.3 Community-Based Physical Activity Interventions

A recent systematic review identified five interventional studies (since 1999) that evaluated the impact of physical activity on cardiometabolic health-related outcomes in Indigenous adults living in Canada (11). While community consultation was reported in all five studies, the authors concluded that enhancing the cultural relevance of intervention design could elicit greater positive health outcomes.

For instance, in a diabetes management program conducted by Daniel and colleagues (51), the authors concluded that the program was ineffective despite efforts in community engagement. For instance, Indigenous health workers were hired and trained to facilitate interviews with community members in the planning of a 16-month physical activity and behaviour change intervention. The goal was to identify community-specific needs, perceptions of diabetes, and culturally relevant intervention strategies. Indigenous health workers participated in a training course on group dynamics, participant observation, and interviewing techniques. However, it was noted that hiring and training Indigenous health workers using colonial approaches were ineffective strategies. Intervention strategies related more to the western notions of “health professional culture” (e.g., western approaches such as exercise classes, supermarket and restaurant tours, forums on diabetes) rather than focusing on traditional ways of teaching and learning (e.g., traditional activities such as berry picking, hunting, gathering). The authors concluded that the ineffectiveness of the intervention stemmed from the lack of several factors including the integration of Indigenous and western perspectives of health, emphasis on empowering an Indigenous led approach, and establishment of a community consensus on priorities (51). In this example, community consultation was present but lacked cultural relevance.
In a similar diabetes management intervention conducted by Heffernan and colleagues (52), it can be seen that a community-based approach can be effective when it is more culturally relevant to the Indigenous community. Similar to the group interviews conducted by Daniel and colleagues (51), Heffernan and colleagues (52) chose to use focus groups as a method of community consultation. Focus groups were chosen as the method of community engagement because of its cultural relevance to the oral traditions of teaching and learning unique to the partner community. However, in contrast to the interview groups (51), these focus groups were more family-oriented and inclusive of diverse community members including individuals living with (and without) diabetes, Elders, political leaders, artists, health care workers, and social workers (52). In addition, focus group moderators were local village residents (in the study conducted by Daniel et al. (51)), it is not known whether or not the hired Indigenous health workers were local residents). This level of community engagement demonstrated the effectiveness of an Indigenous design and led approach (52). In fact, the Indigenous led approach empowered the community to create culturally relevant intervention activities. For instance, exercise programs integrated traditional activities including trials of traditional herbal medicine (e.g., medicine based on lily root prepared by a traditional healer from the community), and a modified traditional diet (participants were empowered to gather and use their own food supplies such as berries) (52). Strong adherence to these community-designed activities led to improvements in cardiometabolic health, including a significant decrease in total cholesterol and significant increase in high density lipoprotein.

In contrast to the outcomes observed in the study conducted by Daniel and colleagues (51), the clinically relevant improvements in cardiometabolic risk factors observed in the
study by Heffernan and colleagues (52) provide a strengths-based example demonstrating the importance of designing culturally relevant intervention activities with the community. The health-related benefits of physical activity are undeniable (6), but achieving these benefits in community-based research requires culturally safe methodologies that involve extensive collaboration and consultation. Culturally irrelevant, inappropriate, and/or unsafe research methodologies can create barriers to physical activity participation and render research interventions ineffective.

Observations from the study conducted by Gray-Donald et al. (53) provide another example regarding the importance of creating culturally relevant research methodologies. In this study (53), two research nutritionists (not from the community) received “training in cultural beliefs,” developed and adapted local teachings, and worked with a team of health care workers to facilitate a 10-month physical activity intervention in prenatal services. Despite living and working in the communities with integrated roles as research nutritionists, the use of western generic guidelines and methodologies alone (e.g., counselling activities via radio broadcasts, pamphlets, supermarket tours, and cooking demonstrations) were culturally irrelevant to the community, resulting in low levels of involvement and participation in community-based events during the intervention.

Culturally safe community-based events are essential for success in research with Indigenous communities because they can create comfort and trust among participants and with the researcher, and stimulate enthusiasm and interest in research-related activities (18). As reported by Heffernan et al. (52), the enthusiasm and interest generated from participating in culturally relevant activities even led to the spontaneous creation of health and wellness projects within the community not part of the intervention. These examples
highlight the importance of culturally relevant community engagement practices. Specifically, research methodologies need to draw from Indigenous perspectives of teaching and learning, which involve strong engagement with members who live within those communities. This knowledge gap has been highlighted by several sources in the literature for over a decade, and has not been adequately addressed by robust, validated, strengths-based research (6,11,13,19,36,54).

The most recent community-based and Indigenous led interventional study by Foulds et al. (36) addressed an element of this longstanding knowledge gap. Foulds and colleagues (36) demonstrated the cardiometabolic benefits of a community-based physical activity intervention in which activities were led by Indigenous community members (centered around Elders). To date, this study is the largest physical activity intervention investigating cardiometabolic health-related measures with Indigenous adults living in Canada (involving 273 research participants from 21 Indigenous communities in British Columbia, Canada). The cardiometabolic health-related outcomes in this 13-week intervention included significant improvements in waist circumference, total cholesterol, and systolic blood pressure (36). In contrast to previous studies identified in the systematic review (11), the novelty of the study conducted by Foulds and colleagues was the choice to participate in group physical activity of self-selected intensity (e.g., walking, walking/running, running). Empowering the choice to self-select physical activity intensity differed from the western deficits-based approach of assigning generic walking groups. This strengths-based approach focused on building the innate strengths of individuals to train within their limits with support from community members (5,925 individuals participated in the physical activity sessions). A follow-up study conducted in a thesis
investigation (involving a 13-week Indigenous led training program entitled "Aboriginal Run Walk") reproduced similar cardiometabolic health improvements among 87 participants from 6 communities in British Columbia (55).

The strengths-based approaches demonstrated in the studies by Heffernan et al. (52), Foulds et al. (36), and de Faye (55) showed the importance of designing and implementing culturally safe methodologies in all research with Indigenous communities. Culturally safe research respects and honors the traditional, cultural, and historical perspectives of teaching and learning unique to each community, and are mandatory because they create comfort and trust among participants and with the researcher (18). For instance, in the study conducted by Ho et al. (56), failure to integrate a community's built environmental factors into the design and implementation of a 9-month physical activity intervention was concluded to be a possible reason to explain low physical activity adherence. In contrast, by integrating the strengths of each community into the research design, Foulds et al. (36) and de Faye (55) demonstrated that a 13-week intervention was sufficient to show marked improvements in cardiometabolic-related health outcomes. Collectively, these studies demonstrated the cultural relevance of a community-based and Indigenous led approach in intervention design. While community-based intervention designs are community-specific, one similarity is that they transfer ownership of all research activities to Indigenous community members, and empower self-determination in Indigenous community leaders to be the key advocates of health behaviour change within their own community (5).

Among the studies evaluated in this literature review, it is evident that the interventions that empowered an Indigenous led approach and a family-oriented perspective of teaching and learning had the greatest success in eliciting positive
cardiometabolic health-related outcomes. To date, limited studies have directly examined the cardiometabolic benefits of an Indigenous led and community-based physical activity intervention conducted within an Indigenous community (11). Furthermore, while previous studies have focused extensively on evaluating directly measured indices of cardiometabolic-related risk factors for metabolic syndrome (e.g., central adiposity, hypertension, blood triglycerides levels, high density lipoprotein levels, and glycosylated hemoglobin in fasting blood glucose levels), the invasive protocol of blood sampling has been perceived as a colonial approach. Additionally, assessing risk factors through blood sampling is a western deficits-based perspective of health, which is incompatible with the Indigenous perspectives of wholistic health and wellbeing (5,9,10). As such, assessing cardiometabolic health using methods involving blood sampling may be culturally unsafe.

Building on previous research, it is important to explore new strengths-based methodologies to assess cardiometabolic health (e.g., predicting cardiorespiratory fitness via short, submaximal fitness tests such as the 6-minute walk test (57)).

There is clear evidence demonstrating the impact and relevance of culturally safe community consultation in physical activity research with Indigenous communities. Regardless of the irrefutable evidence underlying the health-related benefits of routine physical activity participation (6), culturally irrelevant research methodologies (e.g., western generic exercise prescriptions) greatly limit the usage and effectiveness of evidence-based guidelines. While these guidelines have been at the forefront of evidence-based best practice in primary and secondary (e.g., clinical exercise rehabilitation) prevention settings, a one-size-fits-all principle is not community-specific and ignores the impacts of colonization (5). As such, these guidelines must be modified (or eliminated...
altogether) to draw upon the traditional, historical, and cultural perspectives of health and wellbeing reflective of local teachings. Doing so ensures that all aspects of the research are conducted by, grounded in, or engaged with, Indigenous communities pertaining to their wisdoms and perspectives of teaching and learning (14). Conclusive remarks articulated by all authors in the systematic review (11) provide evidence for these claims.

2.4 Implications for Cultural Safety Research

2.4.1 Culturally Safe Knowledge Translation Strategies

While generic physical activity guidelines have been established as a benchmark to obtain optimal health benefits, evidence shows that a one-size-fits-all approach is neither culturally relevant nor safe in any research with Indigenous communities (5,6). Generic guidelines need to be modified or eliminated altogether in support of traditional ways of teaching and learning (5). Knowledge translation activities provide one platform to create community-specific plans from generic guidelines. Facilitating knowledge translation activities in sharing circles is one approach to learn with (and about) the community.

As defined by the Canadian Institutes of Health Research (14), knowledge translation is “a dynamic and iterative process that includes synthesis, dissemination, exchange and ethically-sound application of knowledge to improve the health of Canadians, provide more effective health services and products and strengthen the health care system.” As critiqued by the systematic review (11), evidence-based knowledge needs to be shared and harmonized using culturally relevant and safe strategies. As advocated by leading experts in this field (5,11,36), these strategies need to use a community-based and Indigenous led approach to empower self-determination. As such, we propose a modified definition of
knowledge translation (the co-creation, sharing, and culturally-safe application of knowledge) to reflect a strengths-based perspective of knowledge sharing in support of traditional ways of teaching and learning.

2.4.2 Co-Creation in Knowledge Sharing Circles

Sharing circles are a culturally familiar way of talking in a group setting allowing for the accommodation of Indigenous oral history and storytelling traditions unique to the community (16,17). Their significance for Indigenous peoples is that talking and listening to one another is the desired interaction. Equally important is that sharing circles are an established cultural practice that create comfort and trust among participants and with the researcher (18). This method is similar to focus groups in qualitative research, but emphasize participants sharing stories with one another in relation to questions asked to the group (58). Through sharing circles, researchers and community members can engage in culturally safe knowledge translation activities and enable the reciprocal sharing of knowledge from different worldviews.

In addition to knowledge sharing, the sharing circle format can be used to facilitate other culturally safe knowledge translation activities including co-creation. Co-creation is the “act of collective creativity” (p. 6) involving two or more people (59). Co-creation falls within the general scope of participatory action research, but differs from conventional qualitative research methodologies such as focus groups, semi-structured interviews, and surveys in several ways (59,60). A distinction between co-creation and conventional qualitative research is that co-creation is activity-based. For instance, co-creation involves the facilitation of a creative group activity (e.g., sharing ideas through dialogue and
recording ideas on a poster) that enables researchers to gain insight on the participants’ beliefs, values, and perceptions of a topic in question (in contrast to a systematic interview involving a question-and-answer approach as demonstrated by Daniel et al. (51)). These open-ended, creative activities provide an inclusive sharing space for participants to connect different ways of knowing, which is a knowledge sharing method consistent with the “Two-Eyed Seeing” approach commonly observed in community-based research (19,61). Creating an inclusive sharing space is a culturally relevant aspect in co-creation activities because such a learning environment respects the knowledge of the participants and includes participants in the design and planning process analogous to that of a participatory action approach (61). Enabling participants to freely explore a focused activity related to a specific area of inquiry allows for the integration of novel concepts that may not surface in conventional qualitative research methodologies. As such, co-creation activities have the potential to modify generic guidelines in a culturally safe manner, and contribute to a community-based and strengths-based intervention design.
Chapter 3. Thesis Investigation

This chapter describes a novel approach in physical activity promotion and cardiometabolic disease prevention research with a rural and remote Indigenous community in British Columbia. Methodologies and results are described in this chapter.

3.1 Introduction

Finding culturally relevant and safe ways to increase physical activity and reduce time spent in sedentary behaviours is an important area of health and wellness research with Indigenous communities in Canada. There is strong evidence revealing the decline in physical activity participation and the rise in sedentary activity time among Indigenous adults living in Canada, consistent with findings in the recent National Report of the First Nations Regional Health Survey (Phase 3: Volume 2) (43). For over two decades, these surveys have reflected the voices and aspirations of Indigenous communities from across Canada, expressing their desires to achieve and maintain wholistic health and wellbeing through the Indigenous ways of teaching and learning. Current best practices in cultural safety research with Indigenous communities respect and honour all Indigenous perspectives, and key examples from the literature have demonstrated that the foundation of cultural safety research requires a community-based and Indigenous led approach.

3.2 Methodology

Prior to the intervention, a co-creation activity was conducted within a knowledge sharing circle to identify the health and wellness aspirations of the community and to
design a culturally relevant approach to implement a 13-week healthy lifestyle intervention. Baseline assessments were conducted prior to the start of the intervention. Once per week during the intervention, Indigenous community leaders facilitated one group-based walking activity followed by one knowledge sharing circle. Health and fitness assessments were conducted at the end of the program. All findings were reported back to the community prior to the defence and submission of this thesis, including all previous publications and conference presentations.

3.2.1 Participants: Eligibility and Exclusion Criteria

Community members from Lytton First Nation (aged 19 yr and older) with self-reported Indigenous ancestry (First Nation, Inuit, and Métis) were invited to participate in a 13-week walking and healthy lifestyle counselling program. All participants completed written informed consent. Consented participants completed the evidence-based Physical Activity and Readiness Questionnaire for Everyone (PAR-Q+), which is a self-screening tool that is used extensively in Canada and worldwide (62). On the PAR-Q+, participants answered 7 evidence-based questions regarding their current health status. Answering “No” to all 7 questions indicated that the individual was free of chronic medical conditions, and would receive unrestricted clearance for physical activity participation. Answering “Yes” to 1 or more questions required the completion of additional questions and potential further medical screening by qualified exercise and/or healthcare professionals. A total of 20 healthy adults (free of chronic medical conditions) were self-screened to participate in the program. All aspects of the program were facilitated by local community leaders, which included Lytton First Nation Band members, restorative justice workers, qualified exercise
professionals, and community nurses. The study was approved by the Clinical and Behavioural Research Ethics Board of the University of British Columbia, and the study adhered to the guidelines established by the Declaration of Helsinki.

3.2.2 Cultural Safety Protocols

All aspects of this study were designed and implemented in consultation and collaboration with Lytton First Nation. Research with Lytton First Nation adhered to the cultural safety guidelines established by the Canadian Institutes of Health Research (14), UBC Tri-Council Policy Statement-2, and National Aboriginal Health Organization’s OCAP® Principles (Ownership, Control, Access and Possession of research data) (63).

3.2.3 Phase One: Co-Creation Activities

The purpose of this co-creation activity was to identify unique health and wellness aspirations that would be of interest and relevance to the community in knowledge sharing circles facilitated during the 13-week healthy lifestyle intervention. In the co-creation activity, we presented eight topics related to Indigenous health and wellness. These topics were derived from the perspectives of Indigenous community leaders (from across British Columbia) who completed a voluntary and anonymous health and wellness survey disseminated at the National Indigenous Physical Activity and Wellness conference, which was hosted by our Indigenous Studies in Kinesiology team (64). We created tentative topics generated by perspectives from Indigenous community members living in British Columbia to ensure that the information we presented to Lytton First Nation in the co-creation activity was culturally relevant.
This co-creation activity was facilitated in small sharing circles with community members in the townhall of Lytton First Nation. The co-creation activity began with the introduction of a topic (e.g., health-related benefits of physical activity), followed by oral discussion of the topic. Thoughts and ideas generated in the discussion were recorded on paper using words and/or pictures (Figure 3.1). Participants were encouraged to reflect and share personal and learned experiences within their comfort zone, and to add, remove, or modify any topic they deemed necessary. Following this co-creation activity, co-creation responses on the posters were qualitatively analyzed using the established approach of affinity diagramming (65).

**Figure 3.1.** Example of co-creation responses generated in a sharing circle

Affinity diagramming is a process used to collect and “meaningfully cluster observations and insights” (p. 12) (65). This process includes organizing the information
into thematic groups based on the researchers’ interpretation of the data, and synthesizing the knowledge into theories that can be used to make generalizations about a topic (66). Using results from the co-creation activity, ideas and perspectives expressed on the poster by community members were summarized on post-it notes. Post-it notes were meaningfully organized into thematic groups on a wall (Figure 3.2). An on-the-wall analysis was conducted by our research team, which involved discussions regarding the identification of key words, the most telling quotes in each thematic group, and the tone of the responses. Through the process of affinity diagramming, revisions to the topics for the knowledge sharing circles were made. The revised topics were actively refined by community members throughout the 13-week healthy lifestyle intervention.

**Figure 3.2.** On-the-wall analysis in affinity diagramming of co-creation responses
3.2.4 Phase Two: Baseline Collection

Baseline data collection included demographics (age, biological sex, self-identified gender), health-related physical fitness (6-minute walk test, anthropometry, musculoskeletal, flexibility) and healthy lifestyle behaviours (physical activity and sedentary behaviour via accelerometry and self-report). Demographic, anthropometric and health-related physical fitness measures were recorded prior to the 6-minute walk test. After all health-related physical fitness assessments were complete, participants completed questionnaires and received an accelerometer to wear (voluntarily) for one week.

An automated blood pressure device (BP Tru, Coquitlam, British Columbia, Canada) was used to measure resting systolic blood pressure, resting diastolic blood pressure, and resting heart rate. The third of three measures of resting systolic blood pressure, resting diastolic blood pressure, and resting heart rate were recorded.

Anthropometric assessments included height, weight, body mass index, waist circumference, and percent body fat. Height was measured to the nearest 0.5 cm with the participants standing on bare feet (with feet together and toes pointed outward) on the base of a stadiometer (SECA, Hanover, MD). Weight and body composition (expressed in % body fat; bioelectrical impedance) were recorded using a digital scale (Tanita TBF-300 WA; Tanita, Arlington Heights, IL) that was re-calibrated and disinfected with each measurement. Body mass index (kg/m²) was calculated using height and weight. Waist circumference was measured using a standard girth tape by positioning the tape on bare skin at the narrowest point between the bottom of the rib cage and the iliac crest (67).

Musculoskeletal and flexibility assessments included grip strength and sit-and-reach flexibility, respectively. To measure grip strength, participants stood with an analog
handgrip dynamometer (Almedic, Montreal, Quebec, Canada) at the side (with arms straight and the dial of the instrument facing outward). The dynamometer was squeezed with maximal force without moving the arm. Grip strength was assessed two times in each hand in alternating fashion. Combined maximal left and right grip strength was recorded to the nearest 0.5 kg. A sit-and-reach flexibility test of the hamstrings and lower back was performed using a standard flexometer, which required participants to reach forward (via arm extension) and push the sliding marker with the fingertips (measuring to the nearest 0.5 cm) while sitting on the floor with legs extended and bare feet placed flat against the flexometer. Measures of musculoskeletal and flexibility fitness were assessed using the Canadian Physical Activity, Fitness, and Lifestyle Approach (CPAFLA) fitness norms of Gledhill and Jamnik (68).

Cardiorespiratory fitness was evaluated using the submaximal 6-minute walk test (57). Cones were laid out every 5 m for a total distance of 20 m, and participants were instructed to walk as fast as possible (without breaking into a running stride) repeatedly in linear fashion between a distance of 20 m. Total distance walked was recorded. Total distance and other participant-specific variables were used to compute a predicted VO₂max value using the following validated equation (57):

$$\text{VO}_2\max \text{ (mL/kg/min)} = 70.161 + (0.023 \times \text{distance [m]}) - (0.276 \times \text{weight [kg]}) - (6.79 \times \text{sex, where } m = 0, f = 1) - (0.193 \times \text{resting heart rate [bpm]}) - (0.191 \times \text{age [yr]})$$

Three fitness groups were created based on normative VO₂max values established by the American College of Sports Medicine (69): Moderately Fit (above the 50th percentile of the norm), Unfit (25th to 50th percentile), and Least Fit (below the 25th percentile).
Two questionnaires were completed following the completion of all health-related physical fitness tests. The modified Godin-Shephard Leisure Time Activity Questionnaire (70) was used to quantify self-reported (subjective) MVPA minutes (Appendix A). The questionnaire required participants to recall average weekly exercise (frequency and total activity minutes) over the past month. We have used this questionnaire extensively with Indigenous peoples in community-based interventions (36,55). Total MVPA minutes were recorded. The Sedentary Behaviour Questionnaire was used to quantify self-reported (subjective) sedentary activity time (Appendix B). The questionnaire required participants to recall average sedentary activity minutes spent on one typical weekday and weekend. The reliability and validity of this survey in community-based research has been documented (71). Total sedentary activity minutes were recorded.

The Actigraph wGT3X-BT accelerometer (firmware v1.9.2) (Pensacola, FL, USA) was used to measure objectively the minutes of physical activity intensity and sedentary activity. The accelerometer was worn on the non-dominant wrist and was initialized to collect activity counts per minute via a 15-sec epoch (72). The accelerometer was worn for seven full days (five weekdays, two weekends), which is the standard wear-time protocol used to measure physical activity intensity (73). Valid wear-time of less than 4 days (3 weekdays, 1 weekend) was used as the exclusion criteria (74). The ActiLife software (v6.13.3) was used to process raw accelerometry data into activity counts using Freedson’s (75) count-based regression model to predict activity intensity for adults. Frequency of sustained MVPA time in bouts of $\geq$30 min was counted to assess adherence to the prescribed progression of MVPA bouts from 15 to 30 min. Adherence rate was calculated as the number of MVPA bouts $\geq$30 min completed over five bouts as prescribed each week.
Total minutes spent in MVPA bouts ≥15 min/week (which included bouts of ≥30 min) were used to compare with international recommendations (150 min/wk or 30 min/day over five days). Frequency of sustained sedentary activity time in bouts of <30, 30-60, and >60 min were recorded.

3.2.5 Phase Three: Intervention

Indigenous community leaders facilitated a group-based walking activity of 30–45 min in duration once per week within the community. Participants were encouraged to invite community members (not part of the intervention) in this family-oriented activity. As such, 15–30 walkers were present in the physical activity component of the intervention. In each walking activity, participants adhered to their individualized exercise prescriptions created by qualified exercise professionals (76). The qualified exercise professionals received specialized training on cultural respect and safety for work with Indigenous peoples, and provided individualized and group-based consultation (in the presence of community leaders) regarding exercise safety and progression throughout the intervention. An example 3-month exercise prescription (24) is provided in Table 3.1.

In each individualized prescription, the frequency (3 days/week), intensity (mild-to-moderate), time (15–20 min/day), and type of activity (walking) was the default starting point. The prescription of intensity was based on age, sex, and baseline resting fitness level, the protocol of which is similar to previous exercise prescriptions used with Indigenous peoples (36) and patients with chronic medical conditions (such as heart disease (77) and transplantation (78)). Participants were educated on two methods to monitor exercise intensity: by calculating heart rate reserve (difference between maximum heart rate and
resting heart rate) and using the Rating of Perceived Exertion scale (0–10) (79).

Participants were encouraged to meet and exceed the prescribed goals by increasing the frequency (3–5 days/week), intensity (moderate-to-vigorous), duration (30–35 min), and type of exercise (brisk walking) at their own leisure.

Table 3.1. Example 13-week exercise prescription

<table>
<thead>
<tr>
<th>Program Stage</th>
<th>Week</th>
<th>Frequency (days/wk)</th>
<th>%HRR</th>
<th>Intensity</th>
<th>Breathing Rate</th>
<th>Duration (min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial Stage: Mild to moderate intensity aerobic exercise</td>
<td>1</td>
<td>3</td>
<td>40–50</td>
<td>3–4</td>
<td>Slightly increased</td>
<td>15–20</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>40–50</td>
<td>3–4</td>
<td>Slightly increased</td>
<td>20–25</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>50–60</td>
<td>3–5</td>
<td>Noticeably increased</td>
<td>20–25</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>3</td>
<td>50–60</td>
<td>3–5</td>
<td>Noticeably increased</td>
<td>25–30</td>
</tr>
<tr>
<td>Improvement: Exercise intensity and duration increase with fitness</td>
<td>5–7</td>
<td>4</td>
<td>60–70</td>
<td>3–4</td>
<td>Noticeably increased</td>
<td>25–30</td>
</tr>
<tr>
<td></td>
<td>8–10</td>
<td>4</td>
<td>60–70</td>
<td>3–4</td>
<td>Noticeably increased</td>
<td>30–35</td>
</tr>
<tr>
<td></td>
<td>11–13</td>
<td>3–5</td>
<td>65–75</td>
<td>3–5</td>
<td>Noticeably increased</td>
<td>30–35</td>
</tr>
</tbody>
</table>

HRR: heart rate reserve; RPE: rating of perceived exertion (10-point scale) (79)

Following a group-based walking activity, community leaders facilitated sharing circles of 30–45 min in duration. Eight sharing circle topics were co-created using feedback from the co-creation activity (Figure 3.3, see Appendix C for detailed descriptions and the order of presentation). Co-creation responses used in the generation of these sharing circle topics are summarized in Appendix D. These discussions revolved around health-related topics chosen by the participants, such as ways to set safe and realistic goals to increase the prescribed frequency, intensity, and duration of walking.
Discussions regarding healthy lifestyle behaviours were facilitated in a sharing circle format led by local community members including Elders, community nurses, strength conditioning trainers, wellness experts, and restorative justice workers. This methodology is similar to focus groups in qualitative research, but emphasize participants sharing stories with one another in relation to questions asked to the group (58). This community-based format enabled participants to share successes and challenges to overcome personal and/or community-based barriers to physical activity participation and healthy living. Such a sharing circle format allowed for a supportive, empathetic, and directive communication style that emphasized open-ended questions and reflective listening to help participants discuss their concerns regarding effective healthy lifestyle behaviour change (80,81).

Through storytelling and knowledge sharing practices, our sharing circles integrated 4 of
93 specific behaviour change techniques as identified by the internationally recognized Behaviour Change Technique Taxonomy (BCTT; version 1) (82): goal setting (e.g., setting goals to meet and exceed the frequency, intensity, duration, and type of exercise prescribed), commitment (e.g., exercise adherence), self-monitoring of behaviour (e.g., self-reporting activity minutes), and self-monitoring of outcome of behaviour (e.g., controlling exercise progression by monitoring exercise intensity).

3.2.6 Phase Four: Post-Intervention Collection

Post-intervention assessments included health-related physical fitness (6-minute walk test, anthropometry, musculoskeletal, flexibility) and healthy lifestyle behaviours (accelerometry and self-report). Anthropometric and health-related physical fitness measures were recorded prior to the 6-minute walk test. Upon completion of all health-related physical fitness assessments, participants completed the Godin-Shephard Leisure Time Questionnaire and the Sedentary Behaviour Questionnaire, and received the same Actigraph wGT3X-BT accelerometer to wear (voluntarily) for one week.

3.2.7 Phase Five: Reporting Back to the Community

All findings were reported back to the community. In adherence to the OCAP® Principles (63), we consulted with Dr. Rosalin Miles (Lytton First Nation community champion) and Roxann Roziere (Lytton First Nation information manager) in a meeting to receive community approval and guidance on methods to store research data in accordance to research policies with Lytton First Nation.
3.2.8 Statistical Analyses

All analyses were performed using SPSS version 24 for Windows (SPSS, Inc., Chicago, IL). A 2 x 3 mixed model ANOVA was used to examine the effects of the intervention on health-related physical fitness (aerobic and musculoskeletal fitness and body composition) and baseline fitness level among three fitness groups. Pre- and post-outcome physical activity behaviour, sedentary activity time, and cardiometabolic health-related measures were compared using paired t-tests. The Bonferroni correction test was used in post hoc analyses. For all statistical analyses, an alpha level of p<0.05 was selected * a priori. Data are reported as Mean ± Standard Error of the Mean (SE).

3.3 Results

3.3.1 Participant Characteristics

A total of 15 participants (13 females; n = 2, 5, 3, 5 for ages < 30, 30–40, 40–50, >50, respectively) completed the health-related physical fitness and anthropometric tests (20 recruited). Collectively, average age was 43.9 ± 3.5 years. Average age among the least fit, unfit, and moderately fit groups were 46.8 ± 5.5, 36.2 ± 5.0, and 48.6 ± 7.1 years, respectively.

3.3.2 Anthropometric, Musculoskeletal, and Flexibility Outcomes

There were no significant changes in body mass, body mass index, waist circumference, percentage body fat, grip strength, and flexibility following the intervention (Tables 3.2, 3.3, 3.4). At baseline, 13 of 15 participants exhibited a BMI > 25 kg/m² (overweight, n = 6;
obese, \( n = 7 \), and 12 of 15 participants (12 of 13 females) revealed elevated waist circumference. Among female participants, the baseline average of percentage body fat was 41.7 ± 2.2%, while the baseline percentage body fat of the male participant was 15.2%. Based on the CPAFLA musculoskeletal fitness norms (68), approximately half the cohort showed a baseline sit-and-reach flexibility rating that was below average (“Needs Improvement”; “Fair”; “Good”; \( n = 7, 4, 4 \), respectively), while baseline grip strength results were less homogeneous (“Needs Improvement”; “Fair”; “Good”; “Very Good”; “Excellent”; \( n = 5, 3, 1, 4, 2 \), respectively).

**Table 3.2. Change in anthropometric outcomes**

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Weight (kg)</th>
<th>Body Mass Index (kg/m²)</th>
<th>Waist Circumference (cm)</th>
<th>Bioelectrical Impedance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
<td>Post</td>
</tr>
<tr>
<td>Least Fit (( n = 5 ))</td>
<td>99.5 ± 5.7</td>
<td>99.2 ± 5.7</td>
<td>37.2 ± 2.0</td>
<td>37.1 ± 2.0</td>
</tr>
<tr>
<td>Unfit (( n = 5 ))</td>
<td>79.7 ± 4.2</td>
<td>81.2 ± 4.0</td>
<td>28.4 ± 3.0</td>
<td>28.9 ± 3.0</td>
</tr>
<tr>
<td>Moderately Fit (( n = 5 ))</td>
<td>65.2 ± 4.2</td>
<td>64.6 ± 4.2</td>
<td>26.2 ± 1.1</td>
<td>25.9 ± 1.2</td>
</tr>
<tr>
<td>Overall (( n = 15 ))</td>
<td>81.5 ± 4.5</td>
<td>81.7 ± 4.5</td>
<td>30.6 ± 1.7</td>
<td>30.7 ± 1.7</td>
</tr>
</tbody>
</table>
Table 3.3. Change in musculoskeletal outcomes

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Grip Strength (kg)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>Least Fit (n = 5)</td>
<td>60.6 ± 7.1</td>
<td>59.8 ± 7.0</td>
<td></td>
</tr>
<tr>
<td>Unfit (n = 5)</td>
<td>71.2 ± 5.9</td>
<td>73.6 ± 3.3</td>
<td></td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>52.4 ± 7.3</td>
<td>47.6 ± 6.5</td>
<td></td>
</tr>
<tr>
<td>Overall (n = 15)</td>
<td>61.4 ± 4.2</td>
<td>60.3 ± 4.2</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.4. Change in flexibility outcomes

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Sit-and-Reach (cm)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>Least Fit (n = 5)</td>
<td>24.0 ± 3.1</td>
<td>23.3 ± 3.6</td>
<td></td>
</tr>
<tr>
<td>Unfit (n = 5)</td>
<td>26.1 ± 3.2</td>
<td>27.8 ± 2.5</td>
<td></td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>31.3 ± 1.7</td>
<td>31.0 ± 3.0</td>
<td></td>
</tr>
<tr>
<td>Overall (n = 15)</td>
<td>25.7 ± 1.7</td>
<td>27.1 ± 1.8</td>
<td></td>
</tr>
</tbody>
</table>

3.3.3 Cardiorespiratory Fitness Outcomes

There were significant main (time and group) and interaction (time x group) effects for \( \text{VO}_2\max \) across the intervention (Table 3.5; Figure 3.4). Across all groups, \( \text{VO}_2\max \) increased (7.1 ± 1.6%) from 29.3 ± 2.1 to 31.0 ± 2.1 mL/kg/min after the 13-week intervention. The least fit group had the lowest \( \text{VO}_2\max \) at baseline and at follow-up (Table 3.5). The interaction effect revealed differential responses between groups with the least fit group demonstrating the greatest improvements in \( \text{VO}_2\max \) (13.3 ± 2.4%) followed by the moderately fit (5.3 ± 1.8%) and unfit (2.7 ± 1.7%) groups. The increase in \( \text{VO}_2\max \) in the least fit group was significantly greater than the improvements observed in the unfit (\( p = 0.008 \)) and moderately fit (\( p = 0.04 \)) groups. Linear regression analysis demonstrated a significant negative correlation (\( p < 0.05, r = -0.76 \)) between change in \( \text{VO}_2\max \) and
baseline values (Figure 3.5), supporting the findings that individuals with the lowest cardiorespiratory fitness had the greatest improvements in VO₂max. There was a significant reduction in resting heart rate, resting systolic blood pressure, and resting diastolic blood pressure across the intervention (Table 3.6).

Table 3.5. Change in predicted maximal aerobic power

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>6MWT Distance (m)</th>
<th>VO₂max (mL/kg/min)</th>
<th>ΔVO₂max (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Least Fit (n = 5)</td>
<td>439.0 ± 31.5</td>
<td>470.2 ± 18.1</td>
<td>20.7 ± 3.5</td>
</tr>
<tr>
<td>Unfit (n = 5)</td>
<td>569.0 ± 24.1</td>
<td>545.0 ± 24.1</td>
<td>34.9 ± 2.0</td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>487.4 ± 19.8</td>
<td>496.2 ± 27.3</td>
<td>32.4 ± 1.6</td>
</tr>
<tr>
<td>Overall (n = 15)</td>
<td>498.5 ± 19.8</td>
<td>503.8 ± 15.0</td>
<td>29.3 ± 2.1</td>
</tr>
</tbody>
</table>

6MWT: 6-min walk test; *main effect for intervention p < 0.05; **significant interaction effect

Table 3.6. Change in resting heart rate and resting blood pressure

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Resting Heart Rate (bpm)</th>
<th>Resting Systolic Blood Pressure (mmHg)</th>
<th>Resting Diastolic Blood Pressure (mmHg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Least Fit (n = 5)</td>
<td>84.8 ± 4.3</td>
<td>76.4 ± 5.6*</td>
<td>135.0 ± 8.3</td>
</tr>
<tr>
<td>Unfit (n = 5)</td>
<td>79.4 ± 5.7</td>
<td>69.2 ± 3.7*</td>
<td>127.2 ± 5.7</td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>77.2 ± 3.8</td>
<td>70.4 ± 2.4*</td>
<td>110.8 ± 3.3</td>
</tr>
<tr>
<td>Overall (n = 15)</td>
<td>80.5 ± 2.6</td>
<td>72.0 ± 2.4*</td>
<td>124.3 ± 4.2</td>
</tr>
</tbody>
</table>

*p < 0.05
**Figure 3.4.** Significant interaction effect between aerobic fitness groups

![Graph showing the interaction effect between aerobic fitness groups.](image)

**Baseline Fitness**

- Least Fit
- Unfit
- Moderately Fit

**Average Change in VO\textsubscript{max} (%)**

**Figure 3.5.** Lower baseline fitness associated with greater improvements in fitness

![Graph showing the relationship between baseline VO\textsubscript{max} and change in VO\textsubscript{max}.](image)

**Baseline VO\textsubscript{max} (mL/kg/min)**

**Change in VO\textsubscript{max} (%)**
3.3.4 Physical Activity Levels Meeting International Recommendations

The increase in MVPA minutes completed in bouts of ≥30 min approached international recommendations (Table 3.7; Figure 3.6). There was a main effect for the intervention. There were no interaction effects likely owing (at least in part) to the small sample size for each group. With the inclusion of MVPA minutes completed in bouts of ≥15 min, overall MVPA time (275.5 ± 60.2 min/week) was above international recommendations following the intervention (Table 3.8). Overall, international physical activity guidelines were met by increasing daily MVPA time (9.4 ± 4.0 min/day; ~17% change) in adherence to exercise bouts ≥30 min.

Table 3.7. Accelerometry-measured MVPA frequency and time in bouts ≥ 30 min

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Frequency of MVPA Bouts ≥ 30 min (#/week)</th>
<th>MVPA Time ≥ 30 min (min/week)</th>
<th>Change in MVPA Time ≥ 30 min Bouts (min/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Least Fit (n = 3)</td>
<td>2.3 ± 1.9</td>
<td>5.0 ± 3.1</td>
<td>70.0 ± 55.7</td>
</tr>
<tr>
<td>Unfit (n = 3)</td>
<td>3.3 ± 0.3</td>
<td>5.0 ± 2.0</td>
<td>100.0 ± 10.0</td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>2.0 ± 1.5</td>
<td>4.2 ± 1.5</td>
<td>60.0 ± 46.5</td>
</tr>
<tr>
<td>Overall (n = 11)</td>
<td>2.4 ± 0.8</td>
<td>4.6 ± 1.1*</td>
<td>73.6 ± 24.4</td>
</tr>
</tbody>
</table>

*main effect for intervention $p < 0.05$

Table 3.8. Accelerometry-measured MVPA frequency and time in bouts ≥ 15 min

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>Frequency of MVPA Bouts ≥ 15 min (#/week)</th>
<th>MVPA Time ≥ 15 min (min/week)</th>
<th>Change in MVPA Time ≥ 15 min Bouts (min/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Least Fit (n = 3)</td>
<td>16.0 ± 11.1</td>
<td>15.7 ± 8.8</td>
<td>240.0 ± 167.0</td>
</tr>
<tr>
<td>Unfit (n = 3)</td>
<td>13.7 ± 4.3</td>
<td>22.0 ± 9.6</td>
<td>205.0 ± 63.8</td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>14.8 ± 6.4</td>
<td>17.8 ± 5.9</td>
<td>222.0 ± 95.7</td>
</tr>
<tr>
<td>Overall (n = 11)</td>
<td>14.8 ± 3.9</td>
<td>18.4 ± 4.0</td>
<td>222.3 ± 58.5</td>
</tr>
</tbody>
</table>
Figure 3.6. Accelerometry-measured MVPA increased significantly and was above international recommendations of 150 min/week (dashed line)

![Graph showing changes in MVPA time before and after intervention](image)

Significant changes were also observed in self-reported MVPA, in which all fitness groups met international recommendations following the intervention (Table 3.9). However, there were significant differences between the self-reported and directly assessed (via accelerometry) MVPA (min/week) measures in 11 participants reflecting a marked underestimation via self-report at baseline (~21.7%) and overestimation after the intervention (31.0%). This discrepancy was observed in the number of participants that were above international recommendations of MVPA time (seven of fifteen (~46.7%) via self-report and eight of eleven (~72.6%) via accelerometry). Change in VO$_2$max was significantly ($p < 0.05$) correlated with change in self-reported ($r = 0.42$; Figure 3.7) and accelerometry-measured ($r = 0.24$) MVPA minutes completed in exercise bouts $\geq$ 30 min. No significant changes were observed in percent change in MVPA and in total Actigraph wear time.
Table 3.9. Change in self-reported MVPA time

<table>
<thead>
<tr>
<th>Fitness Group</th>
<th>MVPA Time (min/week)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td></td>
</tr>
<tr>
<td>Least Fit (n = 5)</td>
<td>89 ± 17</td>
<td>184 ± 19*</td>
<td></td>
</tr>
<tr>
<td>Unfit (n = 5)</td>
<td>316 ± 55</td>
<td>508 ± 70*</td>
<td></td>
</tr>
<tr>
<td>Moderately Fit (n = 5)</td>
<td>118 ± 27</td>
<td>392 ± 73</td>
<td></td>
</tr>
<tr>
<td>Overall (n = 15)</td>
<td>174 ± 52</td>
<td>361 ± 79*</td>
<td></td>
</tr>
</tbody>
</table>

*p < 0.05

Figure 3.7. Self-reported MVPA time positively associated with change in VO$_2$max

3.3.5 Exercise Adherence and Adverse Events

There were no reported cases of exercise-related adverse events during the 13-week intervention. Overall, MVPA time in bouts of ≥15 min increased, but the change was not significant (Table 3.8). MVPA time in bouts of ≥30 min increased across the intervention in
all groups (Table 3.7). The average weekly frequency of completing five MVPA bouts of ≥30 min as prescribed increased significantly from 2.4 ± 0.8 to 4.6 ± 1.1 per week (adherence rate of 92.7 ± 21.3%), reflecting a transition from 73.6 ± 24.4 to 139.1 ± 31.9 min/week.

3.3.6 Sedentary Activity Time

Self-reported sedentary activity time decreased significantly by 24.5 ± 6.3 % (p = 0.003) (Table 3.10, Figure 3.8). Accelerometry-measured indices revealed a significant (p = 0.04) decrease in the frequency of time spent in prolonged sedentary bouts lasting >60 minutes (pre: 11.2 ± 1.2, post: 8.1 ± 1.1 per week) (Figure 3.9), non-significant change in total sedentary activity time (pre: 5.1 ± 0.5, post: 5.7 ± 0.6 hrs/day), and non-significant increase in total breaks in sedentary bouts (pre: 100.6 ± 10.8, post: 108.4 ± 10.3). The reduction in self-reported sedentary activity time was associated (p = 0.02, r = -0.56) with increased accelerometry-measured MVPA minutes. Among the sedentary activities reported, weekly screen time decreased significantly (p = 0.002) from 3.5 ± 0.4 to 2.4 ± 0.3 hr/day, and the strongest association (p = 0.03, r = -0.67) was observed between reduced computer/video game screen time and increased accelerometry-measured MVPA minutes (Table 3.10, Figure 3.10).
Table 3.10. Change in self-reported sedentary activity time

<table>
<thead>
<tr>
<th>Sedentary Activity</th>
<th>Weekday (hr/day)</th>
<th>Weekend (hr/day)</th>
<th>R (n=11)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Pre</td>
</tr>
<tr>
<td>Computer/video game</td>
<td>1.2 ± 0.3</td>
<td>0.6 ± 0.2</td>
<td>1.1 ± 0.3</td>
</tr>
<tr>
<td>Paperwork/office work</td>
<td>3.2 ± 0.7</td>
<td>2.3 ± 0.7</td>
<td>0.95 ± 0.5</td>
</tr>
<tr>
<td>Transportation by vehicle</td>
<td>1.7 ± 0.4</td>
<td>1.3 ± 0.3*</td>
<td>2.6 ± 0.4</td>
</tr>
<tr>
<td>Playing a musical instrument</td>
<td>0.4 ± 0.1</td>
<td>0.1 ± 0.0</td>
<td>0.1 ± 0.0</td>
</tr>
<tr>
<td>Television</td>
<td>2.4 ± 0.3</td>
<td>1.6 ± 0.3*</td>
<td>2.4 ± 0.4</td>
</tr>
<tr>
<td>Sitting/reading</td>
<td>1.0 ± 0.3</td>
<td>1.1 ± 0.3</td>
<td>1.0 ± 0.3</td>
</tr>
<tr>
<td>Sitting/listening to music</td>
<td>0.5 ± 0.1</td>
<td>0.5 ± 0.2</td>
<td>0.75 ± 0.3</td>
</tr>
<tr>
<td>Sitting/talking on the phone</td>
<td>0.8 ± 0.3</td>
<td>0.7 ± 0.4</td>
<td>0.3 ± 0.1</td>
</tr>
<tr>
<td>Doing arts/crafts</td>
<td>0.5 ± 0.2</td>
<td>0.3 ± 0.1</td>
<td>0.7 ± 0.2</td>
</tr>
<tr>
<td>Total sedentary activity time</td>
<td>11.7 ± 0.1</td>
<td>8.5 ± 0.1*</td>
<td>9.9 ± 0.1</td>
</tr>
</tbody>
</table>

R represents the correlation coefficient between change in self-reported total sedentary activity time (hr/day) and change in accelerometry-measured MVPA time (min/wk), *p < 0.05

Figure 3.8. Self-reported sedentary activity time decreased significantly
**Figure 3.9.** Significant reduction in accelerometry-measured sedentary activity time in bouts >60 min

![Bar chart showing frequency (per week) of sedentary activity by duration of sedentary bout (min). Baseline and post-intervention data are compared.]

**Figure 3.10.** Inverse relationship between changes in accelerometry-measured MVPA time and self-reported screen time

![Scatter plot showing the change in screen time against the change in MVPA time (min/wk). A negative correlation is observed.]


Chapter 4. Conclusion

This chapter presents an evidence-based analysis of the findings, strengths and limitations of the thesis investigation, and future implications for co-creating culturally safe research methodologies with Indigenous communities in Canada.

4.1 Evidence-Based Review of the Findings

To date, limited studies have directly examined the cardiometabolic benefits of an Indigenous led and community-based healthy lifestyle intervention conducted within a remote and rural Indigenous community. This study is unique in presenting directly measured indices of health-related physical fitness, physical activity behaviour, and sedentary activity behaviour after a 13-week healthy lifestyle intervention. The key findings from this study revealed that a culturally relevant and safe, community-based, Indigenous led, health and wellness intervention can lead to significant and clinically relevant improvements in cardiometabolic health, physical activity behaviour, and sedentary behaviour. Importantly, the greatest benefits occurred in the least fit individuals. The study also showed the potential for this program to prevent against further weight gain. These findings demonstrated that extensive and culturally relevant community engagement played a key role in eliciting effective behaviour change.

Indigenous led approaches have been widely advocated to improve cardiorespiratory fitness in Indigenous communities. A recent systematic review of the literature has revealed that the cardiorespiratory fitness of Indigenous peoples may be declining, increasing the risk for chronic disease and premature mortality (31). In the present study, the increase in aerobic fitness (~7%) would be associated with a clinically relevant
reduction in the risk for chronic disease and premature mortality (3,6,8,24,37). In a position stand articulated by the American College of Sports Medicine (41), a ~7% increase in aerobic fitness is expected following the adherence of exercise prescriptions over a three month period. The position stand states that a 10–15% increase in aerobic fitness is typically observed in adherence to 6–12 months of aerobic-based exercise at an intensity of 40–50% heart rate reserve (which was the starting point in this study), and that training at this intensity has been shown to elicit significantly greater improvements in aerobic fitness among individuals with lower baseline fitness (41). Consistent with this trend, we demonstrated that aerobic-based exercise at this starting intensity led to a ~13% increase in aerobic fitness in the least fit group over a three month period. Furthermore, while accelerometry-measured MVPA time doubled in both the least fit and moderately fit groups, the greatest changes in aerobic fitness were observed in the least fit group (Figure 3.4). These observations are clinically relevant. For instance, Myers and colleagues revealed risk reductions for premature mortality of 10–25% for every 1-MET increase in aerobic fitness (83), with greater risk reductions (roughly 30% per 1-MET increase) in those with extremely low aerobic fitness levels (e.g., <5 METs). While aerobic fitness is a stronger predictor of the risk for chronic disease and premature mortality than physical activity behaviour (3,6,8,24,37), physical activity behaviour is an important contributor to aerobic fitness.

Various factors explain changes in aerobic fitness with training including physical activity behaviours. In the current study, there were significant increases in both subjectively and objectively measured indices of MVPA. As observed via accelerometry, there was a strong adherence to the exercise prescription by the participants with the
entire cohort approaching international recommendations (139.0 ± 31.9 min/week) by completing an average of 4.6 ± 1.1 MVPA bouts of ≥30 min out of the five bouts as prescribed. Overall, the ~17% increase in completing MVPA of ≥30 min demonstrated evidence for health behavioural change in physical activity participation. The ~17% increase in MVPA minutes reflects a ~ten min increase (per day) in the transition from ≥15 to ≥30 min bouts of MVPA as prescribed (Table 3.7, Figure 3.6). A ~ten min daily increase in MVPA has clinical relevance, as international guidelines recommend meeting 30 min/day of MVPA in bouts of ≥10 min to accommodate for individuals with extremely low baseline fitness.

Consistent with evidence demonstrating the relationship between minor volumes of MVPA (e.g., threshold of ten min) and significant gains in health-related benefits (3,6,8,24,37), the results in our study revealed that the ~ten min daily increase in MVPA led to predictable changes in health-related physical fitness measures. For instance, the reductions in resting heart rate and blood pressure were similar amongst groups and were within clinically recommended ranges for adults following the intervention (e.g., heart rate = 60–80 bpm and blood pressure less than 120/80 mmHg) (84,85). Our observations also align with empirical evidence at the highest level. In a recent systematic review of systematic reviews, Warburton and colleagues (6) revealed a dose-response (curvilinear) relationship between physical activity and health status, such that marked health-related benefits were observed with relatively minor volumes (e.g., ten min per day) of physical activity. Research from cardiac rehabilitation settings also suggests that a ten min increase in MVPA can have profound clinical implications (29). Although changes in MVPA did not explain all of the variance in the changes in aerobic fitness, further research is warranted to
fully examine the other mechanisms responsible for the change in aerobic fitness with a healthy lifestyle intervention of this nature.

Another important finding in this study was the misrepresentation of MVPA minutes via self-report. The over-reporting of MVPA minutes is not uncommon (86), as over-estimation of self-reported MVPA by up to 56.8% has been documented (87). In our study, we observed a marked difference between the subjective and objective measures of MVPA both before and after the intervention. In particular, self-reported MVPA times were underestimated and overestimated pre- and post-intervention, respectively. These observations were distinct from what is frequently observed in the general population (e.g., overestimation in both pre- and post-intervention assessments), and further research is warranted to determine the reasons for underestimation. This finding also emphasizes the need to take objective measures of physical activity when feasible (73).

In addition to significant improvements in cardiorespiratory fitness, this study also showed the potential for this program to prevent against further weight gain. At baseline, the participants demonstrated a body composition that placed them at a higher risk for chronic disease (88) with a graded risk response according to baseline aerobic fitness (e.g., Least Fit > Unfit > Moderately Fit, \( p < 0.05 \)). The observation that health-related benefits could be obtained despite no weight loss is clinically relevant to primary and secondary prevention programs in Indigenous communities. Indigenous peoples have frequently been shown to be at an increased risk for overweight, obesity, and cardiometabolic conditions (such as heart disease and diabetes) (33-35). In British Columbia, our team has previously demonstrated that the prevalence of overweight, obesity, and abdominal obesity was 29.4, 48.6, and 65.1%, respectively in Indigenous men and women (34). Both obesity and
abdominal obesity were significantly greater in rural (e.g., Northern and Interior) regions of British Columbia in comparison to more urban centres. While many research studies focus on the changes in body composition (e.g., weight loss) that occur after an intervention, our findings support the clinical practice of preventing weight gain in the initial stages of a physical activity and/or exercise-training program.

Preventing weight gain in the initial stages of a physical activity intervention is important from two perspectives. Firstly, it is feasible for marked cardiometabolic health benefits to occur with relatively small changes in body composition (3). In fact, it has been shown that small incremental increases in both volume and intensity of physical activity are associated with larger gains in health-related benefits in previously inactive individuals (3,6,8,24,29,37,89). Secondly, no weight gain over a four-month period can be considered an important benefit for the attenuation of the risk associated with weight gain. Our present study revealed that the healthy living intervention was sufficient to prevent further weight gain in at-risk participants. This finding is consistent with current weight management recommendations related to the prevention of weight gain. For instance, 45–60 min of MVPA per day are often recommended to prevent weight gain, and 60–90 min of MVPA per day are required to sustain long-term weight loss (88,89). Dividing the accelerometry-measured MVPA time (~275 min/week) by five (as per international guidelines of 150 min/week over five days) revealed an average of ~55 min/day spent in MVPA, which was within the recommendation to prevent weight gain.

Moreover, increasing evidence has demonstrated a positive relationship between musculoskeletal fitness and health status, particularly markers of disability and functional status (3,6,8,24,37). As such, we have widely advocated the assessment of musculoskeletal
fitness (8,24). Our current investigation focused on aerobic activities, and as such it is not surprising to find no significant changes in grip strength or flexibility across the intervention. Future research should explore the effectiveness of a combined aerobic and musculoskeletal program in community-based interventions, as it has been shown that the integration of neuromuscular and flexibility exercises can enhance functional status in clinical settings (90). In particular, musculoskeletal programs should focus on improving and/or maintaining grip strength, since grip strength is positively correlated to performance in activities of daily living (91) and inversely related to premature mortality and developing chronic disability (92,93). Improving grip strength is also a primary prevention for fall-related injuries (e.g., fragility fractures of the hip and wrist) (94) that can undermine routine physical activity participation especially amongst the elderly. Accordingly, future community-based research should examine the effects of integrating musculoskeletal and flexibility exercises into comprehensive healthy living programs for the primary and secondary prevention of chronic medical conditions.

Results from self-reported and accelerometry-measured indices of sedentary behaviour further support the significant and clinically relevant improvements in cardiometabolic health observed in this study. While a small non-significant increase in accelerometry-measured total sedentary activity time was observed (5.1 ± 0.5 to 5.7 ± 0.6 hours per day), we also observed a significant decrease in the frequency of extremely long bouts of sedentary activity (e.g., >60 min). It can be postulated that after the intervention, extremely long bouts of sedentary activity may have been interrupted more frequently (with physical activity), considering that the total number of sedentary breaks increased post-intervention (although non-significantly). This finding is relevant because it has been
demonstrated that simply increasing the number of sedentary breaks and reducing larger bouts of sedentary activity time can improve glycemic control in individuals with type 2 diabetes (95) (an example of improved cardiometabolic health). Furthermore, we postulate that increased interruptions in sedentary behaviour could be attributed to the internalization of healthy lifestyle behaviours that were shared in the knowledge sharing circles (e.g., sharing evidence-based knowledge translation messages of “every little bit of activity counts” and “sit less, walk more” (6)). In fact, we observed a strong inverse relationship ($p < 0.05, r = -0.65$) between accelerometry-measured MVPA minutes and self-reported minutes spent watching television/playing video games (Table 3.10). Collectively, these findings support the use of knowledge sharing circles as a culturally safe method to convey and internalize healthy lifestyle behaviours such as increasing physical activity and reducing sedentary behaviours. It can be postulated that the internalization of healthy lifestyle behaviours contributed to the significant and clinically relevant improvements in cardiometabolic health observed in this study.

Interpreting results from the Sedentary Behaviour Questionnaire, it can be postulated that the reduction in extremely long bouts of sedentary activity could be attributed in part to the significant reduction in self-reported screen time. Specifically, among the 9 activities listed in the Sedentary Behaviour Questionnaire, “computer and video game,” “transportation by vehicle,” and “television” were the only sedentary activities reduced significantly post-intervention, with the greatest inverse association observed between changes in MVPA time and computer/video game time (Figure 3.10). The magnitude of such a correlation ($r = -0.65$) was not consistent among all reported sedentary activities. For instance, there was minimal association ($r = -0.03$) between changes in the self-
reported sedentary activity of “sitting and talking on the phone” and changes in accelerometry-measured MVPA. The findings indicate that certain sedentary lifestyle behaviours (e.g., screen activities) were most reduced in this intervention, which was not an unexpected outcome considering reducing screen time was a community-based goal communicated in sharing circles. Similar to the success of interventional outcomes described in the literature review (36,52,55), there is immense value in creating and implementing interventions that are based on the aspirations of the community. In addition to evidence highlighted in the literature, the findings in this study provide a compelling argument in support of community-based interventions that empower an Indigenous led design and a family-oriented perspective of teaching and learning.

In our study, integrating exercise prescriptions with healthy lifestyle counselling (via knowledge translation activities in sharing circles) in a community-based program improved cardiorespiratory fitness, and the greatest changes in aerobic fitness were being generally observed in the least fit group. These findings are consistent with the dose–response relationship between physical activity and health status, such that the health-related gains associated with physical activity are greatest among the least fit individuals. Furthermore, sedentary activity time reduced significantly post-intervention. Specifically, changes in MVPA time and screen time exhibited the greatest significant negative correlation. Therefore, we reject our null hypotheses based on these findings.

4.2 Strengths, Limitations, and Directions for Future Research

This strengths-based healthy lifestyle intervention was unique in that the weekly physical activity component (walking) was supplemented with knowledge sharing circles
facilitated by and for community members. One of the major strengths of this intervention was that the research team listened and responded to the aspirations of the community in a culturally appropriate manner. In the co-creation activity prior to the intervention, we learned that there is enormous value placed on intergenerational teaching and learning facilitated by traditional Indigenous Elders, who are sacred knowledge keepers, historians, spiritual leaders, experts, and teachers (96). Key findings from the co-creation responses revealed that: wherever possible, knowledge sharing should reflect traditional Indigenous practices and activities communicated as much as possible through oral storytelling, particularly by traditional Indigenous Elders; and healthy lifestyle interventions should encompass wholistic, strengths-based, family-oriented and land-based activities led by community members (Appendix D). The data collected in the co-creation activity provided insight on culturally safe ways to connect the healthy lifestyle intervention with land-based activities unique to Lytton First Nation.

In response to the feedback received in the co-creation activity, unique lifestyle counselling topics were discussed in the sharing circle, which were facilitated by local Elders and other community leaders. Focusing on the centrality of Elders created a culturally safe teaching and learning environment that allowed for a supportive, empathetic, and directive communication style analogous to that of current best practices in motivational interviewing (97,98) (these methods have been used to reduce cardiometabolic disease risk in group-based therapy (99)). The sharing circles in this study emphasized open-ended questions and reflective listening, enabling participants to share successes and challenges to overcome personal and/or community-based barriers to physical activity participation and healthy living. As shown in the literature, this strengths-
based approach can empower the self-determination in individuals to internalize, commit, and progress toward their own health and wellness goals (100,101). The 75% completion rate of this study (15 of 20 participants completed the study) is one measure of success.

Furthermore, each discussion topic in the sharing circle (along with the knowledge translation resources shared) was refined on a weekly basis based on direct feedback from community members. As defined by the Canadian Institutes of Health Research, this dynamic process of knowledge exchange and dissemination is culturally appropriate because it empowers community members to take ownership in identifying emerging health and wellness issues as a community (14). As identified by the co-creation responses, Indigenous community members view and value health and wellness from the perspective of the community as a whole, rather than at the individual level. Our strengths-based approach in knowledge translation respected the community-based and family-oriented perspectives of knowledge exchange and dissemination.

However, to further highlight the importance of strengths-based approaches in research with Indigenous communities, the current established definition of knowledge translation should be modified to emphasize the element of cultural safety. While the current definition of knowledge translation is the “synthesis, dissemination, exchange, and ethically-sound application of knowledge” (14), a strengths-based definition of knowledge translation should reflect the co-creation, sharing, and culturally-safe application of knowledge. This modified definition resonates more strongly with the strengths-based work co-created in this thesis investigation.

The findings from this study have important implications for the health and wellbeing of Indigenous peoples. At the community-level, we demonstrated that using culturally safe
and Indigenous led methods to implement exercise prescriptions is effective in eliciting marked improvements in cardiometabolic health (e.g., aerobic fitness, resting heart rate, resting blood pressure). The exercise program was also effective in preventing weight gain. These findings are clinically relevant in primary and secondary prevention programs in Indigenous communities, as they provide novel insight on how to design and implement culturally safe and relevant approaches to harmonize the knowledge translation message of “every little bit of activity counts” (6). With reference to this key messaging slogan, we co-created an Indigenous led healthy lifestyle intervention model “With Every Step, We Grow Stronger” (27) to fill knowledge gaps related to healthy lifestyle behaviours (including routine physical activity and reducing sedentary behaviours) and cultural safety.

Future research should make adaptations that build upon the strengths and weaknesses unique to this study. For instance, future research should consider integrating sharing circles into the intervention, seek direct input from community members on discussion topics through sharing circles, and invite key community leaders to facilitate all activities of knowledge exchange. Furthermore, an intervention involving participants of all ages would increase the sample size required for larger effect sizes and significant findings. However, while a larger sample size will increase statistical power, the retention of program participants may depend on an appropriate ratio of facilitators to participants unique to the community. An increase in the number of participants may require more community leaders to be present to facilitate program activities. Finding community members who are voluntarily able to participate as program leaders can also be a limitation. These challenges are community-specific, and can be prevented and/or overcome through respectful communication with the community (25).
Furthermore, while the lack of a control group is a limitation in community-based designs such as this study, community-based designs are more practical and realistic. However, we also recognize the challenges associated with the replicability of community-based interventions. While it is important to ensure that methodologies can be replicated by other researchers, community-based designs focusing on the aspirations of the participants can often lead to abrupt changes in methodology before and during an intervention. These changes can affect data collection processes and the intervention design. For instance, some participants opted out of wearing accelerometers as the devices were considered colonial. In our sharing circles, the topic of air quality and cardiovascular health was integrated to discuss ways to remain physically active in the presence of environmental smoke stemming from local wildfires. These examples show the dynamic nature of community-based designs, and researchers should be educated on how to respond to these changes in a culturally safe manner. While these limitations are not ideal, researchers should see these challenges in a strengths-based perspective, as these limitations can provide new problem-solving opportunities to build meaningful relationships with the community.

To enhance the level of community engagement, interventions should involve youth, as the involvement of youth was identified in the co-creation responses as an important environment for intergenerational teaching and learning. Integrating youth into healthy lifestyle interventions is also highly relevant in health and wellness research within Indigenous families. For instance, a 32-year follow-up of a longitudinal observational study involving 17,248 participants revealed that childhood television viewing time tracks well into adulthood, and that parents’ healthy lifestyle behaviours and social positions are
influenced by their children’s television viewing habits (102). The evidence suggests that reciprocal interactions in healthy living behaviours can occur between parents and children, and that lifestyle behaviours are governed by complex socio-behavioural factors that can be compounded by a myriad of factors related to the social determinants of Indigenous health and wellness (15,103-107). As such, future health and wellness research with Indigenous communities should look to integrate different age groups to investigate the complex social, cultural, historical, and economical factors that shape healthy living in Indigenous families.

Limitations related to the collection of data were also noted. For instance, motivation and previous performance have been documented as factors that contribute to the variability of distance walked in the 6-min walk test (108). Furthermore, while the combination of questionnaires and accelerometry provides greater insight on physical activity and sedentary behaviour (73), compliance in wearing accelerometers can limit the availability of valid data. As identified in the systematic review (11), it has traditionally been a challenge to conduct accelerometry-based research with Indigenous communities. In this study, 11 of 15 participants wore accelerometers in the pre- and post-program assessments. Additionally, while control groups may be difficult to establish in community-based research, their inclusion can assist in the comparison of between-group interactions including sex- and gender-based differences. However, it is important to highlight that owing to the overwhelming evidence supporting the health benefits of routine physical activity participation, the inclusion of a control group that does not receive these benefits is widely cautioned against.
4.3 **Conclusive Remarks**

Indigenous communities in Canada are returning to traditional ways of being active on the land. More important than ever, we need to empower Indigenous leaders to be the key advocates of health behaviour change in their community. In addition, generic health and wellness guidelines should be modified to reflect the traditional, cultural, and historical perspectives of health and wellness unique to each and every community. This thesis investigation demonstrates how an Indigenous designed and led, community-based healthy lifestyle intervention can provide a culturally relevant strategy to increase health-related physical fitness, increase physical activity participation, and reduce sedentary behaviours. Building upon the strengths of this thesis investigation and past scholarly contributions, future research should focus on the co-creation aspects of intervention design. Co-creation activities in knowledge sharing circles provide an inclusive learning space where different worldviews of health and wellness can be shared. These established cultural practices are effective in sharing the knowledge, experiences, challenges, and successes that shape healthy living behaviours in Indigenous communities and families. A united approach fosters meaningful relationships between researchers and the community allowing for research to be conducted “in a good way.”
References


60. Sanders EBN, Stappers, PJ. Convivial toolbox: Generative research for the front end of design. Amsterdam, Bis Publishers, 2012.


Appendices

Appendix A: The Modified Godin-Shephard Leisure Time Questionnaire

We would like you to recall your average weekly exercise over the past month. How many times per week on average did you do the following kinds of exercise over the past month?

When answering these questions please:
- Only count exercise that was done during free time (i.e., not occupation or housework).
- Note that the main difference between the three categories is the intensity of the exercise.
- Please include the average frequency (times per week) and the average duration for each respective category (i.e., Strenuous, Moderate, and Mild Exercise).

1a. **STRENUOUS EXERCISE** (HEART BEATS RAPIDLY, SWEATING)
(e.g., running, jogging, hockey, soccer, squash, cross country skiing, vigorous swimming, vigorous long distance bicycling, vigorous aerobic dance classes, heavy weight training)

<table>
<thead>
<tr>
<th>Times Per Week</th>
<th>Average Duration (min)</th>
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1b. **MODERATE EXERCISE** (NOT EXHAUSTING, LIGHT PERSPIRATION)
(e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

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<thead>
<tr>
<th>Times Per Week</th>
<th>Average Duration (min)</th>
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</table>

1c. **MILD EXERCISE** (MINIMAL EFFORT, NO PERSPIRATION)
(e.g., easy walking, yoga, bowling)

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<thead>
<tr>
<th>Times Per Week</th>
<th>Average Duration (min)</th>
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</table>

2. During a typical 7-Day period (a week), in your leisure time, how often do you engage in any regular activity **long enough to work up a sweat** (heart beats rapidly)?

<table>
<thead>
<tr>
<th>OFTEN (At least 3 times)</th>
<th>SOMETIMES (Normally 1-2 times)</th>
<th>RARELY or NEVER</th>
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## Appendix B: The Sedentary Behaviour Questionnaire

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>≤15 min</th>
<th>30 min</th>
<th>1 hr</th>
<th>2 hr</th>
<th>3 hr</th>
<th>4 hr</th>
<th>5 hr</th>
<th>6 hr</th>
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<tbody>
<tr>
<td>Watching television</td>
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<tr>
<td>Playing computer/video games</td>
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<td>Sitting while listening to music</td>
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<tr>
<td>Sitting and talking on the phone</td>
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<td>Doing paperwork or office work</td>
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<td>Sitting and reading</td>
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<td>Playing a musical instrument</td>
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<td>Doing arts and crafts</td>
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<td>Sitting and driving/riding in a car, bus, or train</td>
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On a typical weekend day, how much time do you spend (from when you wake up until you go to bed) doing the following?

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<thead>
<tr>
<th>Behaviour</th>
<th>≤15 min</th>
<th>30 min</th>
<th>1 hr</th>
<th>2 hr</th>
<th>3 hr</th>
<th>4 hr</th>
<th>5 hr</th>
<th>6 hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching television</td>
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<tr>
<td>Playing computer/video games</td>
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<tr>
<td>Sitting while listening to music</td>
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<tr>
<td>Sitting and talking on the phone</td>
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<tr>
<td>Doing paperwork or office work</td>
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<td>Sitting and reading</td>
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<tr>
<td>Playing a musical instrument</td>
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<tr>
<td>Doing arts and crafts</td>
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<td>Sitting and driving/riding in a car, bus, or train</td>
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## Appendix C: Intervention Timeline and Key Messages

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<tr>
<th>Week</th>
<th>Topic</th>
<th>Key Messages and Activities</th>
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<tbody>
<tr>
<td>1</td>
<td>Health Benefits of Physical Activity</td>
<td>• Introducing the 6-minute walk test and its importance in providing individualized physical activity plans</td>
</tr>
</tbody>
</table>
| 2    | Exercise Health Safety and Prescription | • The health benefits of routine physical activity and exercise  
• How to incorporate traditional and non-traditional Indigenous physical activities into an exercise program  
• How to modify and monitor the duration and intensity of exercise  
• How to exercise in areas with limited resource with optimal safety in both indoor and outdoor facilities |
| 3    | Goal Setting                   | • The health benefits of routine physical activity and exercise  
• Integrating SMART goals into traditional and non-traditional Indigenous physical activity and exercise programs |
| 4    | Indigenous Health and Wellness | • The opportunities and potential barriers to healthy living at the personal and community level  
• Sharing of individualized physical activity plans |
| 5    | Nutrition and Health           | • The relationship between nutrition and health in traditional Indigenous culture: a holistic approach  
• Key nutrition messaging, serving sizes, recommended caloric intake in the context of exercise, dietary recommendations |
| 6    | Goal Setting and Progression   | • Effective self-management strategies and tools  
• How to assess risk and develop strategies to reduce this risk |
| 7    | Healthy Lifestyle Behaviours   | • Strategies for self-monitoring and adjusting lifestyle behaviours  
• Indigenous understandings of health and wellbeing in the context of achieving optimal healthy lifestyle behaviours |
| 8    | Smoking and Alcohol            | • Effective strategies for reducing/eliminating smoke exposure and moderating alcohol consumption  
• Air quality and cardiovascular health |
| 9    | Resistance Training            | • Effective resistance training for health  
• Safety precautions when performing resistance exercises |
| 10   | Goal Setting and Progression   | • Effective goal setting, meal planning, adjusting program according to changes in health-related fitness |
| 11   | Stress Management              | • Identifying sources of stress and self-management  
• Indigenous knowledge and coping strategies |
| 12   | Relapse and Behaviour Change   | • Reflection upon adopted healthy living behaviours  
• Overcoming barriers to behaviour change  
• Highlighting key motivation and coping strategies |
| 13   | Goal Setting and Progression   | • Effective self-management strategies and tools  
• Feedback for education workshops |
### Appendix D: Summary of Co-Creation Responses

<table>
<thead>
<tr>
<th>Proposed Topics</th>
<th>Co-Creation Feedback</th>
<th>Education Design Principles</th>
</tr>
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</table>
| **Traditional Indigenous health and wellness knowledge** | - Sharing traditional Indigenous health and wellness knowledge was perceived as a culturally relevant method to connect the community to cultural teachings  
- Prayers and a spiritual understanding of why things were done were perceived to be important  
- Community-specific activities such as gathering, hunting, and berry picking (among other examples) were perceived to be a key part of relating teaching to culture | - Wherever possible, content should reflect traditional Indigenous practices and activities  
- Any information pertaining to traditional knowledge should be communicated as much as possible through oral storytelling, particularly by Elders |
| **Themes** | - There is a perceived loss of connection to traditional knowledge  
- Connection to traditional activities is deeply important  
- Oral storytelling (by Elders) is an important method to share traditional knowledge | |
| **Effects of residential schools and colonization** | - This topic was perceived to be an important part of their recent history, and is considered especially important for any non-Indigenous peoples to learn  
- Elders were described as “hurt and tired of talking about it”  
- Participants emphasized that no activities be made around interviewing people about their experiences, as it was described as too personal  
- Many of the effects were described: anger, shame, sadness, trauma, sexual abuse, alcohol and drug abuse | - Issues regarding addictions, mental health and trauma need to be considered through the lens of residential schools and colonization, and their ongoing influence through multiple generations  
- This topic needs to be carefully managed for cultural sensitivity to prevent any unintended hurtful outcomes |
| **Themes** | - Residential schools have impacted multiple generations, leading to social isolation, loss of language, and trauma associated with alcohol, drugs and abuse  
- Some Elders do not want to share these experiences | |
<table>
<thead>
<tr>
<th>Proposed Topics</th>
<th>Co-Creation Feedback</th>
<th>Education Design Principles</th>
</tr>
</thead>
</table>
| A holistic approach to health and wellness | • There is a strong connection between mental and physical wellbeing  
• Consulting Elders for advice was indicated  
• Emphasis was placed on the evolution of the medicine wheel  
• Reconnecting with the land and its natural resources is a key element in health and wellness | • A holistic approach (embedding the traditional medicine wheel’s emphasis on physical, mental, emotional and spiritual wellness) should form the basis of education on healthy lifestyles |
| **Themes** | | |
|  | • There is strong support for a holistic approach to improve the interconnectedness among the four aspects of wellness  
• Holistic perspectives of health and wellness share connections with traditional Indigenous health and wellness knowledge |  |
| Healthy lifestyle behaviours | • Discussions revolved around self-care, lifestyle choices and alternative practices such as meditation, walking, and yoga  
One suggestion was to have participants sign a “letter of commitment” to living a healthy lifestyle | • Connections to land-based activities are central to healthy lifestyle behaviours and holistic health and wellness |
| **Themes** | | |
|  | • Education should reflect cultural competency, emotional safety, and hands-on activities that build life skills |  |
| Risk of cardiometabolic disease in Indigenous peoples | • Chronic diseases were understood to be an issue in Indigenous populations  
• The concepts of “risks” and “disease” emphasized a negative connotation on these topics (deficits-based perspectives)  
• There is a need to consider and mitigate community-specific risk factors using a strengths-based approach | • When discussing chronic disease among Indigenous populations, include contributing factors such as the effects of socio-economic conditions and colonization  
• A strengths-based approach, rather than a deficits-approach, is needed to address this topic |
| **Themes** | | |
|  | • Increased knowledge and awareness needs to be Indigenous specific  
• Education needs to include the effects of colonization on disease  
• Disease status is related to socio-economic status, and access and the cost of food |  |
<table>
<thead>
<tr>
<th>Proposed Topics</th>
<th>Co-Creation Feedback</th>
<th>Education Design Principles</th>
</tr>
</thead>
</table>
| Community-based approaches to health and wellness   | • Ideas discussed: diabetes prevention program, Elder led activities, a recreation center, and education-focused camps  
• Creating a social norm around strengths-based health and physical activity is the goal  
• Identify and include community members who wanted change, e.g., local "champions"                                                                 | • The inclusion of families and community is important in developing sustainable changes toward strengths-based healthy living behaviours |
| **Themes**                                          |                                                                                                           |  
• Communities and families are key to building support  
• Talking/listening is key to engaging with the community

| Healthy lifestyle interventions to improve health and wellness | • Many ideas were discussed here, including: group support; motivation issues; use of an “Indigenous guru” who might record videos; dieticians and other health professionals  
• All activities should reflect a strengths-based approach  
• The focus should be on traditional, land-based activities that are led by community members and are inclusive of families | • Healthy lifestyle approaches should center around community-based learning  
• Activities must be strengths-based, land-based, family-oriented |
| **Themes**                                          |                                                                                                           |  
• Healthy behaviours should be taught through community-based and Indigenous led initiatives  
• Trauma is perceived as a result of residential schools and colonization

| Engaging Indigenous youth and Elders in community-based health and wellness interventions | • There is a need to groom young champions and role models  
• There is a need to provide support and education to families in need  
• Emphasis is on intergenerational teaching and learning | • Include Elders as a key component in knowledge dissemination as well as community engagement and building youth leadership |
| **Themes**                                          |                                                                                                           |  
• Healthy lifestyle interventions should include Elders and youth to create a safe space for intergenerational teaching and learning |