ASSESSMENT AND TRAINING OF PHYSICAL LITERACY
IN EARLY CHILDHOOD EDUCATORS

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in
THE FACULTY OF GRADUATE AND POSTDOCTORAL STUDIES
(Kinesiology)

THE UNIVERSITY OF BRITISH COLUMBIA
(Vancouver)

June 2019

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Assessment and training of physical literacy in early childhood educators

submitted by Elizabeth Jean Buckler in partial fulfillment of the requirements for the degree of Doctor of Philosophy in Kinesiology

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Abstract

Educators working in early childhood education and care receive little to no training in physical activity or physical literacy. However, they are expected to adhere to government standards for physical activity and skill development during the childcare day. This dissertation sought to determine what characterizes a successful intervention aiming to train educators in physical activity and/or physical literacy, what barriers and facilitators educators identify in meeting daily activity standards, what the physical literacy of educators is, and if educator physical literacy is associated with their behaviours and intentions to provide physical activity or physical literacy activities regularly. A systematic review was undertaken to parse apart the distinct characteristics of effective training interventions in physical activity or physical literacy. Training programs that provided ongoing support, relied on a theoretical framework, and objectively measured study fidelity were more successful. Educators were interviewed (n=24) to assess facilitators and barriers they face when implementing policy mandated activity standards. Results demonstrated that the personal values of educators facilitated adherence, and if physical space was poor, or resources were low, adherence was inhibited. Finally, a cross-sectional study measured the physical literacy of educators (n=94), and utilized regression analysis to determine relationships between measured physical literacy and self-reported behaviours and intentions to provide physical activity and/or physical literacy opportunities daily. Physical activity behaviour and understanding were high, but the remaining components of physical literacy were moderate. A relationship was found between educator self-reported intentions and behaviours for providing physical activity opportunities and the physical literacy component of understanding, but no relationship was found for the other components of physical literacy. The results of these three
studies demonstrate that educators are trainable in physical activity and physical literacy, but high-quality training programs that provide continued support and/or training for educators are needed. Training programs may not need to focus on the personal physical literacy of educators. Mandating training for educators to provide quality physical literacy opportunities to children should be a high public health priority.
Lay Summary

Early childhood (particularly ages 3-5 years) is an important time for the development of movement behaviours, including physical literacy and physical activity. Almost half of all Canadian children aged 0-4 attend childcare regularly under the care of an early childhood educator. Currently, educators receive minimal training in providing physical literacy opportunities. This dissertation aimed to determine what constitutes quality physical literacy training for educators and if the physical literacy of educators is associated with their provision of activity and skill opportunities. The three studies that make up this dissertation found that training programs are effective and should offer ongoing support to educators, but that educators may face barriers in the physical space and resources they utilize. Physical literacy training for educators should be mandatory during pre-employment training and updated with professional development workshops in order to provide high quality physical activity and physical literacy opportunities for children in childcare.
Preface

Chapter 2 is a systematic review undertaken in collaboration with my supervisory committee Drs. Faulkner, Puterman, and Beauchamp. I completed the search, title, abstract, and full article screening, data extraction, and data analyses. All first draft writing was undertaken by myself, with editing and input from Drs. Faulkner, Puterman, and Beauchamp. Two research assistants acted as second reviewers, Ms. Elizabeth de Souza conducted a secondary title, abstract, and full text screening, as well as a secondary data extraction. Ms. Elizabeth Rizzardo conducted a secondary risk of bias analysis.

Chapter 3 is a qualitative analysis of interviews conducted as part of a larger collaborative research project between the University of Victoria, the University of British Columbia, BC Children’s Hospital Research Institute, and Child Health BC. This qualitative project is nested within a larger quantitative research project evaluating the uptake of the Active Play standards and the related provincial capacity building workshop. I interviewed a portion (25%) of the participants, and Dr. Jennifer McConnell-Nzunga conducted the remaining 75% of the interviews. Interview transcription was conducted by a paid research assistant. I conducted all thematic analysis on the data. All first draft writing was undertaken by myself, with editing and input from Drs. Faulkner, Puterman, and Beauchamp.

Chapter 4 is a cross-sectional analysis of the physical literacy of early childhood educators. The conception of this project took place in collaboration with my committee members. I was present for all data collection. I completed all data analyses with support and guidance from my
committee members. All first draft writing was undertaken by myself, with editing and input from Drs. Faulkner, Puterman, and Beauchamp.

Chapter 3 received ethical approval from Research Ethics BC Harmonized ethics board and is covered under certificate number BC16-128

Chapter 4 received ethical approval from the University of British Columbia’s Behavioural Research Ethics Board and is covered under certificate number H18-00666.
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List of Abbreviations

AP standards = active play standards

BC = British Columbia

BOT-2 = Bruininks-Oseretsky Test of Motor Proficiency, Second Edition

CI = confidence interval

CPM = counts per minute

CVD=cardiovascular disease

ECE = early childhood educator

ECEC = early childhood education and care

FMS = fundamental movement skills

HOP = Healthy Opportunities for Preschoolers

LTAD = Long-Term Athlete Development

LS = locomotor skills

MPA = moderate physical activity

MVPA = moderate to vigorous physical activity

NL = non-locomotor skills

OA=osteoarthritis

OC = object control skills

PA = physical activity

PAR-Q+ = physical activity readiness questionnaire

PICOS = population, intervention, comparison, outcome, study design

PL = physical literacy

RCT = randomized controlled trial
SB = sedentary behaviour

SC = step count

SKIP = Successful Kinesesthetic Instruction for Preschoolers

TGMD-2 = Test of Gross Motor Development

TPA = total physical activity

VPA = vigorous physical activity
Acknowledgements

This dissertation would not have been possible without the support and guidance of my supervisory committee, Dr. Eli Puterman, Dr. Guy Faulkner, and Dr. Mark Beauchamp. Your mentorship has shaped me as a researcher. I am beyond grateful to have had the opportunity to work with the three of you. I would like to acknowledge the funding agencies who provided financial support for my research, including the Canadian Institutes of Health Research, the UBC Faculty of Education, and the UBC School of Kinesiology. My sincere gratitude to the many members of the FAST and POP-PA Lab for your support, including Annie Lasinsky, Sarah Koch, Ben Hives, Luke Peddie, Negin Riazi, and Krista Glowacki. Thank you to the many research assistants who dedicated their time to my project, including Liz de Souza, Beth Rizzardo, Sioban McCormick, Tommy Yang, Spencer Pratt, Madisen Obrovac, Haley Montgomery, and Ally van Tassel. To my family, I thank you for the endless support you have provided me over my graduate school endeavors, and for literally and figuratively talking me up the hill every day. Finally, to Rob and Ellie, thank you for keeping me smiling.
For Bupup
Chapter 1: Introduction

Physical literacy represents a growing area of research in physical activity, health, and public policy. Physical literacy is the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activity for life (Whitehead, 2013). Physical literacy is gaining momentum as a potentially valuable, modifiable influence on engagement in important health behaviours, particularly participation in physical activity and a reduction in sedentary behaviour (Belanger et al., 2018; Cairney, Dudley, Kwan, Bulten & Kriellars, 2019a). The relationship between physical literacy and physical activity may be reciprocal, and ongoing research efforts are needed to determine causality (Cairney et al., 2019a). While physical literacy is characterized as a lifelong process, importance should be placed on ensuring children begin that journey positively.

Early childhood, particularly the preschool years (ages 3-5), is a significant time in motor development, as children move from developing rudimentary movement skills, such as walking and balancing, to more complex movement skills, such as jumping, throwing, and kicking (Gallhue, Ozmun & Goodway, 2012; Payne & Isaacs, 2016). Approximately 50% of Canadian parents utilize early childhood education and care (ECEC) for their 0-4-year-old children (Sinha, 2014). These services represent a valuable point of contact to enhance the physical literacy experiences of children during this critical developmental time. Physical literacy of children is increasingly being called for in public policy; for example, in British Columbia, licensed ECEC centres must follow newly released Standards for Active Play (AP Standards; Government of British Columbia, 2016). These standards provide direction for time spent in physical activity, outdoor physical activity time, and the provision of opportunities for children to develop
fundamental movement skills and physical literacy (Government of British Columbia, 2016). Little is known about the capacity of educators working in ECEC to promote physical literacy, and an exploration of this is necessary.

This dissertation aims to explore the potential of training educators in physical literacy and physical activity as well as to investigate the physical literacy of educators and how this is related to their provision of opportunities for developing physical literacy among the children under their care. This chapter provides an overview of the background literature, unpacking the importance of physical activity, fundamental movement skills, and physical literacy during the early childhood years, and positioning fundamental movement skills within physical literacy. Additionally, the philosophical standpoint of this dissertation in reference to physical literacy is presented. Finally, rationale for the three included studies, and their unique contribution to the literature is described. Chapter 2 is a systematic review investigating the characteristics of successful interventions that aimed to train educators in physical activity and/or physical literacy. Chapter 3 is a qualitative examination of the barriers and facilitators faced by British Columbian educators in implementing mandated standards for physical activity and physical literacy, as well as how participation in a provincial training workshop supported the implementation of these standards. Chapter 4 is a cross-sectional study assessing the physical literacy of a sample of early childhood educators, as well as an analysis of the relationship between educator physical literacy and self-reported provision of physical literacy activities to children in ECEC. Chapter 5 compares and contrasts the data in these three studies, and provides recommendations for future study in this field. Table 1.1 provides an outline of the main body chapters.
Table 1.1
Overview of main body chapters of the dissertation, Chapters 2, 3 and 4

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<td>Systematic review</td>
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1.1 Fundamental Movement Skills

There is substantial research on the relationship between fundamental movement skills and physical activity. Fundamental movement skills are foundational movement patterns, sometimes referred to as the letters and words of physical literacy, and can be positioned within the physical competence component of physical literacy. Three major sub-categories of fundamental movement skills exist, including: locomotor (e.g., running, jumping, skipping), manipulative (e.g., throwing, catching, kicking), and non-locomotor (e.g., balance, swaying,
twisting). Fundamental movement skills appear to be a relevant and modifiable predictor of lifelong physical activity. Research has shown that children with high fundamental movement skill proficiency are more likely to be active and fit adolescents and adults (Barnett, van Beurden, Morgan, Brooks, & Beard, 2008; Barnett, van Beurden, Morgan, Brooks, & Beard, 2009; Lubans, Morgan, Cliff, Barnett, & Okely, 2010; Wrotniak, Epstein, Dorn, Jones & Kondilis, 2006). There are various sets of skills labeled as fundamental movement skills within the literature. These skills provide the foundation for activity-specific skills, with basic movement patterns having the potential to be further refined (Robinson et al., 2015; Stodden et al., 2008). For example, a child who masters the basic skill of kicking has the potential to progress towards mastering a field goal, a corner kick, and a home run in kickball. Fundamental movement skills extend beyond sport and physical activity participation, acting as the foundation for activities of daily living (e.g., dodging out of the way of a cyclist on the sidewalk or jumping to reach an item on a high shelf). A baseline level of proficiency in these foundational skills is necessary for participation in physical activity and activities of daily living.

Each fundamental movement skill has a specific age range in which typically developing children are capable of acquiring the skill. In general, proficiency in locomotor skills is achieved first, with running identified as one of the first skills acquired (Gabbard, 2012; Gallahue et al., 2012; Payne & Isaacs, 2016). Complex manipulative skills, such as catching, are achieved later due to the necessity of sensory-perceptual development (Gabbard, 2012; Gallahue et al., 2012; Payne & Isaacs, 2016).

Despite the clear importance of fundamental movement skills, there is a paucity of evidence to indicate changes in proficiency levels across generations. However, there is growing evidence that today’s children are performing fundamental movement skills at levels below
previously established norms, which may indicate a population level decline in fundamental movement skill proficiency (Burrows, Keats & Kolen, 2014; Foulkes et al., 2015; LeGear et al., 2012; Okeley & Booth, 2004). Without historical data, there is no acceptable proficiency barrier for motor competence, but research indicates that the motor competence of children has the potential to improve with effective instruction (Hardy, Barnett, Espinel & Okely, 2013). Within Canada, there is no empirical evidence that children are not performing fundamental movement skills with proficiency, nor evidence to suggest that Canadian children have sufficient movement skill proficiency. However, there is evidence that the fitness of Canadian children has declined significantly from 1981 to 2007-2009, with demonstrated significant differences in flexibility and strength (Tremblay et al., 2010). These declines in fitness may also be indicative of declines in movement skill proficiency, as many movement skills require a degree of fitness to perform, for example, the minimum strength needed to propel oneself off the ground in a two-foot jump.

Movement skill proficiency does not arise spontaneously as children grow and mature (innate development), but is learned through practice (Clark, 1995). This is not to say that the growth and maturation of the skeletal, muscular, and nervous systems do not play a vital role in the acquisition of movement skills, but that the development of these systems does not solely equate to skill acquisition (Clark, 1995). Children need frequent opportunities and appropriate learning environments to practice and refine these skills, and may even require feedback to augment the learning of a skill (Clark, 1995; Saemi, Wulf, Varzaneh, & Zarghami, 2011; Saloni, Schmidt, & Watler, 1984). Providing these opportunities, environments, and feedback at age- and developmentally-appropriate timelines is critical.

Early childhood may be the most beneficial time for intervention and training of fundamental movement skills, as the majority of fundamental movement skills can be achieved
by the end of this period (Gabbard, 2012; Gallahue et al., 2012; Payne & Isaacs, 2016). This is also supported by a model, introduced by Stodden and colleagues (2008) and further developed by Robinson and colleagues (2015), describing the relationship between fundamental movement skill proficiency, perceived skill competence, and physical activity engagement. A child needs both the skill set, and the perception of competence in the skill set, to engage in activities requiring these skills (Stodden et al., 2008). However, during early childhood, children do not possess the cognitive skills to accurately assess skill proficiency as they use effort or persistence to assess their competence (Harter, 1999; Harter & Connell, 1984; Nicholls, 1978; Nicholls & Miller, 1983). This was reflected in LeGear et al.’s (2012) study, which demonstrated that most children ranked their perceived skill competence as high, despite low measured skill proficiency. As such, it is important that children are provided appropriate opportunities to learn and refine fundamental movement skills, prior to developing the cognitive skills to more accurately self-assess or compare the self to others. Within the field, scholarly societies, researchers, and public policy makers advocate for the need to focus on movement skill proficiency in the early years (BC Ministry of Education, N.D.; Government of British Columbia, 2016; Lu & Montague, 2016; NASPE, 2011). LeGear et al. (2012) refer to this as a “window of opportunity” for training fundamental movement skills, as children may be less likely to give up or self-exclude from participation or practice during the early childhood age range.

1.2 Physical Activity

The health benefits of participation in physical activity throughout life are well-documented (Carson et al., 2016; Carson, Chaput, Janssen & Tremblay 2017a; Carson et al., 2017b; Janssen & Leblanc, 2010; Pedersen & Saltin, 2015; Timmons et al., 2012). Increased
physical activity is associated with better physiological, psychological, and cognitive health. These benefits are typically associated with meeting public health physical activity guidelines. In Canada, the physical activity recommendations for adults are 150 minutes of moderate to vigorous physical activity per week in bouts of a minimum of 10 minutes (Tremblay et al., 2011). For children aged 5-18 years, physical activity guidelines recommend 60 minutes of moderate to vigorous physical activity each day, and these guidelines are incorporated into broader 24-hour movement guidelines (Tremblay et al., 2016). The 24-hour guidelines include minimum sleep time, maximum time in leisure-time sedentary screen activities (e.g. watching television), and a general recommendation to include as much light physical activity as possible. For the early years, physical activity recommendations call for 180 minutes of physical activity at any intensity (light physical activity to vigorous physical activity) working towards 60 minutes of “energetic play” which can be loosely defined as moderate to vigorous physical activity (Tremblay et al., 2017). Like the guidelines for older children, these are incorporated into 24-hour movement guidelines.

Despite the clear guidelines, and well-known health benefits of physical activity, population levels of physical activity remain low (Colley et al., 2011; 2017). Approximately 15% of Canadian adults do not meet activity guidelines (Colley et al., 2011). For children and youth, 7% meet daily physical activity guidelines on 6 of 7 days of the week (Colley et al, 2017). For children aged 3-4 years, the results are more promising, with 73% of children meeting the guidelines (Garriguet et al., 2016). However, this participation drops significantly at age 5, with only 30% of children meeting physical activity guidelines. At age 5, the guidelines shift from 180 minutes of physical activity at any intensity, to 60 minutes of moderate to vigorous physical activity every day, which may account for this apparent sharp decline in participation.
High physical activity participation in the early years may not be sufficient to track into adolescence and adulthood. As children age and become adolescents and adults, there is a marked decrease in physical activity participation (Sallis, 2000); therefore, if participation in physical activity were higher or of a greater intensity during the early years, this decrease may be mitigated by already higher participation levels. Children aged 9-18 years who have high physical activity levels are more likely to be active as adults (Telama et al., 2005). That said, the mechanisms explaining the decrease in participation in physical activity with increasing age are not well understood, and an increase in participation in activity at a certain point in time may not be enough to attenuate the sharp decline in participation seen with age.

1.3 Physical Literacy

The most commonly accepted definition characterizes physical literacy as the motivation, confidence, physical competence, knowledge, and understanding to value and take responsibility for engagement in physical activities for life (Whitehead, 2013). Physical literacy originated in the field of physical education, and was introduced by Whitehead in 2001 as a philosophical framework to support a non-traditional physical education model, where summative physical outcomes are not the only goal of the physical education program. However, even Whitehead’s earlier work (see Whitehead, 1990) presented foundational concepts of physical literacy. In 1993, Whitehead presented an unpublished paper at the International Association for Physical Education and Sport for Girls and Women Congress, which is considered the first modern discourse of physical literacy (Whitehead, 2001). Whitehead is widely regarded as the “modern champion” of physical literacy (Cairney, Kiez, Roetert & Kriellaars, 2019b; Dudley, Cairney,
Alternative definitions of physical literacy also exist. For example, Higgs (2010) framed
physical literacy in a sport relevant, long-term athlete development model (LTAD). However,
this type of definition does not reflect the holistic, multidimensional nature of physical literacy,
and is exclusive of those who pursue physical activity opportunities outside of sport. In 2015, at
the International Physical Literacy conference, Canada released a consensus statement developed
in consultation with Canadian and international experts defining physical literacy in line with
Whitehead’s (2013) definition (Tremblay et al., 2018a). This definition (the motivation,
confidence, physical competence, knowledge, and understanding to value and take responsibility
for engagement in physical activities for life) will be employed throughout this dissertation.

The core components of physical literacy (motivation, confidence, physical competence,
knowledge and understanding) contribute to the overall holistic concept of physical literacy, but
can each be defined in isolation. Motivation reflects the intrinsic desire to participate in physical
activity (Whitehead 2010; 2013). Confidence relates to belief in one’s capability to participate in
physical activities (Whitehead, 2010). Physical competence represents an individual’s physical
movement capabilities, where one moves efficiently and effectively in varying environments
(Dudley et al., 2017; Jurbala, 2015; Whitehead 2010; 2013). Fundamental movement skills are
considered to be an important component of these movement capabilities. Knowledge and
understanding are typically linked, relating to one’s ability to describe what makes movement
effective and to know and value the health benefits of physical activity (Whitehead, 2010; 2013).
In its current, modern conceptualization, the theoretical basis of physical literacy highlights the
concept that the elements of physical literacy, namely motivation, confidence, physical
competence, knowledge, and understanding, are interrelated, and influence the development of each other (Whitehead, 2010). For instance, a motivated child may be more likely to develop confidence and physical competence through increased participation (Cairney et al., 2019a; Whitehead, 2010).

Physical literacy is rooted in monism, a philosophical perspective that positions the individual as one, where mind and body are the same, and frames the physical literacy journey as one with no end point or goal (Whitehead, 2010; Whitehead, 2001). This monistic viewpoint is in opposition to a dualistic framework where the individual is made up of mind and body, which are separate (Whitehead, 2010). In a dualistic framework, specific movement outcomes or age ranges are utilized to examine the movement capacity of individuals (Whitehead, 2010). Beyond this, physical literacy embraces the concept of embodied movement, defined as the human capacity to interact with the world through physical movement (Whitehead, 2010). Physical literacy provides a means to describe the development and change in the ways humans physically interact with their world. Physical literacy in early infancy represents the development of rudimentary movement skills through trial and error. In early to middle childhood, children develop movement skills through affordances opportunity, instruction, and games, augmented by the innate confidence they have in themselves. In adolescence and adulthood, movement skills are refined and applied to sport and activity specific contexts, and motivation and confidence are built upon. Finally, in older adulthood, individuals may experience age-related declines in movement capacity, but continue to engage in high levels of physical activity. Physical literacy captures each of these different experiences (Whitehead, 2010; Whitehead 2013). At each of these life stages, there is opportunity for embodied interaction with the world. A positive
physical literacy journey is one that allows the individual to engage in joyful, engaged movement experiences.

1.3.1 Physical Literacy in Current Literature

Physical literacy has gained increasing attention, both expanding its research in the realm of physical education, and gaining relevance in health promotion and public policy research. (Belton, Issartel, McGrane, Powell & O’Brien, 2019; British Columbia, 2016; Cairney et al., 2010; Dudley et al., 2017; Giblin, Collins, & Button, 2014; Jurbala 2015; Mandigo, Francis, Lodewyk, & Lopez, 2009). Physical literacy provides a relatable metaphor, using the concept of reading skills, or traditional literacy, as a rationale for the importance of physical activity (Mandigo et al., 2009 is one such example of this metaphor use). Researchers, including Dudley and colleagues (2017) point to the United Nations Educational, Scientific, and Cultural Organization who note that achieving literacy requires more than the acquisition of a basic skill set (UNESCO, 2006). Simply having the foundational skills to read is not enough to be a literate individual, and similarly, having the foundational movement skills is not enough to be a physically literate individual. With an increasing public focus on the low physical activity of children, physical literacy acts as a relatable and powerful metaphor to use in health communication and advocacy efforts.

The increased attention research and policy have placed on physical literacy has led to an increase in debate over what physical literacy is and how it should be studied or utilized. A number of position papers, reviews, and opinion pieces have been published in the past five years, describing and debating the perspectives from which researchers should examine physical literacy. Notably, Jurbala (2015) highlighted the four likely perspectives from which physical
literacy is considered: phenomenological physical literacy, physical literacy as motor
development, practical physical literacy, and physical literacy in policy. Phenomenological
physical literacy examines physical literacy from a philosophical standpoint, in line with
Whitehead’s work, where engagement in movement is undertaken with the whole self, with mind
and body working together. Physical literacy as motor development encapsulates the perspective
that participation in activity and sport is enhanced through the development of fundamental
movement skills, or foundational skills that form the basis of activity and sport specific skills.
Those who acquire or develop proficient fundamental movement skills can progress to more
complex movement skill sets. Practical physical literacy examines the competencies of physical
literacy and what the benefits are for those who hold these competencies. Practical physical
literacy is also employed in a physical education context in that teachers look for means to assess
and develop physical literacy, particularly from a school or grades-based standards approach.
The physical literacy in policy perspective views physical literacy as a “slogan” or inspirational
message in physical education and sport, particularly sport achievement, as a means for
successful participation. Jurbala concluded that physical literacy in all of these areas has
potential to inspire and engage individuals in physical activity. However, a greater body if
empirical evidence is needed to support physical literacy as a means to promote behaviour
change.

Considerable research has been published on physical literacy in the few years following
Jurbala’s paper outlining the four perspectives of physical literacy. I would argue that practical
physical literacy should be divided into physical literacy in physical education and physical
literacy in health, as the outcome goals of education and health research are not always
synonymous. In the current dissertation, I conduct research that traverses four areas of physical
literacy: physical literacy as motor development, physical literacy in physical education, physical literacy in health, and physical literacy in policy. I acknowledge the value of phenomenological physical literacy, and recognize that incorporating this concept into physical education, health, and policy research perspectives is important. Several researchers have worked to incorporate phenomenological physical literacy to their health and policy research perspectives (Cairney et al., 2019a; 2019b; Dudley et al., 2017; Robinson & Randall, 2016). However, research, particularly quantitative research, has inherent dualistic qualities that will stray at times from the roots of phenomenological physical literacy. This compromise is necessary given that population physical activity levels are very low, and before we can engage the population in embodied movement, we may first need to engage the population in physical activity at all.

1.3.1.1 Physical Literacy as Motor Development

Motor development is the relationship between a growing and maturing person and the interaction they have with their environment (Payne & Isaacs, 2016). Like physical literacy, motor development takes a lifespan approach in viewing the human experience. However, researchers have in the past conflated physical literacy and motor development, while reducing both physical literacy and motor development to simply fundamental movement skills. Fundamental movement skills should be viewed as a key component of physical literacy embedded in physical competence, but that needs to be augmented by information on motivation, confidence, knowledge, and understanding. Many definitions and measures of physical literacy incorporate fundamental movement skills (CS4L 2018; Higgs, 2010; Lodewyk & Mandigo, 2017; Tremblay et al., 2018). While physical literacy should not be reduced to fundamental movement skills, these skills are included within the physical literacy model as a component of
physical competence. Having the capability to perform skills needed to be active may not be enough to engage all people in physical activity, and instilling motivation, confidence, and knowledge in children to be active will increase the likelihood of participation. Two other models, Stodden and colleagues’ (2008) model, and the LTAD incorporate fundamental movement skills and are often used as representations of physical literacy, but are insufficient or inappropriate models to describe physical literacy.

Stodden and colleagues’ (2008) model interlinks physical activity, perceptions of skill competence, and actual skill competence. This research generated to support this model is used frequently as initial empirical evidence for the importance of physical literacy in health and development (Cairney et al., 2019a; Jurbala, 2015). Researchers have acknowledged the shortcomings of this model, namely the psychological or cognitive elements are limited to perceived skill competence (Cairney et al., 2019a). One could consider physical literacy an extension or new layer from which to examine these interrelationships, but this model, and that of Whitehead’s (2010) are distinct. The LTAD model has adopted physical literacy as a key component to athlete development (Higgs, 2010; Jurbala 2015). While I do not dispute the role of physical literacy in athlete development, physical literacy is not solely restricted to the realm of athletes. The LTAD is typically used with the intention of developing high performance athletes, which excludes the majority of the population. While the LTAD does attempt inclusivity with an “Active for Life” category, the stage based model focuses on preparing children and adolescents to compete and succeed in athletics (Sport for Life, 2019). Physical literacy may provide a more balanced approach to athlete development in Canada, but a solely sport-based model is not representative of a population approach to improving physical activity behaviour.
There are important links between physical literacy and motor development. The progression from infancy onwards, and recognition of individual and developmental differences provide important overlap between the two. However, the concepts are also distinct. When motor development is considered from a lifelong perspective it is not solely focused on an individual’s physical activity participation in the way physical literacy is. Motor development also focuses on other aspects of movement acquisition as well as the role of maturation. This may include fine motor skill acquisition (e.g. for writing), the role of motor competence in developing cognitive skills (e.g. posture needed to read), and fetal development (Gabbard, 2012; Gallahue et al., 2012; Payne & Isaacs, 2016). While researchers in the fields of physical literacy and motor development should collaborate and learn from each other, the two should not be considered synonymous.

1.3.1.2 Physical Literacy in Physical Education

Several papers have focused on what role physical literacy should play in a physical education context (Lundvall, 2015; Mandigo et al., 2009; Roetert & MacDonald, 2015). Three key themes are prevalent in these papers: what physical literacy means in an education context (and are alternate definitions or explanations needed?), what should the learning outcomes of physical literacy be, and how should educators assess physical literacy in a school context. A number of papers noted that physical literacy should be contextualized and applied to physical education in order to make the concept accessible to working educators. Lundvall (2015) noted that, historically, physical education has lacked a shared philosophy (Lundvall, 2015). Mandigo and colleagues (2009) highlighted that in 2009, prior to the release and acceptance of Whitehead’s definition of physical literacy, the working definition of physical literacy in Canada
had been developed in relation to the LTAD in a sport context. A physical education specific
definition was needed, not to separate it from sport, but in order to work with sport effectively.
They proposed a working definition of physical literacy for physical educators (p.28):

“individuals who are physically literate move with competence in a wide variety of
physical activities that benefit the development of the whole person. Physically literate
individuals consistently develop the motivation and ability to understand, communicate,
apply, and analyze different forms of movement. They are able to demonstrate a variety
of movements confidently, competently, creatively, and strategically across a wide range
of health-related physical activities. These skills enable individuals to make healthy,
active choices throughout their lifespan that are both beneficial to and respectful of
themselves, others and their environment.”

The role of sport in a physical literacy based physical education curriculum is debated.
Mandigo and colleagues (2009) looked to physical literacy as a potential bridge between sport
and physical education, whereas Roetert and MacDonald (2015) discouraged using sport in a
physical education context. Sport should be used with care and caution in a physical education
context. Relying on sport as the primary education tool, particularly when competition is used,
will increase self-comparison to other students and potentially increase activity withdrawal
amongst students with low movement skill capability (Roetert & MacDonald, 2015). Students
should be exposed to a wide variety of physical activity types, including sport. Ultimately, the
learning environment of a physical literacy driven physical education curriculum may differ
significantly from a traditional model, where reliance on team sports and competition is high.
Roetert and MacDonald (2015) suggested a mastery-oriented climate, where practice
opportunities are high and individual learning is tracked.
Assessment is a key component of physical education. Educators are required to provide grades or progress reports to students and their parents. Many researchers share the view that scores or grades assigned to students should focus on individual assessment and progress, and performance should not be compared to population norms (Lundvall, 2015; Mandigo et al., 20019; Roetert & MacDonald, 2015). Comparison between peers should not be encouraged in the context of physical literacy, which Lundvall (2015) stated strongly. Lundvall (2015) discourages educators from using outcome based performance assessments (e.g. speed and strength) and inter-student comparisons. These types of comparative or outcome based assessments may reduce confidence in students who perform at a level below their peers. The context of assessment demarcates physical literacy in an education context versus physical literacy in a research context. Assessment in the context of summative educational reporting (e.g. end of term grades) should not be confused with assessment in a research specific context where measurement of intervention or program effectiveness is the goal. In a research context, care should be taken to minimize sharing of results between students. When results are reported to child participants or their parents, researchers should consider removing percentile or normative rankings. Gathering important research data should not be done at the expense of the confidence or enjoyment a child has in a physical activity experience.

1.3.1.3 Physical Literacy in Health

Physical literacy has been proposed as a potential determinant of health (Cairney et al., 2019a). Cairney and colleagues (2019a) published a review where they positioned physical literacy as a health determinant within the existent motor development and phenomenological physical literacy research (Cairney et al., 2019a). Cairney and colleagues’ (2019a) model is
illustrated in Figure 1.1, where the interrelationships between components of physical literacy are shown, as well as the relationship between physical literacy and health. Importantly, this review sought to distinguish physical literacy from existent motor development models, and identify physical literacy as a health determinant. For example, Stodden and colleagues (2008) model links perceptions of movement capability and actual movement capability to engagement or disengagement in physical activity, and Cairney and colleagues (2019a) highlighted that this

Figure 1.1. Conceptual model linking physical literacy, physical activity and health. Note: CVD=cardiovascular disease, OA=osteoarthritis
model fails to incorporate motivational factors beyond perceived motor competence when
compared to physical literacy. Developmental coordination disorder, a condition identified by
idiopathic motor coordination difficulties, was presented as a case study to examine the
relationship between physical literacy and health. Children with developmental coordination
disorder tend to withdraw from both formal and informal physical activities, have lower
motivation and self-efficacy for physical activity than their peers, are more likely to experience
social isolation, and have increased risk of overweight or obesity and metabolic syndrome.
Cairney and colleagues (2019a) postulated that children with developmental coordination
disorder represent an example of what physical illiteracy may present as, and the resultant health
concerns presenting in this population indicate that poor physical literacy may directly impact
health. This initial examination of physical literacy as a health determinant presents a foundation
to establish further health promotion and policy research.

1.3.1.4 Physical Literacy in Policy

Jurbala (2015) positioned physical literacy in policy as simply a “slogan” or message for
physical activity promotion. While the use of physical literacy as a messaging may have merit in
inspiring interest in the idea, if policy makers wish to effectively use the concept to generate
population behaviour change then a more critical look is needed. Dudley and colleagues (2017)
provided context in which physical literacy in policy can be more than just “slogan” or
messaging with four pillars of physical literacy policy: movement competencies, movement
contexts, the journey of movement, and the power structures of movement.

Movement competencies are often categorized as fundamental movement skills in the
literature; however, it is highlighted that fundamental movement skills are typically measured on
land, in able-bodied individuals and are not a comprehensive assessment of all types of movement. In a policy context, agencies should provide opportunity for the acquisition of movement competencies, but that broad, diverse experiences should be provided, and early specialization should be avoided. I acknowledge the concerns presented by Dudley and colleagues (2017) regarding the current assessment of movement skills in land-based settings only. However, financial, time, and safety-constraints make the use of water, air, ice or snow based skill assessments challenging, but as researchers we need to strive to work creatively and in collaboration to account for the varied environments movement skills are performed in.

Movement contexts represent the idea that “physical literacy is situated, practiced, and applied in context” (p. 443). That is to say, that physical activity is no longer practiced for human survival, as in an evolutionary context, and instead the strategies, tactics, and rules of physical activity are socially constructed and must be understood for participation. Policy makers must consider the social and environmental factors that influence participation, and work to promote equitable and inclusive activity contexts.

The journey of physical literacy describes the changing movement experiences of individuals throughout the lifecourse. Of particular relevance to this dissertation, is the notion that the preschool years are critical for the foundation of physical literacy, and everyone who is in contact with a child should be promoting physical activity, and physical literacy. When generating policy recommendations to promote the journey of physical literacy, policy makers should consider that individuals need to be prepared to engage in movement experiences they will face now, but also the capacity to adapt these movement competencies for new experiences in the future.
Finally, the power structure of movement reflects on the sociocultural barriers individuals may face. Populations who are marginalized face greater barriers to physical activity participation. Women and girls, people who identify as lesbian, gay, bisexual, transgender, or queer (LGBTQ+), individuals living with a disability, and people from a marginalized or minority culture are at increased risk of disengagement from physical activity due to these barriers. Those in a position of power need to first recognize these imbalances, and then engage with these populations to determine how best to provide equitable opportunity. When developing policy, researchers and stakeholders should reflect on the pillars of physical literacy in policy to ensure these policies are reflective of physical literacy, are fair and equitable, and ultimately have a goal of improving the health of the entire population.

1.3.1.5 Philosophical Viewpoint of this Dissertation

For the purpose of this dissertation, I took a pragmatic approach. In the interest of promoting public health and engaging a greater portion of the population in physical activity, I recognize that measurement and promotion of physical literacy is necessary in order to conduct quality health promotion research. However, measurement of physical literacy in a research context should differ from measurement and tracking in a physical education context. As Lundvall (2015) said, physical educators should “discontinue an assessment practice based on how fast, high, or strong a student’s performance is and what separates students in terms of performance” (p. 116). In research, the use of objective classification measures that examine differences between and within individuals may be necessary, particularly when the issue of causality is in question. This viewpoint deviates from the monistic framework physical literacy is
The use of physical literacy outside of a phenomenological lens is beneficial for other research fields, as the metaphor of physical literacy draws significant attention to the importance of physical activity for health, and creates parity between physical literacy and other educational outcomes, such as language, science and math (Roetert & MacDonald, 2015). Currently, population engagement in physical activity is low, and because of this, it stands to reason that the majority of the population is not engaging in embodied movement. Public health agencies, physical educators, and health researchers should consider where common ground lies and work creatively to engage individuals of all ages in health promoting physical activity, and physical literacy presents an opportunity for this. Physical literacy provides an important perspective where every individual is considered, and incorporating this into health and policy research will serve to elevate these fields. I acknowledge the spirit of Whitehead’s (2013) conceptualization of physical literacy and aspire to incorporate that spirit whenever possible in this dissertation; however, I recognize that my pragmatic approach results in some deviation from the original conceptualization.

1.3.2 Physical Literacy Assessment

The issue of measurement in physical literacy has been a topic of significant debate. On the one hand, health and education researchers, and public policy makers seek reliable assessment tools to measure changes, which are necessary to make a case for financial funding for projects (e.g. research grants, allocation of government funds; Cairney et al., 2019a). Researchers on this side of the debate also highlight the need for an increasing toolkit to promote
physical activity participation, particularly given low population levels of inactivity, and likely in turn low levels of physical literacy (Cairney et al., 2019a; Longmuir & Tremblay, 2016). Cairney and colleagues (2019a) highlighted the potential of physical literacy as a powerful messaging tool for health promotion. They further state that measuring physical literacy outcomes in conjunction with physical activity behaviour may contextualize physical inactivity and aid in the generation of new intervention strategies to engage the population in activity.

Any measurement of physical literacy presents issues for researchers who adhere strongly to phenomenological physical literacy (see Robinson & Randall, 2016). These researchers highlight that measurement and tracking of physical literacy milestones takes on a dualistic perspective, where physical literacy can be “achieved”. If we are to stay true to the original definition and qualities of physical literacy, quantitative measurement is not possible. Edwards and colleagues (2017) noted that quantitative measures of physical literacy alone may not be sufficient, and qualitative measures may provide additional supplement to this. However, I would argue that from a population perspective, attempting to track and quantify physical literacy is important.

Assessing physical literacy is a challenging task. The multiple components of motivation, confidence, physical competence, knowledge, and understanding are difficult to measure with only one assessment tool (Edwards et al., 2018). Using fundamental movement skills as a singular measure of physical literacy has been criticized in the literature, as it does not provide a full picture of physical literacy, and reduces physical literacy to a one-time assessment or a set of skills to be achieved, versus the lifelong, changing journey that it is defined as (Edwards et al., 2018; Robinson & Randall, 2016). For the purpose of this dissertation, I acknowledge the difficulty in generating a measurement tool that is true to Whitehead’s conceptualization of
physical literacy, but from a research perspective, particularly a funding perspective as highlighted by Cairney and colleagues (2019a), the generation of reliable tools that can assess population progress on their physical literacy journey is necessary. I also acknowledge that true physical literacy may never be completely measured through quantitative means. A summary of the existent assessments of physical literacy utilized in Canada follows.

In Canada, three “families” of physical literacy assessment tools are in existence. The Physical Literacy Assessment for Youth (PLAY) Tools, the Canadian Assessment of Physical Literacy (CAPL), and Physical and Health Education Canada’s Passport for Life (Lodewyk & Mandigo, 2017). The CAPL assesses physical literacy in four domains: motivation and competence, knowledge and understanding, daily behaviour, and physical competence in children 8-12 years of age (Longmuir et al., 2015). The PLAY Tools are composed of a series of physical literacy assessments for youth (aged 7-12 years), including teacher, parent, and self-assessments, and an assessment for children and youth with disabilities (Cairney et al., 2018a; CS4L, 2018). The PLAY tools focus on the physical competence domain of physical literacy, subdivided into five components: running, locomotor skills, upper and lower body object controls skills, and balance, stability and body control (CS4L 2018). Recently, an assessment of physical literacy for the early years, The Preschool Physical Literacy Assessment Tool, was added to this tool set (Cairney et al., 2018b). Passport for Life is intended to be used in a physical education setting as a formative assessment tool of physical literacy, and researchers have published internal consistency and test-retest reliability data for children in grades 3-9 (Lodewyk & Mandigo, 2017). Passport for Life provides measures of four components of physical literacy: active participation, living skills, fitness skills and movement skills (Lodewyk & Mandigo, 2017). Robinson and Randall’s (2016) critique of the three Canadian physical literacy tools
determined that Passport for Life provides the most well-rounded assessment, with the smallest focus on physical competency. However, it should be noted that Passport for Life is intended to be a practitioner (e.g. physical education teacher) tool, whereas the CAPL can be utilized by educators, but is also intended to be used as a population monitoring tool (Longmuir et al., 2015). That said, a recent publication utilized Passport for Life to assess an after-school intramural program in elementary school aged children; therefore, the tool may have significant utility in a research context (Mandigo, Lodewyk & Treday, 2019). To date, there are no instruments for assessing physical literacy of adults; however, there has been some initial examination of how we might frame physical literacy in an older adult population, through the generation of a physical literacy model for older adults (Jones et al., 2018).

1.3.3 Population Physical Literacy

A first wave of data was released assessing the physical literacy of 8-12 year olds in Canada using the CAPL (Tremblay et al., 2018b). Participants were from 7 of the 10 Canadian provinces (New Brunswick, Newfoundland, and Saskatchewan were not sampled), and 10,034 children took part in the assessments. The CAPL provides a summary score, category scores, and category rankings for individuals who complete all components of the assessment (Longmuir et al., 2015). The majority of participants were categorized as “progressing” in all four domains of physical literacy (Tremblay et al., 2018b). This category is the 3rd ranking, below excelling and achieving, but above beginning. Ultimately, population comparisons cannot be made with this data due to the lack of comparable data sets, as this is the first wave of population physical literacy data. Another study examining this initial data released from the CAPL study found that children who received higher scores on physical competence and motivation and confidence
domains of the assessment were more likely to meet guidelines for physical activity and screen
time (Belanger et al., 2018). Due to the very recent release of the Preschool Physical Literacy
Assessment Tool, no population data have been published as of yet in an early childhood
population.

1.4 Early Childhood Education and Care

Early childhood is a particularly salient time for increasing physical activity levels, as
well as providing developmentally appropriate fundamental movement skill opportunities for
children. Early childhood may also represent an important time in the physical literacy journey,
as children are experiencing their formative physical activity and fundamental movement
experiences (Dudley et al., 2017). Moreover, early childhood education centres serve as an
important first point of contact for these opportunities. In Canada and internationally, early
childhood education facilities are providing care to an increasing number of children (Friendly,
Grady, MacDonald & Forer, 2015; Morgan, 2005; OECD 2018). From 1992 to 2012 the number
of regulated ECEC spaces in Canada increased from 371,573 to 986,842 (Friendly et al., 2015),
which is a 2.7-fold increase. Over half of Canadian parents report using ECEC for their child
aged 0-4 years (Sinha, 2014).

The minimum education requirements for early childhood educators vary from province
to province, with program training lengths ranging from eight months to two years, with high
school graduation being the only pre-requisite to entering these programs (Friendly et al., 2015).
All provinces have minimal staff training requirements, and the absolute minimum by any
province is that a minimum of one staff member hold an early childhood education
license/training, with no other requirements for any other childcare employees (Friendly et al.,
Given these minimal training requirements, it is unlikely that early childhood educators are receiving an appropriate level of training in the areas of physical activity and physical literacy for the childhood population. An examination (completed November 2015) of course outlines and program requirements provided on British Columbia college websites offering early childhood education training (e.g. Langara College, Camosun College, Vancouver Community College, Northern Lights College) found that no program in early childhood education offered a full or partial semester course dedicated to physical literacy, physical activity, gross motor skills, or fundamental movement skills. Some programs offered one or two courses that identified movement experiences or physical skills as one of multiple course outcomes. This evidence suggests that current training programs in early childhood education are insufficiently training students in physical literacy and related concepts.

Current evidence suggests educators do not receive sufficient training in physical literacy and physical activity, there is some evidence that more education and more training is positively associated with physical activity of children in their care. For example, Dowda and colleagues (2004) demonstrated that children were more physically active in ECEC with college trained staff. This training was not necessarily physical activity specific, but a higher education ranking resulted in greater activity time. A survey of trainee educators in Ontario demonstrated that those who had taken a minimum of one course in physical activity and/or physical education had significantly higher self-efficacy to facilitate physical activity; however, the majority of respondents had not taken any courses in this area (Martyniuk & Tucker, 2014). A survey of employed educators in BC found similar results, with the majority reporting they were not offered formal courses in physical activity, motor skill development, or motor skill acquisition during pre-service training (Buckler & Bredin, 2018).
ECEC educators represent a viable population to target as physical literacy and physical activity promoters. However, many questions remain as to how to support this group best in delivering these outcomes. The purpose of this dissertation is to (1) quantify and qualify how training programs support educators in delivering high quality physical activity and physical literacy opportunities in an ECEC setting, and (2) quantify if educators have sufficient physical literacy to generate these opportunities and explore how their personal physical literacy is associated with the likelihood of these opportunities to occur. I completed three studies to address these overarching aims.

1.5 Current Dissertation Studies

First, a systematic review was conducted to determine the characteristics of effective interventions that aimed to improve physical literacy, physical activity, and/or fundamental movement skills in preschool aged children through the training of educators working in ECEC settings. This study expands on previous systematic reviews to provide a detailed exploration of the characteristics of training programs that were successful in improving physical literacy and physical activity in the children intervention trained educators care for. Insights from this study will inform future training interventions of educators, and large-scale policy mandated training, with a goal of improving physical literacy and physical activity in children attending ECEC. Second, a qualitative study was conducted to examine educators’ perceived challenges and successes in implementing the new AP standards in licensed ECEC settings, as well as to evaluate the perceived strengths and weaknesses of the provincial capacity building workshop in augmenting the application of these standards in licensed ECEC settings. This study investigates if new policy impacts the practice of early childhood educators, which remains unclear in the
current literature. Third, a cross-sectional study of educators was completed to assess the physical literacy of early childhood educators, and determine which components of physical literacy are associated with their behaviours and intentions in providing physical activity and physical literacy opportunities for the children they care for. This is the first study to quantitatively measure physical literacy in an ECEC educator population, and one of the first studies to quantitatively measure physical literacy incorporating psychological, cognitive, physical, and behavioural components of physical literacy. This is also the first study to examine if educator physical literacy is related to behaviours and intentions to provide activity opportunities in an ECEC setting.

These three studies all contribute to a greater understanding of some of the challenges and opportunities in promoting physical literacy in the ECEC setting. The findings of this dissertation will aid in the refinement and implementation of successful training programs for ECEC educators in physical literacy and physical activity. This has the potential to enhance the movement environment for children in these programs. The findings will also determine if and how policy in British Columbia is associated with the movement environment in ECEC. Finally, the results of this dissertation will determine if the personal physical literacy of educators is an area for intervention to improve physical literacy and physical activity opportunities in ECEC. Influencing educators to improve health behaviours engaged in by children attending ECEC regularly has significant potential to improve the greater health of the population, as there is evidence that these behaviours track throughout the lifespan. Put simply, to improve the physical literacy of young children perhaps we need to first start by helping early childhood educators reignite their own physical literacy journeys.
Chapter 2: A systematic review of the effectiveness of educator training in interventions to improve physical literacy and/or physical activity of children attending early childhood education or care

Participation in physical activity during early childhood is considered to be exceptionally important, given the multitude of benefits for healthy development, including physiological health, cognition, psychosocial wellbeing, and motor development (Carson et al., 2016; Carson et al., 2017a; 2017b; Hinkley et al., 2014; Timmons et al., 2012). Physical activity in this context reflects engagement in age-appropriate, health promoting movement in line with national physical activity guidelines (Tremblay et al., 2011; 2016; 2017). High levels of participation in physical activity during early childhood are associated with better fundamental movement skills when children begin formal schooling (Barnett, Salmon, & Hesketh, 2016). Strong fundamental movement skills may facilitate participation in physical activity in later years through an improvement in perceived competence and confidence (Robinson et al., 2015).

Early childhood is also considered a key time point in the development of physical literacy, defined as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for participation in physical activity throughout the lifecourse (Whitehead, 2013). The concept of physical literacy integrates fundamental movement skills, as a component of physical competence, into its theoretical framework, and physical activity as a behavioural outcome. While strong fundamental movement skills have been identified as a predictor of physical activity behaviour, physical literacy enhances this model and incorporates the importance of psychological and cognitive factors (i.e. motivation,
confidence, knowledge, understanding) in influencing physical activity behaviour (Whitehead, 2013). While previous research has focused on fundamental movement skills as a separate entity, for the purposes of this paper we have included fundamental movement skills in the overall concept of physical literacy. Physical literacy and physical activity ultimately have a reciprocal relationship, with physical activity supporting the development of physical literacy, and physical literacy promoting engagement in physical activity (Whitehead, 2013). Physical literacy was hypothesized as a determinant of health (Cairney et al., 2019a).

While there is substantial evidence to support the importance of physical activity and fundamental movement skills, and growing evidence in support of the importance of physical literacy, population activity, skill proficiency, and physical literacy levels are low. One third of Canadian children aged 3-4 years are not meeting current Canadian physical activity recommendations (180 minutes of physical activity at any intensity, working up to 60 minutes of energetic play) (Chaput et al., 2017; Tremblay et al., 2017). Fundamental movement skills in preschool children in Canada and internationally are lower than previously established normative data assessed 20 to 30 years prior, which may indicate that population levels of movement skills have decreased since the establishment of these norms (Foulkes et al., 2015; LeGear et al., 2012; Ulrich, 2000; Veldman, Jones, Santos, Sousa-Sá, & Okely, 2018). There is no published data on physical literacy of preschool-aged children; however, current data on Canadian children aged 8-12 years indicate that there is significant room for improvement in the physical literacy of the population (Tremblay et al., 2018).

ECEC represents a potentially viable setting to target physical activity and physical literacy in preschool children. Between 1992 and 2014 the number of regulated ECEC spaces in Canada increased over 3-fold (Friendly et al., 2015), and similar increases have been identified
in other developed nations (Morgan, 2005; OECD 2018). In Canada, reports suggest that nearly 40% of children are spending at least 30 hours per week in ECEC (Sinha, 2014). While in ECEC, children are under the care of an early childhood educator. Previous survey research has identified that educator training has little to no focus on physical activity, fundamental movement skills, and/or physical literacy (Buckler & Bredin, 2018; Martyniuk & Tucker, 2014). Additionally, there is some evidence to suggest that physical activity levels while children are at ECEC are relatively low (Vanderloo et al., 2014).

Many factors are related to physical activity time in childcare (see Tonge, Jones, & Okely, 2016). Tonge and colleagues’ (2016) systematic review identified that educator training and qualifications, educator presence (e.g. prompts by educators regarding physical activity), play area size, and access to an outdoor play area were all associated with increased physical activity. Modifications to play area size and access to outdoor space require significant financial support, but enhancing the knowledge and capabilities of educators can be done with relative efficiency through education and training. Thus far, associations between educator training and qualifications are drawn from correlation research, and prospective studies to examine the effects of improving education and qualifications in educators on promoting physical activity and physical literacy have not been conducted. Recently, childcare governing bodies in Canada have introduced standards to promote the improvement of physical activity, fundamental movement skills, and physical literacy in ECEC (Alberta, 2017; Government of British Columbia, 2016); however, long-term impact of these new standards is not yet known.

Several systematic reviews have examined interventions to promote physical activity and/or fundamental movement skills in preschool aged children (Finch, Jones, Yoong, Wiggers & Wolfenden, 2016; Mehtälä, Sääkslahti, Inkinen & Poskiparta, 2014; Wick et al., 2017).
Overall findings of these reviews have demonstrated that interventions can be successful, but that effectiveness varies depending on study design, and many studies lack rigor (Finch et al., 2016; Mehtälä et al., 2014; Wick et al., 2017). For instance, Wick and colleagues (2017) noted that only eight of the 30 studies included in their review received high ratings for methodological quality, the majority of studies did not apply intention-to-treat analyses, and nearly one-third did not provide enough information to rate the randomization procedures. Many of the interventions included within these reviews were run by members of the research team, particularly when the study purpose was to improve fundamental movement skill proficiency (e.g. Alhassan, Nwaokelemeh, Lyden, Goldsby, & Mendoza, 2013; Robinson & Goodway, 2009; Wang, 2004). Interventions run by the research team, or other external experts, lack generalizability, as researchers often have advanced degrees in motor development, child development, physical education, or kinesiology, granting them high level knowledge and training in the field that typically trained educators would not possess. This is particularly pertinent as Finch and colleagues (2016) found that in pragmatic, or “real world” conditions, interventions were not effective at improving physical activity behaviours in ECEC. As well, interventions that used educators did not significantly improve physical activity (standardized mean difference (SMD)=0.27, 95% CI -0.13-0.68), but those that used experts were able to (SMD=1.26, 95% CI 0.20-2.32). This was echoed by Wick and colleagues (2017) who found interventions run by external experts had significantly greater improvements in fundamental movement when compared to those implemented by non-specialist educators (standardized mean difference=1.45, 95% CI 0.52-2.40).

Given that long-term sustainability of improving the physical activity and physical literacy behaviours in ECEC is unlikely with short-term external expert led interventions,
researchers and policy makers need a better understanding of what has contributed to the success of educator led interventions. While reviews have highlighted the significant differences in intervention success between external expert and educator led interventions, they did not examine what made successful educator led interventions efficacious. To our knowledge, no review has examined the characteristics of successful interventions that are implemented by educators to promote physical activity and/or physical literacy.

The purpose of this study is to determine the characteristics of effective interventions that aimed to improve physical literacy and/or physical activity in preschool aged children through the training of educators working in ECEC settings. The unique contributions this study provides are (1) the in-depth examination of training programs to enhance the capabilities of educators to provide successful physical activity and/or physical literacy opportunities to children attending ECEC (2) the incorporation of physical literacy interventions alongside those that examine physical activity and beyond those that only examine fundamental movement skills. Generating a picture of what comprises a successful training intervention (e.g. length of training, method of training, and assessment of fidelity) will inform future training programs and hopefully result in educators who are proficiently trained in implementing physical activity and physical literacy in ECEC.

2.1 Methods

This systematic review follows the PRISMA guidelines for reporting systematic reviews. The study protocol was registered on PROSPERO on March 8, 2018 (http://www.crd.york.ac.uk/PROSPERO/display_record.php?ID=CRD42018087249). A meta-analysis was not conducted.
2.1.1 Inclusion Criteria

2.1.1.1 Interventions

Interventions that aimed to improve at least one component of physical literacy (i.e. motivation, confidence, physical competence, knowledge, or understanding) or time spent in physical activity in children aged 2-6 years through training of educators to implement the intervention. Interventions using an experimental design with a control group were included, which could include quasi-experimental designs to randomized controlled trials.

2.1.1.2 Participants

Child participants needed to be in regular childcare with a provider who was trained to implement the intervention. Children were between the ages of 2 and 6 years. Children were typically developing, inclusive of children living with overweight or obesity, and children who may be living in socioeconomically disadvantaged areas.

2.1.2 Exclusion Criteria

If any of the following criteria was met studies were excluded. Child participants were under the age of 2 years or over the age of 6 years. Child participants were part of a clinical population (e.g. diagnosed autism spectrum disorder, cerebral palsy). Child participants did not attend any formal childcare. The intervention did not take place in an ECEC. Someone other than the typical educators in that setting implemented the intervention. We excluded papers not published in English.
2.1.3 Search Strategy

Six relevant databases were selected and searched (MEDLINE, EMBASE, CINAHL, ERIC, Australian Education Index, and Sport Discus). The search was conducted in April 2018. Search terms were identified by members of the research team, through consultation with the subject librarian, and through examination of a similar systematic review that looked at school teachers as the implementers of interventions (Lander, Eather, Morgan, Salmon, & Barnett, 2017). A PICOS (Population, Intervention, Comparison, Outcome, Study Design) framework was used when developing the search strategy. Three major categories were used to develop the search: location (Preschool* OR daycare OR “child care” OR childcare OR creche OR “early childhood educat*” OR “early year*” OR “nursery school”); study design (Intervention* OR program* OR strategy* OR trial* OR experiment* OR “Random* Control Trial” OR “quasi experimental” OR behavioural* OR behavioral*); and intervention outcome (“PhysicalADJ2 activ*” OR “fundamental movement skill*” OR “fundamental motor skill*” OR “motor skill*” OR “movement skill*” OR “motor development” OR “gross motor” OR “locomotor” OR “object control” OR “physical literacy” OR perce* ADJ2 competence OR motivation ADJ3 physical OR confidence ADJ3 physical OR knowledge ADJ3 physical activity” OR understanding ADJ3 physical OR self-efficacy ADJ3 physical OR play). One author (EJB) conducted the initial searches, and two authors (EJB and EdS) assessed titles, abstracts, and full text articles for eligibility. Any disagreements were resolved via discussion with a third author (EP or GF).

2.1.4 Data Collection

Two authors (EJB and EdS) extracted data. Data extracted were categorized into three main included general information about the study: (1) authors, year published, title, country,
and study purpose; (2) information on the training of educators: previous experience or training of the educators, length of the training program, method of training program delivery, theoretical underpinnings of the training, brief description of the training, by whom the training was conducted, educator perceptions of the intervention; and (3) information on the intervention outcomes and child participants: age and sex of child participants, study design, study duration, time points of data collection (e.g. pre, post, follow-up), data collection tools for physical activity (e.g. accelerometers, pedometers), and/or physical literacy (e.g. the Test of Gross Motor Development 2 for fundamental movement skills, questionnaires for motivation or confidence), study outcomes, and intervention fidelity. Protocol papers were utilized to supplement information when available (Adamo et al., 2014; Manios et al., 2014; Adams, Molyneux & Squires, 2011; Adams, Zask & Dietrich, 2009; Niederer et al., 2009; Tucker et al., 2015).

2.1.5 Risk of Bias

Two authors (EJB and ER) assessed each study using a modified Cochrane Risk of Bias analysis (Higgins & Green, 2011). This modified checklist has been used in a similar previous publication (Lander et al., 2017). See Table 2.1 for the outlined checklist. As per Cochrane guidelines, results of the risk of bias were not summed and instead each item was evaluated separately (Higgins & Green, 2011). Initial agreement between reviewers was high (89%). Any disagreement was resolved via discussion with a third author (EP). Risk of bias assessment for each study is in Table 2.2.
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<th>Item</th>
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<td>Randomization (generation of allocation sequence, allocation concealment and implementation) clearly described and adequately completed</td>
</tr>
<tr>
<td>B</td>
<td>Valid measures of PA/PL (validation in same age group has been published or validation data provided by author)</td>
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<tr>
<td>C</td>
<td>Blinded outcome assessment (those responsible for assessing PA/PL were blinded to group allocation of individual participants)</td>
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<td>D</td>
<td>Participants analyzed in group they were originally allocated to, and participants not excluded from analysis because of non-compliance for treatment or because of missing data</td>
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<td>E</td>
<td>Covariates accounted for in analysis (e.g., baseline score, group or cluster for RCT, and other relevant covariates when appropriate such as age and sex)</td>
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<td>F</td>
<td>Power calculations reported for main PA/PL outcome</td>
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<td>G</td>
<td>Presentation of baseline characteristics for treatment groups (age, sex, and at least 1 PA/PL outcome)</td>
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<td>H</td>
<td>Drop out for PA/PL outcome measure described with &lt;20% drop out for studies with follow-up of 6 months, and &lt;30% drop out for follow-up with &gt;6 month follow-up</td>
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<tr>
<td>I</td>
<td>Summary results for each group and estimated effect size (difference between groups) and precision (e.g. 95% CI)</td>
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Table 2.2
Risk of bias assessment for included studies

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<th>C Blinded outcome assessment (those responsible for assessing PA/PL were blinded to group allocation of individual participants)</th>
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<th>H Drop out for PA/PL outcome measure described with &lt;20% drop out for studies with follow-up of 6 months, and &lt;30% drop out for follow-up with &gt;6 month follow-up</th>
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<td>Y</td>
<td>X</td>
<td>Y</td>
<td>Y</td>
<td>X</td>
<td>X</td>
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</tr>
</tbody>
</table>

Note: Y = reported in full, X = not reported or reported as not completed, CI = confidence interval, FMS = fundamental movement skills, abstract only refers to papers that reported data in the abstract but not in the manuscript text.
2.2 Results

Figure 1 provides an overview of the retrieval and inclusion of papers. A total of 21,977 articles were identified through database searches, 7,842 from MEDLINE, 7,772 from EMBASE, 524 from Sport Discus, 3,279 from CINAHL, 2,286 from ERIC and 324 from Australian Education Index. Following the removal of duplicates 15,083 articles remained. Title review brought this total to 460. One article was added in from the authors’ own records. Following the review of abstracts 114 articles remained. Full text review excluded 72 papers for the following reasons: program was not implemented by a classroom teacher (n=40), no control group (n=8), no training provided to classroom teachers (n=7), no direct measure of physical activity, or physical literacy outcomes (n=6), unclear who implemented intervention (authors did not reply to contact attempts by researchers) (n=4), papers were follow-up studies to included articles (n=3), age of participants (n=2), physical activity or physical literacy were secondary outcomes and not compared to controls (n=1), purpose of intervention was not to change behaviour(s) of child participants (n=1). A total of 43 papers, which reported on 41 interventions were included for analysis. Studies took place in the United States (n=20), Australia (n=7), Canada (n=6), Germany (n=3), Finland (n=2), Switzerland (n=2), the United Kingdom (n=2) and Spain (n=1).

2.2.1 Study Characteristics

Table 2.3 provides an overview of relevant data retrieved from each paper. Table 2.4 provides a comparison of characteristics of successful training programs. Of the 43 included papers, 30 aimed to promote physical activity, 24 to promote physical literacy, 23 of which focused on fundamental movement skill development. Of these papers, 11 aimed to promote
Records identified through database searching
- MEDLINE (n = 7842)
- EMBASE (n = 7722)
- Sport Discus (n = 524)
- CINAHL (n = 3279)
- ERIC (n = 2286)
- Australian Education Index (n = 324)

(n = 21,977)

Additional records identified through other sources
(n = 1)

Records after duplicates removed
(n = 15,084)
Records at abstract screening
(n = 460)

Records screened
(n = 461)

Full-text articles assessed for eligibility
(n = 115)

Studies included in qualitative synthesis
(n = 43)

Records excluded
(n = 346)

Full-text articles excluded, with reasons
- Program not implemented by classroom teacher n = 40
- No training was provided n = 7
- No direct measure of outcomes n = 6
- No control group n = 8
- Age of participants n = 2
- Purpose was not to change behaviour n = 1
- Unclear who implemented, no response received from authors n = 4
- Secondary outcomes not compared to control n = 1
- Used for follow-up data only n = 3

Total excluded n = 72

Figure 2.1. Flow of article retrieval and selection in review process
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Intervention duration</th>
<th>Length of training and method of delivery</th>
<th>Theoretical underpinnings</th>
<th>Description of training</th>
<th>Trainer</th>
<th>Fidelity</th>
<th>Satisfaction</th>
<th>Significant intervention effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adamo et al., 2016</td>
<td>Two arm cluster RCT</td>
<td>6 months</td>
<td>6 hours, face to face, plus bi-weekly 60-90 min booster sessions</td>
<td>Not described</td>
<td>Used Healthy Opportunities for Preschoolers (HOP) resources</td>
<td>Early learning physical activity specialist A master trainer with experience in promoting PA in preschool children</td>
<td>No</td>
<td>No</td>
<td>PL: yes LS: yes OC: no</td>
</tr>
<tr>
<td>(Linked to Goldfield study)</td>
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<tr>
<td>Adamo et al., 2017</td>
<td>Single site, 3 arm cluster RCT</td>
<td>6 months</td>
<td>6 hours, face to face, plus bi-weekly 60-90 min booster sessions</td>
<td>Socioecological conceptual model of health. Based on train-the-trainer approach.</td>
<td>Used HOP resources. Canadian PA recommendations as a baseline for programming. Training manual and log sheets provided. Some supplemental equipment provided if needed. Third arm of intervention included a parent training component.</td>
<td>A master trainer with experience in promoting PA in preschool children</td>
<td>No</td>
<td>No</td>
<td>TPA: no MVPA: no SB: no</td>
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<tr>
<td>(Linked to Wasenius study)</td>
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<tr>
<td>Alhassan et al., 2012</td>
<td>Quasi-experimental</td>
<td>6 months</td>
<td>8 hours, face to face</td>
<td>Not described</td>
<td>Teachers provided with lesson plans to implement, designed to meet Early Childhood Program Standards and Guidelines for Preschool Learning Experiences</td>
<td>Trained physical education specialist Yes – calendar of implementation dates</td>
<td>No</td>
<td></td>
<td>SB: Yes LPA: No* MVPA: No LS: No Leap: Yes</td>
</tr>
<tr>
<td>Annesi et al., 2013a</td>
<td>Cluster randomized</td>
<td>8 weeks</td>
<td>4 hours, face to face</td>
<td>Social cognitive and self-efficacy theory. Mastery and self-management, self-regulatory skills based</td>
<td>Gross motor and age appropriate behavioural skills. Goal setting. Self-monitoring of progress. Acknowledgement of PA. Cues or reminders to increase self-efficacy or self-regulation were built into lesson plans</td>
<td>Not described</td>
<td>No</td>
<td>No</td>
<td>MVPA: Yes</td>
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<tr>
<td>Annesi et al., 2013b</td>
<td>Cluster randomized</td>
<td>9 months</td>
<td>4 hours face to face</td>
<td>Social cognitive and self-efficacy theory. Mastery and self-management, self-regulatory skills based</td>
<td>Not described</td>
<td>No</td>
<td>No</td>
<td>MVPA: Yes</td>
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<td>VPA: Yes</td>
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<tr>
<td>Annesi et al., 2013c</td>
<td>Cluster randomized</td>
<td>8 weeks</td>
<td>4 hours, face to face</td>
<td>Social cognitive and self-efficacy theory. Mastery and self-management, self-regulatory skills based</td>
<td>Not described</td>
<td>No</td>
<td>No</td>
<td>MVPA: Yes</td>
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<td>VPA: Yes</td>
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<td></td>
<td></td>
<td>SB: No</td>
</tr>
<tr>
<td>Study</td>
<td>Design Type</td>
<td>Duration</td>
<td>Time Commitment</td>
<td>Intervention Details</td>
<td>Study Staff</td>
<td>Assessment Plan</td>
<td>Compliance Level</td>
<td>Other Measures</td>
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<tr>
<td>Annesi et al., 2013d</td>
<td>Cluster randomized</td>
<td>9 months</td>
<td>4 hours, face to face</td>
<td>Social cognitive and self-efficacy theory. Mastery and self-management, self-regulatory skills based</td>
<td>Not described</td>
<td>Study staff conducted monthly assessments using a standardized form to assess protocol compliance.</td>
<td>No</td>
<td>VPA: Yes LMPA: Yes LPA: Yes MPA: Higher in control SB: No</td>
<td></td>
</tr>
<tr>
<td>Bellows et al., 2013</td>
<td>Randomized intervention</td>
<td>18 weeks</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Movement skill concepts introduced in 4 day/week lessons, 72 lessons, 143 activities within the lessons</td>
<td>Not specified</td>
<td>Program surveys were administered 6 times to determine teachers’ impressions</td>
<td>PL: Yes NL: Yes LS: Yes OC: Yes SC: No</td>
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<tr>
<td>Bellows et al., 2017</td>
<td>Controlled quasi-experimental longitudinal</td>
<td>1 year</td>
<td>Not specified</td>
<td>Not specified</td>
<td>Movement skill concepts introduced in 4 day/week lessons, 72 lessons, 143 activities within the lessons</td>
<td>Not specified</td>
<td>18 week logs were kept to determine % of days implemented</td>
<td>OC: Yes Continued positive change at 1 and 2 year follow-up NL: No Running speed and agility: No Side to side jump: yes Standing long jump: No</td>
<td></td>
</tr>
<tr>
<td>Birnbaum et al., 2017</td>
<td>Cluster randomized controlled</td>
<td>1 year</td>
<td>3 face to face training sessions</td>
<td>No</td>
<td>Four energy balance related behaviours. Change in physical space, implement structured PA</td>
<td>Local research teams</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Study</td>
<td>Design</td>
<td>Duration</td>
<td>Frequency</td>
<td>Interventions</td>
<td>Team Composition</td>
<td>Outcomes</td>
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<tr>
<td>Bonis et al., 2014</td>
<td>Quasi-experimental with randomization</td>
<td>6 months</td>
<td>4 face to face workshops</td>
<td>No session including FMS activities. Workshops taught importance of PA and healthy eating. Selected 3-4 priority areas to develop an improvement plan.</td>
<td>Four dieticians with physical activity training experience and NAP SACC certification. Sports scientists specialized in PA and health, and by physicians.</td>
<td>No</td>
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<tr>
<td>Bonvin et al., 2013</td>
<td>Single blinded cluster randomized controlled trial</td>
<td>10 months</td>
<td>5 face to face workshops. Meetings every two months with trained educators to idea share</td>
<td>Socioecological conceptual model. Five themes: movement and motor development, moving – a pleasure and a need, practical aspect of PA, health promotion in childcare centres, implementation of the project.</td>
<td>No Educator satisfaction was tracked.</td>
<td>MPA: Yes VPA: Yes</td>
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<tr>
<td>Brian et al., 2017a</td>
<td>Cluster randomized trial</td>
<td>8 weeks</td>
<td>3 hours active learning, 3-hour intro and practice period of lessons, 1 hour of research fidelity. Gradual reduction in trainer support. Face to face.</td>
<td>Mastery motivation. Used T-SKIP modified version of SKIP (Successful Kinesthetic Instruction for Preschooler) using direct instruction, mastery motivation and high autonomy. Teachers must be able to prove competency in motor</td>
<td>Lead researcher and research team. Check sheets and digital recording of lessons.</td>
<td>No OC: Yes PL: No MVPA: No</td>
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<tr>
<td>Study</td>
<td>Design Type</td>
<td>Duration</td>
<td>Intervention Details</td>
<td>Control Measures</td>
<td>Effect Measures</td>
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<tr>
<td>Brian et al., 2017b</td>
<td>Quasi-experimental</td>
<td>6 weeks</td>
<td>Two 30-minute coaching sessions. Ongoing support, gradually reduced. Face to face. Dynamic systems theory and Newell’s model of constraints. Used SKIP. Training walked teachers through content they would use via an iPad. Lead researcher and research team. Check sheets and digital recording of lessons.</td>
<td>No</td>
<td>OC: Yes</td>
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<tr>
<td>Chuang et al., 2018</td>
<td>Non-randomized control trial</td>
<td>7-10 months</td>
<td>6 hours of face to face training. Social cognitive theory and social ecological model. Teachers provided with 9 lessons of nutrition curriculum, structured indoor and outdoor activity, activity intended to promote FMS and MVPA.</td>
<td>No</td>
<td>MVPA: Yes, Indoor VPA: Yes</td>
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<tr>
<td>Finch et al., 2014</td>
<td>Cluster randomized trial</td>
<td>6 months</td>
<td>6 hours of face to face training, 2 phone support calls, 2 hour visit with feedback provided during intervention. Social ecological models of health behaviour change. Target staff instructional practices and interactions with children. Two qualified early childhood teachers with background in child health.</td>
<td>Staff reported satisfaction with the program</td>
<td>SC: No</td>
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<tr>
<td>Fitzgibbon et al., 2011</td>
<td>Group randomized control trial</td>
<td>14 weeks</td>
<td>3-hour initial training, plus three in-school training sessions, face to face. Social cognitive theory and self-determination theory. Nutrition and physical activity lessons on exercise and healthy eating. Intervention coordinator. Self-report by teachers of number of required and attended activities.</td>
<td>No</td>
<td>MVPA: Yes</td>
<td></td>
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<tr>
<td>Study</td>
<td>Design, Duration</td>
<td>Methodology</td>
<td>Weekly meetings</td>
<td>Exercise routines</td>
<td>Support</td>
<td>Additional Resources</td>
<td>Findings</td>
<td></td>
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<tr>
<td>Froehlich-Chow et al., 2016</td>
<td>Wait-list comparison design, randomized 48 weeks</td>
<td>Received implementation manual, activity and nutrition resources, and activity bag. Ongoing support and communication with trainers</td>
<td>Two fully scripted exercise routines were provided.</td>
<td>Four components: Healthy Start Manual, HOP resources, Food Flair and ongoing support</td>
<td>Certified Literacy, Education, Activity and Play (LEAP) trainers</td>
<td>Educators felt intervention was positively improving PA and FMS in the children</td>
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<tr>
<td>Goldfield et al., 2016 (linked to Adamo 2016 study)</td>
<td>Two arm parallel group cluster randomized controlled trial 6 months</td>
<td>Two three hour workshops, plus 12 biweekly 1-hour booster sessions, face to face</td>
<td>Not described</td>
<td>Used HOP resources</td>
<td>Experienced master trainers</td>
<td>No</td>
<td></td>
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</tr>
<tr>
<td>Hardy et al., 2010</td>
<td>Randomized controlled trial 5 months</td>
<td>One day workshop, face to face</td>
<td>Not described</td>
<td>Training focused on healthy eating, activity, limiting recreational screen time, provision of unstructured activity play time, and how to create healthy fundraising policies</td>
<td>Not described</td>
<td>No</td>
<td></td>
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<tr>
<td>Iivonen et al., 2011</td>
<td>Quasi-experimental 8 months</td>
<td>Two 3-day training seminars, face to face</td>
<td>Not described</td>
<td>Physical education curriculum, forty-five 45-minute lesson plans taught twice a week</td>
<td>Not described</td>
<td>No</td>
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</tbody>
</table>

Findings:
- **PL:** No
- **MVPA:** Yes
- **TPA:** No
- **SB:** No
- **LPA:** Yes
- **LS:** Yes
- **OC:** Yes
- **FMS:** Yes
- **Running speed in boys:** Yes
- **OC:** No
- **NL:** No
- **Standing broad jump:** No
<table>
<thead>
<tr>
<th>Study</th>
<th>Design</th>
<th>Duration</th>
<th>Intervention</th>
<th>Evaluation</th>
<th>Costs</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jones et al., 2015</td>
<td>Parallel group randomized controlled trial</td>
<td>12 months</td>
<td>Three 1-hour training sessions, face to face</td>
<td>Not described</td>
<td>Research team support staff member</td>
<td>No No SB: No MVPA: No</td>
</tr>
<tr>
<td>Jones et al., 2016</td>
<td>Two arm randomized controlled trial</td>
<td>6 months</td>
<td>Two 90-minute professional development programs, plus a 60 minute hands-on practice time, face to face</td>
<td>Social cognitive theory</td>
<td>Provision of structured and unstructured activities, professional development focuses on gross motor skill development</td>
<td>Study project manager, and an early childhood educator trained in the program by the research team</td>
</tr>
<tr>
<td>Jones et al., 2011</td>
<td>Two arm-parallel cluster randomized controlled pilot trial</td>
<td>20 weeks</td>
<td>Four 30-minute professional development sessions, face to face</td>
<td>Social cognitive theory</td>
<td>Provision of structured and unstructured activities, professional development focuses on gross motor skill development</td>
<td>Evaluation of lessons via checklist, interviews with staff at baseline and follow-up</td>
</tr>
<tr>
<td>Kirk &amp; Kirk, 2016</td>
<td>Two group quasi-experimental design</td>
<td>8 months</td>
<td>Full day training session at beginning of school year. Member of research team was available during implementation</td>
<td>Not described</td>
<td>Principal investigator</td>
<td>Observations by research staff members</td>
</tr>
</tbody>
</table>

Week over the school year. Evidence based strategies to improve healthy eating and physical activity within childcare services. Provided resources.
<table>
<thead>
<tr>
<th>Study</th>
<th>Design Type</th>
<th>Duration</th>
<th>Intervention Details</th>
<th>Outcome Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kirk et al., 2014</td>
<td>Two group quasi-experimental design</td>
<td>6 months</td>
<td>Full day training session at beginning of school year, face to face</td>
<td>Program goal was to provide two 15 minute academic content MVPA lessons per day</td>
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<td>Observations by research staff members</td>
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<td>Ratings of program components via survey</td>
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<td>TPA: Yes</td>
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<tr>
<td>Krombholz, 2012</td>
<td>Two group quasi-experimental design with matched controls</td>
<td>20 months</td>
<td>Not described</td>
<td>Improve competency in providing structured physical activity.</td>
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<td></td>
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<td>Enhance awareness of benefits of physical education, particularly for high risk (e.g. overweight or low FMS) children</td>
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<td>Educator report of number of PA sessions delivered</td>
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<td>Not described</td>
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<td>PL: Yes</td>
</tr>
<tr>
<td>Mehtala et al., 2017</td>
<td>Cluster randomized trial</td>
<td>12 months</td>
<td>Face to face</td>
<td>Socioecological model</td>
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<td>Program was developed following baseline measurements in consultation with teachers</td>
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<td>Likelihood of continuation of intervention components reported by teachers</td>
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<td>MVPA: Yes (lost at follow-up)</td>
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<td>LPA: Yes</td>
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<td>TPA: Yes</td>
</tr>
<tr>
<td>O'Dwyer et al., 2013</td>
<td>Cluster randomized trial</td>
<td>6 weeks</td>
<td>Face to face, ongoing gradual reduction in support with active play professional</td>
<td>Socioecological model</td>
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<td>Trained staff in administering a physical activity curriculum.</td>
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<td>Resources provided.</td>
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<td>Active play professional</td>
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<td>Not described</td>
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<td>Not described</td>
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<td>MVPA during active sessions:</td>
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<td>Yes</td>
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<td>TPA: No</td>
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<td>SB: No</td>
</tr>
<tr>
<td>Pate et al., 2016</td>
<td>Cluster randomized controlled trial</td>
<td>Fall to spring</td>
<td>Face to face</td>
<td>Socioecological model</td>
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<td></td>
<td>Collaboration between research staff and preschool teachers</td>
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<td></td>
<td>University-based research staff</td>
</tr>
<tr>
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<td></td>
<td>Process evaluation from multiple</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not described</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>MVPA: Yes</td>
</tr>
<tr>
<td>Study (year)</td>
<td>Study Design</td>
<td>Duration</td>
<td>Intervention Details</td>
<td>Researcher Details</td>
</tr>
<tr>
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</tr>
<tr>
<td>Penalvo et al., 2013</td>
<td>Cluster randomized trial</td>
<td>One school year</td>
<td>30 hour course, face to face. Social cognitive theory and trans-theoretical model of change to incorporate the intervention into classrooms. Using Study of Health and Activity in Preschool Environments elements to adapt instruction and environment in individual ways to promote PA sources (e.g. PA levels, encouragement of activity, child enjoyment of activity)</td>
<td>Experts Ongoing support from external and internal program coordinators to enhance adherence. Resources provided.</td>
</tr>
<tr>
<td>Puder et al., 2011</td>
<td>Cluster randomized controlled single blinded study</td>
<td>One school year</td>
<td>Two afternoon workshops, face to face. Additional hands on training via health promoter visits. Socioecological model Training in activity, nutrition, screen time and sleep. Changing of attitudes, education and behaviours in teachers in these areas. Provision of lessons in topic areas to teachers.</td>
<td>Health promoters Report of number of lessons implemented</td>
</tr>
<tr>
<td>Reilly et al., 2006</td>
<td>Cluster randomized controlled trial</td>
<td>24 weeks</td>
<td>Three training sessions, face to face. Not described Trained in physical activity program to increase activity and FMS</td>
<td>Not described</td>
</tr>
<tr>
<td>Authors</td>
<td>Design</td>
<td>Timeframe</td>
<td>Setting</td>
<td>Interventions</td>
</tr>
<tr>
<td>-----------------</td>
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<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Roth et al., 2015</td>
<td>Cluster randomized controlled trial</td>
<td>One academic preschool year (approx. 11 months)</td>
<td>Two afternoon workshops (one prior to the start of the intervention, one at halfway point), face to face. Ongoing supervision and support</td>
<td>Workshop 1: Importance of activity and FMS, healthy eating, psychomotor approach to early childhood education. Introduction to intervention contents (PA lessons, encouragement of FMS use). Workshop 2: Strengthened importance of activity and how to apply psychomotor approach to improve activity, additional information on healthy eating and motor development</td>
</tr>
<tr>
<td>Trost et al., 2008</td>
<td>Quasi-experimental</td>
<td>8 weeks</td>
<td>One 3 hour training session, face to face</td>
<td>Incorporation of physical activity into the preschool curriculum, including academic lessons</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Duration</td>
<td>Intervention Details</td>
<td>Outcome Measures</td>
</tr>
<tr>
<td>---------------------</td>
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</tr>
<tr>
<td>Tucker et al., 2017</td>
<td>Single-blind cluster randomized controlled trial</td>
<td>1 year</td>
<td>4 hours, face to face, Not described</td>
<td>Training of staff emphasized shorter activity bouts, reducing sedentary time, and Canadian guidelines. Increased frequency of time spent outside, and provision of equipment.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g, response of children</td>
<td>MVPA (indoor + outdoor): Yes for weeks 7-8</td>
</tr>
<tr>
<td>Veldman et al., 2015</td>
<td>Pilot cluster randomized trial</td>
<td>8 weeks</td>
<td>2 hours, face to face, Not described</td>
<td>Program developed with directors of childcare centres and university researchers. Program was to increase educators confidence and familiarity with intervention, as well as promote facilitation of three movement skills through program activities.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g, response of children</td>
<td>LPA: Yes MVPA: Yes SB: Yes (All lost at follow-up)</td>
</tr>
<tr>
<td>Vidoni et al., 2014</td>
<td>Quasi-experimental</td>
<td>11 weeks</td>
<td>Unspecified length, face to face, Not described</td>
<td>Provision of 11 weeks of structured activity, received a handbook to help implement activities. Goal of program is to improve visual, A program expert attended by a researcher and graduate assistant to determine teachers’ opinions on acceptability of the intervention.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>g, response of children</td>
<td>PL: Yes Jump: No* Balance: No* Kick: Yes</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Duration</td>
<td>Intervention Description</td>
<td>Outcome Measures</td>
</tr>
<tr>
<td>--------------------------------------------</td>
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<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>Wasenius et al., 2017 (Linked to Adam et al., 2017)</td>
<td>3-arm cluster randomized controlled trial</td>
<td>6 months</td>
<td>Two three-hour workshops, plus 12 one-hour bi-monthly booster sessions, face to face. Socioecological model of health. Based on train-the-trainer approach. Auditory and motor skills. Used HOP resources. Canadian PA recommendations as a baseline for programming. Training manual and log sheets provided. Some supplemental equipment provided if needed. Third arm of intervention included a parent training component. A master trainer with experiment in preschool physical activity promotion.</td>
<td>Not described</td>
</tr>
<tr>
<td>Webster et al., 2015</td>
<td>Within subject design</td>
<td>4 days</td>
<td>90 minute face to face workshop. Teachers received information packages including project information, activity break resources, techniques to manage behaviour, a CD, movement activity resources, and safety tips. Lead author. Reliability checks to ensure teachers conducted activity breaks on dates assigned, length of breaks recorded.</td>
<td>Not described</td>
</tr>
<tr>
<td>Winter &amp; Sass, 2011</td>
<td>Quasi-experimental</td>
<td>24 weeks</td>
<td>20 hours of training, face to face and via media. Ecological theory. Awareness of risks of overweight and how to encourage healthy lifestyle behaviours. Parents and children also received resources. No description. Monitoring visits and interviews with teachers to ensure program completion. Self-assessment ratings.</td>
<td>Not described</td>
</tr>
<tr>
<td>Authors</td>
<td>Design</td>
<td>Duration</td>
<td>Details</td>
<td>Teachers trained in gross motor skills program, received activity cards and equipment, supplemental activities based on Sesame Street Workshop Healthy Habits for Life</td>
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<tr>
<td>--------------------</td>
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</tr>
<tr>
<td>Yin et al., 2012</td>
<td>Quasi-experimental</td>
<td>18 weeks</td>
<td>6 hour training during in-service at start of school year, four hours of follow-up training, face to face</td>
<td>Early childhood development theory and a systems approach</td>
</tr>
<tr>
<td>Zask et al., 2012a</td>
<td>Cluster randomized</td>
<td>10 months</td>
<td>Not specified</td>
<td>Health Belief Model and Competence Motivational Theory</td>
</tr>
</tbody>
</table>

RCT: randomized controlled trial, LS: locomotor skills, OC: object control skills, TPA: total physical activity, MVPA: moderate to vigorous physical activity, SB: sedentary behaviour, VPA: vigorous physical activity, MPA: moderate physical activity, SC: Step Count, NL: Non-locomotor skills, CPM: Counts per minute, PLK: physical literacy knowledge, Yes = significant treatment effects were observed, No = significant treatment effects were not observed No* = significant treatment effects were not observed but a medium to large effect size was reported.
Table 2.4  
*Summary of selected characteristics in successful interventions*

<table>
<thead>
<tr>
<th>Study</th>
<th>Variable</th>
<th>Risk of bias</th>
<th>Theory</th>
<th>Length of training</th>
<th>Training materials</th>
<th>Booster/Ongoing support</th>
<th>Fidelity assessed?/Method</th>
<th>Was PA or PL primary purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adamo et al. 2016</td>
<td>PA</td>
<td>7</td>
<td>X</td>
<td>6 hours</td>
<td>Resource materials</td>
<td>Y</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Alhassan et al., 2012</td>
<td>PL</td>
<td>6</td>
<td>X</td>
<td>8 hours</td>
<td>Lesson plans</td>
<td>X</td>
<td>Y - Educator report</td>
<td>Y</td>
</tr>
<tr>
<td>Annesi et al., 2013a</td>
<td>PA</td>
<td>4</td>
<td>Y</td>
<td>4 hours</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Annesi et al., 2013b</td>
<td>PA</td>
<td>4</td>
<td>Y</td>
<td>4 hours</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Annesi et al., 2013c</td>
<td>PA</td>
<td>6</td>
<td>Y</td>
<td>4 hours</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Annesi et al., 2013d</td>
<td>PA</td>
<td>4</td>
<td>Y</td>
<td>4 hours</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>Y - Study staff report</td>
<td>Y</td>
</tr>
<tr>
<td>Bellows et al., 2013</td>
<td>PL</td>
<td>5</td>
<td>X</td>
<td>X</td>
<td>Lesson plans</td>
<td>X</td>
<td>Y - Educator report</td>
<td>Y</td>
</tr>
<tr>
<td>Bellows et al., 2017</td>
<td>PL</td>
<td>6</td>
<td>X</td>
<td>X</td>
<td>Lesson plans</td>
<td>X</td>
<td>Y - Educator report</td>
<td>Y</td>
</tr>
<tr>
<td>Birnbaum et al., 2017</td>
<td>PL (but more fitness)</td>
<td>5</td>
<td>X</td>
<td>X</td>
<td>Lesson plans</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Bonis et al., 2014</td>
<td>PA</td>
<td>6</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Brian et al., 2017a</td>
<td>PL</td>
<td>7</td>
<td>Y</td>
<td>7 hours</td>
<td>Lesson plans</td>
<td>Y</td>
<td>Y - Study staff report</td>
<td>Y</td>
</tr>
<tr>
<td>Brian et al., 2017b</td>
<td>PL</td>
<td>6</td>
<td>Y</td>
<td>1 hour</td>
<td>Lesson plans</td>
<td>Y</td>
<td>Y - Study staff report</td>
<td>Y</td>
</tr>
<tr>
<td>Researcher et al., 2018</td>
<td>PA</td>
<td>2</td>
<td>Y</td>
<td>6 hours</td>
<td>Lesson plans</td>
<td>X</td>
<td>Y - Study staff report</td>
<td>Y</td>
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<tr>
<td>Fitzgibbon et al., 2011</td>
<td>PA</td>
<td>7</td>
<td>Y</td>
<td>3 hours</td>
<td>Lesson plans</td>
<td>Y</td>
<td>Y - Educator report</td>
<td>X</td>
</tr>
<tr>
<td>Froehlich-Chow et al., 2016</td>
<td>PA</td>
<td>2</td>
<td>Y</td>
<td>X</td>
<td>Resource materials</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Goldfield et al., 2016</td>
<td>PA</td>
<td>7</td>
<td>X</td>
<td>6 hours</td>
<td>Resource materials</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Hardy et al., 2010</td>
<td>PL</td>
<td>8</td>
<td>X</td>
<td>One day</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Jones et al., 2016</td>
<td>PA and PL</td>
<td>7</td>
<td>Y</td>
<td>4 hours</td>
<td>Lesson plans, behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Jones et al., 2011</td>
<td>PA and PL</td>
<td>7</td>
<td>Y</td>
<td>2 hours</td>
<td>Lesson plans, behaviour promotion</td>
<td>X</td>
<td>Y - Educator report</td>
<td>Y</td>
</tr>
<tr>
<td>Kirk &amp; Kirk, 2016</td>
<td>PA</td>
<td>4</td>
<td>X</td>
<td>One day</td>
<td>Lesson plans</td>
<td>Y</td>
<td>Y - Study staff report</td>
<td>X</td>
</tr>
<tr>
<td>Kirk et al., 2014</td>
<td>PA</td>
<td>4</td>
<td>X</td>
<td>One day</td>
<td>Lesson plans</td>
<td>X</td>
<td>Y - Study staff report</td>
<td>X</td>
</tr>
<tr>
<td>Krombholz, 2012</td>
<td>PL</td>
<td>5</td>
<td>X</td>
<td>X</td>
<td>Resource materials, behaviour promotion</td>
<td>X</td>
<td>Y - Educator report</td>
<td>Y</td>
</tr>
<tr>
<td>Mehtälä et al., 2017</td>
<td>PA</td>
<td>7</td>
<td>Y</td>
<td>X</td>
<td>Behaviour promotion</td>
<td>X</td>
<td>X</td>
<td>Y</td>
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<tr>
<td>O’Dwyer et al., 2013</td>
<td>PA</td>
<td>6</td>
<td>Y</td>
<td>X</td>
<td>Lesson plans,</td>
<td>Y</td>
<td>X</td>
<td>Y</td>
</tr>
<tr>
<td>Study Source</td>
<td>Type</td>
<td>Hours</td>
<td>Type</td>
<td>Y/N</td>
<td>Resource Materials</td>
<td>Behaviour Promotion</td>
<td>Staff Report</td>
<td></td>
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</tr>
<tr>
<td>Pate et al., 2016</td>
<td>PA</td>
<td>7</td>
<td>Y</td>
<td>X</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Penalvo et al., 2013</td>
<td>PL</td>
<td>6</td>
<td>Y</td>
<td>30 hours</td>
<td></td>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Puder et al., 2011</td>
<td>PL</td>
<td>9</td>
<td>Y</td>
<td>Two afternoons</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Reilly et al., 2006</td>
<td>PL</td>
<td>6</td>
<td>X</td>
<td>Three sessions</td>
<td></td>
<td>Lesson plans</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Roth et al., 2015</td>
<td>PA and FMS</td>
<td>9</td>
<td>X</td>
<td>Two afternoon workshops</td>
<td>Lesson plans</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Trost et al., 2008</td>
<td>PA</td>
<td>5</td>
<td>X</td>
<td>3 hours</td>
<td>Lesson plans</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Tucker et al., 2017</td>
<td>PA</td>
<td>8</td>
<td>X</td>
<td>4 hours</td>
<td>Lesson plans</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Veldman et al., 2015</td>
<td>PL</td>
<td>8</td>
<td>X</td>
<td>2 hours</td>
<td>Lesson plans</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Vidoni et al., 2014</td>
<td>PL</td>
<td>3</td>
<td>X</td>
<td>X</td>
<td>Lesson plans</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Wasenius et al., 2017</td>
<td>PL</td>
<td>8</td>
<td>Y</td>
<td>6 hours</td>
<td>Resource materials</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Webster et al., 2015</td>
<td>PA</td>
<td>3</td>
<td>X</td>
<td>1.5 hours</td>
<td>Lesson plans, resource materials</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Winter &amp; Sass, 2011</td>
<td>PA and PL</td>
<td>4</td>
<td>Y</td>
<td>20 hours</td>
<td>Resource materials</td>
<td>Behaviour promotion</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Study</td>
<td>Intervention</td>
<td>Duration</td>
<td>Completion</td>
<td>Notes</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Yin et al., 2012</td>
<td>PA and PL</td>
<td>3</td>
<td>Y</td>
<td>6 hours Lesson plans, resource materials</td>
<td>Y - Educator report</td>
<td>Y</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zask et al., 2012a</td>
<td>PL</td>
<td>4</td>
<td>Y</td>
<td>X</td>
<td>Lesson plans</td>
<td>X</td>
<td>X</td>
<td>Y</td>
</tr>
</tbody>
</table>

Note:  Y = completed and reported, X = not completed or not reported, PA = physical activity, PL = physical literacy.
physical activity and physical literacy concurrently; however, 4 of the 11 did not directly report on the results of both and split the results into two papers (one physical activity and one physical literacy) (Adamo et al., 2016; Adamo et al., 2017; Goldfield et al., 2016; Wasenius et al., 2017). It should be noted that Adamo and colleagues (2016) did provide some physical activity data, but this was not included in this review as it repeated the results reported by Goldfield and colleagues (2016). Physical activity and physical literacy were the primary outcomes of 32 included papers, and the secondary outcomes for 8 included papers. For the remaining three papers, physical activity or physical literacy were the primary outcome of the published study, but each was a secondary analysis of a larger experiment with a different primary outcome than the reported study (Adamo et al., 2016; Birnbaum, Geyer, Kirchberg, Manios, & Koletzko, 2017; Wasenius et al., 2017).

2.2.2 Measurement Tools

Physical activity was measured via accelerometry in 22 papers of the 30 reporting physical activity data. Of the remaining 8 papers, pedometers were used in three papers (Bellows, Davies, Anderson, & Kennedy, 2013; Finch et al., 2014; Yin et al., 2012) and five papers utilized variations of the System for Observing Fitness Instruction Time (SOFIT) depending on research context (Chuang, Sharma, Perry, & Diamond, 2018; J. Jones et al., 2015; Kirk & Kirk, 2016; Kirk, Vizcarra, Looney, & Kirk, 2014; Winter & Sass, 2011).

Nine different accelerometer cut points for determining physical activity intensity (i.e. sedentary, light, moderate and vigorous physical activity) were used by the various included papers. Several papers reported employing more than one set of established cut points. Pate and colleagues’ (2006) cut points were used most frequently, with 10 of the 22 papers employing
accelerometers using these points (Annesi et al., 2013a, 2013b, 2013c, 203d; Bonvin et al., 2013; Fitzgibbon et al., 2011; Jones et al., 2016; Pate et al., 2016; Puder et al., 2011; Roth et al., 2015). Sirard and colleagues’ (2005) cut points were employed by 5 papers (Alahassan et al., 2012; Annesi et al., 2013c; Jones et al., 2011; O’Dwyer et al., 2013; Trost et al., 2008). Adolph and colleagues’ (2012) cut points were used by 3 papers (Adamo et al., 2017; Goldfield et al., 2012; Tucker et al., 2017). Cut points determined by Pfeiffer and colleagues (2006) were employed by two papers (Goldfield et al., 2012; Webster et al., 2015). Van Cauwenberghe and colleagues’ (2011) cut points were employed by two papers (Bonis et al., 2014; Mehtala et al., 2017). Evenson and colleagues’ (2005) cut points were used by one paper for establishing sedentary behaviour only (Jones et al., 2016). Puyau and colleagues’ (2004) and Reilly and colleagues’ (2003) cut points were employed by one paper (Reilly et al., 2006).

Of the 22 papers using accelerometers, 18 reported using a 15 second epoch (Adamo et al., 2017; Alhassan et al., 2012; Annesi, Smith, & Tennant, 2013a, 2013b, 2013c; Bonis et al., 2014; Bonvin et al., 2013; Fitzgibbon et al., 2011; Froehlich-Chow, Leis, Humbert, Muhajarine, & Engler-Stringer, 2016; Goldfield et al., 2016; Jones, Okely, Hinkley, Batterham, & Burke, 2016; Jones et al., 2011; Pate et al., 2016; Puder et al., 2011; Roth et al., 2015; Trost, Fees, & Dzewaltowski, 2008; Tucker et al., 2017; Webster, Wadsworth, & Robinson, 2015), two reported using a 5-second epoch (Mehtälä et al., 2017; O'Dwyer et al., 2013) and two did not report epoch length (Annesi, Smith & Tennant, 2013d; Reilly et al., 2006).

Physical literacy was most frequently assessed in the form of fundamental movement skills. Fundamental movement skills were most commonly assessed using the Test of Gross Motor Development 2 (TGMD-2), four of the twenty-three papers measuring movement skills utilized the full test (Adamo et al., 2016; Froehlich Chow et al., 2016; Wasenius et al., 2017;
Zask, Adams, Brooks, & Hughes, 2012a), and six used portions of the assessment tool (Alhassan et al., 2012; Brian, Goodway, Logan, & Sutherland, 2017a, 2017b; Hardy, King, Kelly, Farrell, & Howlett, 2010; Jones et al., 2016; Jones et al., 2011). Two papers used the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2) (Bellows et al., 2017; Vidoni, Lorenz, & de Paleville, 2014). The remaining eleven papers used the following assessment tools: Peabody Developmental Motor Scales, second edition (Bellows et al., 2013), standing long jump and jumping side to side as outlined in the Kinderturntest (Birnbaum et al., 2017), Zurich Neuromotor Assessment (Bonvin et al., 2013), APM Inventory (Iivonen, Saakslahti, & Nissinen, 2011), MoTB 3-7 (Krombholz, 2012), an obstacle course plus measures of static and dynamic balance (Puder et al., 2011), movement assessment battery (Reilly et al., 2006), an obstacle course (Roth et al., 2015), three movement skills (jump, kick a stationary ball, balance) (Veldman, Okely, & Jones, 2015), the Brigance Diagnostic Inventory of Early Development-II (Winter & Sass, 2011), and the Learning Achievement Profile Version 3 (Yin et al., 2012). One study measured physical literacy components other than fundamental movement skills. This study utilized knowledge, attitudes and habits scores on physical activity, which was derived from the trans-theoretical model of change (Penalvo et al., 2013).

2.2.3 Intervention Results

Physical Activity. Nineteen of the twenty-nine papers that aimed to increase time spent in physical activity demonstrated significant treatment effects. Nineteen papers demonstrated significant between group by time differences, and of those, fifteen reported significant differences in moderate to vigorous physical activity pre-to-post intervention between the intervention arms (Annesi et al., 2013a; Annesi et al., 2013b, 2013c, 2013d; Bonis et al., 2014;
Chuang et al., 2018; Fitzgibbon et al., 2011; Froehlich Chow et al., 2016; Mehtälä et al., 2017; O'Dwyer et al., 2013; Pate et al., 2016; Roth et al., 2015; Trost et al., 2008; Tucker et al., 2017; Webster et al., 2015), three reported significant changes in total physical activity as measured by accelerometers (Goldfield et al., 2016; Mehtälä et al., 2017; Tucker et al., 2017), two reported significant changes in total physical activity as measured by SOFIT (Kirk & Kirk, 2016; Kirk et al., 2014), two reported significant changes in light physical activity (Goldfield et al., 2016; Mehtälä et al., 2017), and one reported a significant group difference in activity as measured by pedometer step counts (Yin et al., 2012). One paper reported non-significant group differences, but a medium effect size for total physical activity (Winter & Sass, 2011). One study demonstrated greater increases in physical activity in the intervention versus the control group as measured by counts per minute during the program duration, but this change did not continue at the cessation of the intervention lessons (Jones et al., 2011). One study reduced sedentary time in the intervention group compared to the control group, but no between group but did not change activity time (Alhassan et al., 2012). The remaining eight did not demonstrate significant between group change in activity time (Adamo et al., 2017; Bellows et al., 2013; Bonvin et al., 2013; Finch et al., 2014; Jones et al., 2015; Jones et al., 2016; Puder et al., 2011; Reilly et al., 2006). Reported effect sizes ranged from very small to large, and the majority of papers (7 out of 11) reported very small or small effect sizes (Annesi et al., 2013a, b, c; Bonis et al., 2014; Jones et al., 2016; Jones et al., 2011; Roth et al., 2015). Three papers reported medium effect sizes on at least one physical activity variable (Alhassan et al., 2012; Annesi et al., 2013d; Winter & Sass, 2011) and one paper reported a large effect size (Finch et al., 2014).

Physical Literacy. Twenty of the twenty-three papers that aimed to promote physical literacy through fundamental movement skill improvements demonstrated significant treatment
effects between the groups from baseline to end of the intervention (Adamo et al., 2016; Alhassan et al., 2012; Bellows et al., 2013; Bellows et al., 2017; Birnbaum et al., 2017; Brian et al., 2017a, 2017b; Hardy et al., 2010; Jones et al., 2016; Jones et al., 2011; Krombholz, 2012; Puder et al., 2011; Reilly et al., 2006; Roth et al., 2015; Veldman et al., 2015; Wasenius et al., 2017; Yin et al., 2012; Zask et al., 2012a), and the remaining three found no significant between group differences (Bonvin et al., 2013; Froehlich-Chow et al., 2016; Iivonen et al., 2011).

Reported effect sizes ranged from small to large, and the majority of papers (7 out of 10) reported medium effect sizes on at least one fundamental movement skill variable in the treatment arm compared to control arm (Adamo et al., 2016; Alhassan et al., 2012; Bellows et al., 2017; Brian et al., 2017a; Jones et al., 2016; Veldman et al., 2015; Wasenius et al., 2017). The remaining three reported small effect sizes (Jones et al., 2011; Krombholz et al., 2012; Winter & Sass, 2011). In the one study examining psychological constructs of physical literacy, a significantly greater increase in knowledge, attitudes and habits for physical activity was reported in the intervention group compared to the control group (Penalvo et al., 2013).

### 2.2.4 Quality Assessment (Risk of Bias)

Table 2.2 outlines complete risk of bias assessment for each paper. When assessing randomization, we included papers that did not blind educator participants to group allocation (e.g. received training or did not receive training) as providing training in physical activity, or physical literacy to educators would reveal allocation status.

Randomization was fully described in 15 papers, was noted but not described in full in an additional 19 papers, and 9 did not utilize randomization. Age-appropriate measures of physical activity and/or physical literacy with published reliability evidence were used in all but six
papers (Bellows et al., 2013; Birnbaum et al., 2017; Bonvin et al., 2013; Penalvo et al., 2013; Roth et al., 2015; Vidoni et al., 2014). Twelve of the 43 included papers employed blinded outcome assessments, and the remaining 31 papers used unblinded assessments. Participants were analyzed in the group to which they were originally allocated, following intention to treat protocols, in 23 of the included papers, and intention to treat protocols were not followed or not described in the remaining 20. Covariates, such as age, sex and baseline scores, were accounted for in analyses in all but four of the included papers (Chuang et al., 2018; Froehlich-Chow et al., 2016; Vidoni et al., 2014; Webster et al., 2015). Twelve papers provided power calculations for the main physical activity and/or physical literacy outcome, and 31 provided no power calculation. The majority of papers (n=34) provided baseline characteristics for treatment group, and the remaining nine did not provide baseline demographic or anthropometric data for participants. Drop out was not described or exceeded 20% for papers with a follow-up of six months or less, and 30% for papers with a follow-up of greater than six months in 21 papers. Summary results including effect size and confidence intervals were reported in full in 9 of the included papers. Eleven papers reported only confidence intervals and 8 papers reported only effect sizes. The remaining 15 papers did not report confidence intervals or effect size. There were no differences in study quality between successful and unsuccessful interventions as evidenced in Table 2.4.

2.2.5 Characteristics of Training

Nearly all papers (n=41) reported training type, and all described in person, face to face initial training sessions for the educators. Two papers did not provide sufficient detail to report training type (Krombholz, 2012; Zask et al., 2012a). Duration of training was reported in 30
papers. Initial training length ranged from two 30-minute sessions to a 30-hour course (Brian et al., 2017b; Penalvo et al., 2013). Sixteen papers reported providing booster sessions, or ongoing support for educators during the intervention period (Adamo et al., 2017; Adamo et al., 2016; Bonvin et al., 2013; Brian et al., 2017a, 2017b; Finch et al., 2014; Fitzgibbon et al., 2011; Froehlich Chow et al., 2016; Goldfield et al., 2016; Kirk & Kirk, 2016; O'Dwyer et al., 2013; Penalvo et al., 2013; Puder et al., 2011; Roth et al., 2015; Wasenius et al., 2017; Yin et al., 2012). Of those papers, 13 demonstrated significantly greater intervention effects in the treatment group compared to the control group on at least one outcome variable as evidenced in Table 2.4 (Adamo et al., 2016; Brian et al., 2017a, 2017b; Fitzgibbon et al., 2011; Froehlich-Chow et al., 2016; Goldfield et al., 2016; Kirk & Kirk, 2016; O'Dwyer et al., 2013; Penalvo et al., 2013; Puder et al., 2011; Roth et al., 2015; Wasenius et al., 2017; Yin et al., 2012).

Information on who conducted training sessions was reported in 23 of the included papers. In 13 papers an intervention program or content field expert delivered the training (Adamo et al., 2017; Adamo et al., 2016; Alhassan et al., 2012; Bonis et al., 2014; Bonvin et al., 2013; Chuang et al., 2018; Finch et al., 2014; Froehlich-Chow et al., 2016; Goldfield et al., 2016; O'Dwyer et al., 2013; Penalvo et al., 2013; Trost et al., 2008; Vidoni et al., 2014; Wasenius et al., 2017), in 9 papers a member of the research team conducted the training (Birnbaum et al., 2017; Brian et al., 2017a, 2017b; Fitzgibbon et al., 2011; Jones et al., 2015; Kirk et al., 2014; Pate et al., 2016; Webster et al., 2015; Yin et al., 2012), and one study reported using both a program expert and a member of the research team to conduct training (Jones et al., 2016).

All included papers provided at least some description of the content of the training program; however, the detail provided varied widely. Primarily, the purpose of training was to train educators in implementing the intervention. Twenty-four papers provided lesson plans for
educators to implement (Alhassan et al., 2012; Bellows et al., 2013; Bellows et al., 2017; Birnbaum et al., 2017; Brian et al., 2017a, 2017b; Chuang et al., 2018; Finch et al., 2014; Fitzgibbon et al., 2011; Ivonen et al., 2011; Jones et al., 2011; Jones et al., 2016; Kirk et al., 2014; Kirk & Kirk, 2016; O’Dwyer et al., 2013; Puder et al., 2011; Reilly et al., 2006; Roth et al., 2015; Trost et al., 2008; Veldman et al., 2015; Vidoni et al., 2014; Webster et al., 2015; Yin et al., 2012; Zask et al., 2012a). Thirteen papers provided knowledge and training on how to promote physical activity and/or physical literacy (Bonvin et al., 2013; Finch et al., 2014; Hardy et al., 2010; Jones et al., 2016; Jones et al., 2015; Jones et al., 2011; Krombholz 2012; Mehtala et al., 2017; Pate et al., 216; Puder et al., 2011; Roth et al., 2015; Tucker et al., 2017; Winter et al., 2011). Twelve papers provided resources to educators that were not specifically lesson plans such as the Healthy Opportunities for Preschoolers manual, which provides physically active games, including those for children aged 3-5 years (Adamo et al., 2016, 2017; Froehlich-Chow, 2016; Jones et al., 2015; Krombholz, 2012; O’Dwyer et al., 2013; Penalvo et al., 2013; Vidoni et al., 2014; Wasenius et al., 2017; Webster et al., 2015; Yin et al., 2012). Five papers provided training to support educators in modifying knowledge and attitudes in children to support engagement in physical activity, although direct measurement of these variables was only conducted by Penalvo and colleagues (2013) (Annesi et al., 2013a, 2013b, 2013c, 2013d; Penalvo et al., 2013). One study did not provide sufficient training detail to categorize it (Bonis et al., 2014).

### 2.2.6 Characteristics of Interventions

**Length.** Intervention length ranged from 4 days (Webster et al., 2015) to 20 months (Krombholz, 2012). The majority of interventions were 6 months or less (n=25) and 9
interventions, including Webster’s (2015), took place over a period of less than 2 months (Annesi et al., 2013b, 2013c; Brian et al., 2017a, 2017b; O'Dwyer et al., 2013; Trost et al., 2008; S. L. Veldman et al., 2015; Vidoni et al., 2014). Sixteen interventions took place over 6 months to 12 months, and four of these lasted a full year (Bellows et al., 2017; Birnbaum et al., 2017; Jones et al., 2015; Tucker et al., 2017).

Theoretical Framework. Twenty-three papers reported theoretical underpinnings to the intervention, and twenty provided no information on this. Socioecological theory was most commonly reported, included in 11 papers (Adamo et al., 2017; Bonvin et al., 2013; Chuang et al., 2018; Finch et al., 2014; Froehlich Chow et al., 2016; Mehtälä et al., 2017; O'Dwyer et al., 2013; Pate et al., 2016; Puder et al., 2011; Wasenius et al., 2017; Winter & Sass, 2011). Social cognitive theory was utilized by 9 studies (Annesi et al., 2013a, 2013b, 2013c, 2013d; Chuang et al., 2018; Fitzgibbon et al., 2011; Jones et al., 2016; Jones et al., 2011; Penalvo et al., 2013). Dynamical systems theory/Newell’s model of constraints/motor development theories informed two papers (Brian et al., 2017b; Yin et al., 2012). Self-determination theory (Fitzgibbon et al., 2011), the trans-theoretical model of change (Penalvo et al., 2013), health belief model (Zask et al., 2012a), and competence motivational theory (Zask et al., 2012a), were each utilized by one study. One paper used mastery motivation, derived from self-theories, which is not a theory, but provided a framework for the development of the intervention (Brian et al., 2017a; Dweck & Master, 2008). Of the 23 papers reporting theoretical underpinnings, 20 demonstrated significantly greater change on at least one outcome variable in the intervention group compared to the control group as outlined in Table 2.4 (Annesi et al., 2013 a, 2013b, 2013c, 2013d; Brian et al., 2017a, 2017b; Chuang et al., 2018; Fitzgibbon et al., 2011; Froehlich-Chow et al., 2016; Jones et al., 2016; Jones et al., 2011; Mehtälä et al., 2017; O’Dwyer et al., 2017; Pate et al.,
2016; Penalvo et al., 2013; Puder et al., 2011; Wasenius et al., 2017; Winter & Sass, 2011’ Yin et al., 2012; Zask et al., 2012a).

2.2.7 Fidelity and Satisfaction

The majority of papers (24 out of 43) provided some report of intervention fidelity. For 10 of these papers, fidelity was self-reported by educators (Al hassan et al., 2012; Bellows et al., 2013; Bellows et al., 2017; Fitzgibbon et al., 2011; Jones et al., 2016; Krombholz, 2012; Puder et al., 2011; Trost et al., 2008; Veldman et al., 2015; Yin et al., 2012). For the other 14 papers, the study sites were visited by a researcher to monitor intervention adherence (Annesi et al., 2013d; Brian et al., 2017a, 2017b; Chuang et al., 2018; Finch et al., 2014; Jones et al., 2011; Kirk & Kirk, 2016; Kirk et al., 2014; Pate et al., 2016; Penalvo et al., 2013; Reilly et al., 2006; Vidoni et al., 2014; Webster et al., 2015; Winter & Sass, 2011). In all but one (Reilly et al., 2006) of these papers with researcher driven fidelity checks, significant findings were demonstrated. Educator satisfaction with the intervention was reported in ten papers (Bellows et al., 2013; Bonvin et al., 2013; Finch et al., 2014; Froehlich-Chow et al., 2016; Jones et al., 2011; Kirk & Kirk, 2016; Kirk et al., 2014; Mehtälä et al., 2017; Winter & Sass, 2011; Yin et al., 2012).

2.2.8 Follow-Up

Six papers reported follow-up data within the papers included in the review (Bellows et al., 2017; Jones et al., 2011; Mehtälä et al., 2017; O'Dwyer et al., 2013; Roth et al., 2015; Tucker et al., 2017). For two interventions (Penalvo et al., 2013; Zask et al., 2012a), these were reported in three additional publications (Barnett, Zask, Rose, Hughes, & Adams, 2015; Penalvo et al., 2015; Zask et al., 2012b) that were found in the systematic review search. Physical literacy
changes, in the form of fundamental movement skills, were more likely to persist at follow-up than differences in physical activity. Bellows et al. (2017) demonstrated a continued increase in differences in object control skill proficiency between the intervention in control groups at one and two-year follow-up. At three-year follow-up study of Zask and colleagues’ (2012a) intervention found sustained differences in object control skill proficiency in female but not in male participants, and no differences in locomotor skills (Zask et al., 2012b). An additional study examined differences in physical activity at three-year follow-up, even though this was not a part of the original intervention measurement, and found no differences between groups (Barnett et al., 2015). Differences in physical activity time were lost completely at follow-up in four papers (Jones et al., 2011; O’Dwyer et al., 2013; Roth et al., 2015; Tucker et al., 2017); however, O’Dwyer et al.’s (2013) study had only found significant differences during active play sessions, and not in total daily physical activity during the intervention. Methala et al’s (2017) study did not sustain moderate to vigorous physical activity changes at 6-month follow-up, but total and light physical activity group differences were maintained. Penalvo et al.’s (2013) intervention to improve knowledge, attitudes and habits around physical activity demonstrated sustained change at one and two-year follow-up (Penalvo et al., 2015).

2.3 Discussion

This study aimed to determine the characteristics of effective interventions that aimed to improve physical activity, and/or physical literacy in preschool aged children through the training of educators. Training delivery method, length, description, theoretical underpinnings, and trainer were all retrieved from relevant interventions to determine the effects on intervention outcome. Intervention fidelity and educator satisfaction with the intervention were also tracked.
Very few papers provided no information on training of educators (Bellows et al., 2013; Bellows et al., 2017); however, less than a third of papers reported all relevant information on training (Adamo et al., 2016; Bonvin et al., 2013; Brian et al., 2017a, 2017b; Chuang et al., 2018; Finch et al., 2014; Fitzgibbon et al., 2011; Froehlich Chow et al., 2016; Jones et al., 2016; Penalvo et al., 2013; Puder et al., 2011; Wasenius et al., 2017; Yin et al., 2012). This lack of reporting of training details makes drawing concrete conclusions challenging, as not all comparisons can be made between papers. Risk of bias was determined for each study to determine validity of research findings. Only three studies received yes ratings for inclusion of all relevant methodological and outcome data to ensure low risk of bias (Finch et al., 2014; Puder et al., 2011; Roth et al., 2015).

Overall, the majority of studies were able to produce significant behaviour change in physical activity participation in comparison to a control group. Two thirds of interventions were able to establish at least some positive change in one or more physical activity behaviour at intervention completion in comparison to the control group. Increases in physical activity were more common in higher intensity (e.g. moderate to vigorous vs. light) physical activities; however, this may be because this was the most commonly reported outcome. Cross-comparisons of physical activity are relatively complex. Reporting of physical activity was inconsistent between papers, with different methodologies, intensities, time points, and reporting methods (e.g. percentage of time, minutes per hour, total time, accelerometer counts per minute) being used in different papers. The reporting differences in physical activity intensity may be due to slight variations in government physical activity recommendations between countries, updates to these guidelines that followed the publication of these papers, or the introduction of guidelines for the early years. Presently, Australia, Canada and the US recommend 180 minutes of activity...
at any intensity for children of preschool age with a recommendation for 60 minutes of energetic play defined as activities such as running and jumping. The age ranges of these guidelines vary slightly (e.g. 3-4 years in Canada, and 3-5 years in Australia), as well as the wording, which may generate differences between countries of research and publication for reporting specific activity intensities. Additionally, traditional reporting of physical activity as total minutes or hours in a day may not be appropriately representative, particularly as children may spend a range of time in an ECEC setting due to differences in when parents drop off and pick up their child. The use of minutes/hour or percentage was more commonly used in papers within this review; however, no consistent format was used adding to the difficulty of comparisons between papers. We would recommend for future publications, the reporting of total physical activity at any intensity and moderate to vigorous physical activity to ease comparisons between 3-4 and 5-year-old children. As well, the use of either percentage of total time or minutes/hour are appropriate; however, we would recommend the use of minutes/hour due to its prevalence within the relevant literature (Temple, Naylor, Rhodes, & Higgins, 2009; Vanderloo et al., 2014) and the ease at which these values can be translated to assess whether government activity guidelines are being met.

The majority of papers used evidence-based, age-appropriate accelerometer data collection techniques. All but three papers (Froehlich-Chow et al., 2013; Jones et al., 2016; Reilly et al., 2006) reported using cut points for physical activity intensity that were established in preschool aged children. Puyau and colleagues (2004) cut points were established with children aged 7-18 years and therefore may not be representative of 2-6-year-old children. Evenson and colleagues’ cut points were established with an older child population (mean age 7.3 years). Puyau and colleagues’ (2002) cut points were established with a population with a mean age of 10.7 for boys and 11.1 for girls. However, both Jones and colleagues (2016) and
Reilly and colleagues (2006) employed multiple cut points, but it is unclear whether the exact cut points used were appropriate for the population assessed. All papers that reported epoch length indicated using an epoch length of 15 seconds or less. Short epoch lengths are recommended in order to capture the sporadic movements of young children, and a 15 second epoch in particular (Baquet, Stratton, van Praagh & Berthoin, 2007; Cliff, Reilly & Okely, 2009).

There were fewer papers overall that examined components of physical literacy (24 versus 30 examining physical activity). Interventions that focused on the promotion of physical literacy demonstrated greater success with over 88% (vs. 67% of physical activity papers) of papers demonstrating significant between group change in one or more element of physical literacy. All but one of these papers (Penalvo et al., 2013) focused on improving fundamental movement skills. The issues of measurement found in physical activity papers are echoed in interventions designed to improve physical literacy via fundamental movement skills. By far, the most commonly used assessment of skill proficiency was the TGMD-2, ten papers utilized at least a portion of the measurement tool. The TGMD-2 is a well-used assessment, incorporating elements of process- and product-measurements of 12 movement skills categorized as locomotor or object control skills (Ulrich, 2000). However, it is not without criticism, as there is no assessment of stability or non-locomotor skills, and the use of the tool in European countries can present a cultural bias due to the use of baseball skills, which is not a popular sport in Europe (Cools, De Martelaer, Samaey, & Andries, 2009). Eleven of the twenty-three papers reporting on fundamental movement skill interventions used assessments of movement skills not used in any other study. Two papers utilized the BOT-2 short form or elements of it (Bellows et al., 2017; Vidoni et al., 2014), which includes a subtest titled running speed and agility, which does incorporate some elements of fundamental movement skills (e.g. hopping on one or both feet);
however, some of the elements (e.g. shuttle run) are measures of physical fitness rather than fundamental movement skill proficiency specifically or physical literacy, more generally (Deitz, Kartin, & Kopp, 2007). Two other papers also used assessment tools that should be categorized as measures of physical fitness, instead of fundamental movement skill proficiency specifically or physical literacy, more generally. For example, measuring number of jumps in a specified time period or distance of a standing long jump (Birnbaum et al., 2017; Roth et al., 2015). All four of these papers demonstrated greater skill improvements in the intervention versus the control group; however, to what extent the changes are reflective of fundamental movement skill proficiency or, generally, physical literacy is unknown, given the physical fitness measures they used. This is particularly important, given recent criticism of researchers conflating physical literacy with physical fitness (Cairney et al., 2019b).

Non-fundamental movement skill components of physical literacy were assessed in only one study included in the review (Penalvo et al., 2013). This study did not explicitly use the term physical literacy, but the concepts of “Knowledge, Attitudes, and Habits” as they relate to physical activity. This concept fits well under Whitehead’s definition of physical literacy, which we employed for this review (2010; 2013). Cross-comparison between measurement tools is not possible for physical literacy components outside of fundamental movement skills due to the lack of papers exploring improvements in physical literacy in this age group, and the relative paucity of papers exploring the cognitive and psychological components of physical literacy in general (Edwards et al., 2018); therefore, continued work in the area is needed. This is particularly pertinent, given the increasing shift towards applying physical literacy as a determinant of health (Cairney et al., 2019a). A greater body of empirical evidence, where all
components of physical literacy are directly measured, is needed to determine the causal links between physical literacy and health behaviours.

All papers that reported training modality reported face-to-face training. As there was wide variation in intervention success and no other modality reported, we cannot draw conclusions as to the best modality of training. However, large-scale, population level interventions may be difficult to disseminate completely, particularly for those in rural and remote regions. Therefore, it may be challenging to achieve long-term feasibility using face to face training as the only modality of early childhood educator training in physical literacy and physical activity. Research should be conducted to determine the efficacy of online modules or virtual classrooms as an alternative to face-to-face training. While professional development is the only option for employed educators, providing trainee educators with training in physical activity and physical literacy during their education would eliminate the need for this. Incorporating these topics as standard practice into educator training programs has the potential to enhance the health behaviours of all children attending ECEC.

We identified wide variation in training length. Training time was as short as one hour (Brian et al., 2017b) or as long as 30 hours (Penalvo et al., 2013). Most training sessions were under 10 hours in length, and 4-6 hours was the most prevalent length of training. Three papers used significantly longer training periods, but only two of the three interventions had success (Iivonen et al., 2011; Penalvo et al., 2013; Winter & Sass, 2011). Content of training sessions may be more important than length of training sessions; however, significant details regarding the style of lesson delivery (e.g. presentation vs. group discussion) or assurances that participants understood the lesson material (e.g. quizzes or assessments of mastery) were not reported in almost all papers. Brian et al. (2017a) required educators to demonstrate competency through
examination in fundamental movement skill outcomes and had a significant outcome in improving object control skills during their relatively short (8 weeks) intervention. Ensuring trainees demonstrate both confidence and competence in the intervention is critical for intervention fidelity.

Just over half of all included papers provided some measure of intervention fidelity to capture adherence to the study protocol; however, in 10 of these papers educator participants provided self-report assessment. Typically, this was a report of the number of times the educators implemented the intervention (e.g. number of lessons per week or an implementation calendar). While these reports provide a measure of how many times child participants received intervention programming, the results do not indicate how effectively the intervention was implemented. Interventions that used research team members to assess intervention fidelity (e.g. through monitoring visits, recording of intervention lessons) were successful in demonstrating significant between group effects, with the exception of one study. For example, Brian et al.’s two papers (2017a; 2017b) digitally recorded each lesson to monitor fidelity, checking recordings for adherence to protocol. Assessment of fidelity should be conducted by research teams, or via audio or video recording of lessons, to ensure adherence to protocol is maintained, as self-report by educators could lead to biases in results.

Multiple papers used ongoing support or training for educators. Papers that employed these “booster sessions” or check-ins with research team members were highly successful, with 13 of the 16 papers reporting positive change. For example, Adamo and colleagues (2016) and Goldfield and colleagues, (2016), reporting on the same intervention, provided bi-weekly booster sessions and were successful in improving physical literacy, total physical activity, light physical activity, and reducing sedentary behaviours in the intervention group beyond any changes seen in
the control group. However, no significant between group differences were demonstrated in object control skills or moderate to vigorous physical activity. Roth et al. (2015) provided two workshops, one at the start of the intervention and one partway through, as well as ongoing support to childcare providers, and were successful in improving moderate to vigorous physical activity and fundamental movement skills. Brian et al. (2017a, 2017b) provided a gradual reduction in coaching support to educators during intervention implementation. These interventions were successful in significantly improving object control skills. The use of ongoing support was also found to be beneficial for elementary school teachers in a similar systematic review of physical activity and fundamental movement skill interventions targeting school-aged children (Lander et al., 2017).

As noted, only one study assessed any components of physical literacy beyond fundamental movement skills; however, the study demonstrated low risk of bias, and provided all relevant information related to educator training. Training was the longest reported in all papers (30 hours) and educators received ongoing support. This paper provided long-term follow-up data (3 years post intervention), and significant between group differences were demonstrated at this time. As this was the only study to assess non-physical competence components of physical literacy, comparisons with other studies cannot be made.

Very few papers provided follow-up beyond the completion of the intervention. Only six papers reported follow-up data in the original published manuscripts, and two studies reported follow-up data in subsequent publications. Half of these papers reported no sustained behaviour changes at follow-up (Jones et al., 2011; O'Dwyer et al., 2013; Roth et al., 2015; Tucker et al., 2017). For one of these papers, the follow-up period the authors reported was the week following the cessation of the intervention program, and the increase in physical activity was not sustained
in the children in the intervention group compared to the control group (Jones et al., 2011).

Reporting on the sustainability of changes in childcare interventions is important, particularly as these children soon transition out of a childcare environment and into a formal school environment (approximately at 5 years of age), where academic outcomes compete with engagement in healthy behaviours for time. Sustaining positive change is important as the interrelated behaviours of physical literacy and physical activity will likely continue to impact each other in a school setting. For example, physical activity influences locomotor skill proficiency at school starting age (Barnett et al., 2016). Future studies should measure effects after a significant (≥6 months) follow-up period in order to determine lasting results of interventions.

Risk of bias was a concern in the majority of included papers. Only three papers reported sufficient detail to receive a low risk of bias on all assessed levels of information (Finch et al., 2014; Puder et al., 2011; Roth et al., 2015). Complete reporting of summary results that included both estimated effect size and confidence intervals was done in 10 of the included papers. While 18 papers did provide effect sizes (n=8) or confidence intervals (n=10), they did not report both. Complete reporting of statistical analysis reduces risk of bias, and allows for effective data review, particularly if a meta-analysis of results is to be undertaken. Only 12 papers provided proper reporting of power calculations for sample size determination for the physical activity or physical literacy. Multiple papers reported that they were underpowered to demonstrate significant results, which hampers the capability of reviews, such as this one, to draw complete conclusions. Most papers (n=31) did not blind assessors to group allocation; however, it should be noted that in 14 of these papers an objective measure of physical activity (accelerometers or pedometers) was utilized as the primary outcome measure. While accelerometers are not without
limitations, and there is growing evidence that accelerometer methodology can generate extremely varied results (Migueles et al., 2018), researcher bias is considered to be reduced (Cliff et al., 2009). However, given a recent study comparing the use of cut-points for children found that the percentage of participants meeting activity guidelines ranged from 8% to 96% depending on the cut-points used, this assumption that accelerometers are a strictly objective measure should be reconsidered (Migueles et al., 2018). We identified a significant range in the cut points used by papers in this review, and several papers used cut points validated for use in much older children. Higher quality papers are needed to ensure conclusions drawn from the literature are accurate.

This review has multiple strengths. PRISMA guidelines were utilized for reporting the review. A broad range of databases was used for the searches, as well as a robust search strategy. No date restrictions were placed on any searches. The review builds on existing syntheses (e.g., Finch et al., 2016; Mehtala et al., 2014; Wick et al., 2017) through a novel examination of studies incorporating physical activity and physical literacy interventions. It also examines detailed characteristics of educator training in these areas, a unique perspective on the literature. This study is limited by the use of English language only papers. As well, we cannot rule out that publication bias may exist within the current literature. A meta-analysis was not conducted due to the heterogeneity of the papers, and the sparse reporting of training program characteristics; however, that level of analysis might clarify if there is a publication bias in this literature.

The majority of included papers within this review demonstrated positive physical activity, or physical literacy behaviour change, demonstrating that educators are capable of promoting health behaviour change in the children with whom they work. The use of a physical activity or physical literacy expert is not required for successful implementation of an
intervention program to change these behaviours in ECEC. This is important, as the long-term sustainability of expert-led programs is unlikely. Future studies should consider the importance of clear and comprehensive reporting of results (e.g. physical activity at multiple intensities and sub-scores of movement skill assessments). Follow-up studies should be incorporated to determine if results persist once children leave the childcare setting or training support ends. Detailed descriptions of training interventions should be reported in order to increase the possibility of reproducibility of results. Future training interventions of educators in physical activity, and/or physical literacy should utilize objective measures of intervention fidelity, and ongoing resources and support for trainees. While greater research is needed to determine the most efficacious training methods, training educators and educator-trainees in these areas should be prioritized, as increasing physical literacy opportunities in ECEC settings, has the potential to positively impact the health of children in ECEC.
Chapter 3: Perceptions of the facilitators and barriers to implementing new provincial active play standards in childcare. What role does capacity building play?

The early years, in particular the preschool years (3-5 years), are an important time for participation in physical activity. Physical activity, particularly when coupled with physical literacy including fundamental movement skill development opportunities, plays a role in promoting positive development in all aspects of a child’s life including the physical, cognitive, psychological, and social (Timmons et al., 2012). Physical literacy is most commonly defined as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for physical activity throughout the lifecourse (Whitehead, 2013). Fundamental movement skills, a component of the physical competence of physical literacy, are the foundational skills needed to participate in physical activity and sports, and can be subdivided into locomotor skills such as running, leaping, and hopping, and object control skills, such as catching, throwing and kicking (Pangrazi & Beighle, 2013; Payne & Isaacs, 2016). Fundamental movement skill competency is also an important modifiable predictor of participation in physical activity in later childhood and adolescence (Barnett et al. 2008; Barnett et al., 2009; Lubans et al. 2010; Robinson et al., 2015; Wrotniak et al. 2006).

Currently physical activity guidelines suggest a minimum of 180 minutes of physical activity at any intensity for children aged 3-4 years, with a progression towards 60 minutes of "energetic play" or moderate to vigorous physical activity (Tremblay et al., 2017). By age 5, the recommendations change to 60 minutes of moderate to vigorous physical activity each day.
(Tremblay et al., 2016). Garriguet et al. (2016) reported a significant drop in children meeting Canadian physical activity guidelines from age 3-4 to 5 years from 73% to 30%, when the guidelines shift focus from activity of any intensity to activity that is of moderate to vigorous intensity. There is currently no representative data on the physical literacy of preschool aged children; however, age-appropriate physical literacy assessment tools have been recently released (i.e. the Preschool Physical Literacy Assessment Tool; Cairney et al., 2018b). Recent assessments of 8 to 12-year-old Canadian children, using the CAPL found that the majority of children did not meet physical literacy standards for their age (Tremblay et al., 2018).

ECEC presents a unique opportunity to promote physical activity, reduce sedentary behaviours, particularly those that utilize electronic screens, and provide opportunities to develop physical literacy and fundamental movement skills. Over 50% of Canadian children aged 4 years and younger are currently enrolled in ECEC, and of those 70% are in full-time care (minimum 30 hours per week) and similar or higher numbers are found in other developed nations such as the United States, Sweden and France (Morgan, 2005; Sinha, 2014). There is also an upward trend in the number of licensed ECEC spaces in Canada (Friendly et al., 2015).

While ECEC represents a potential opportunity for improving physical activity and movement skill behaviours, there is a growing body of literature suggesting children participate in low amounts of physical activity in an ECEC setting (Temple et al., 2009; Vanderloo et al., 2014). While a recent systematic review found high variability in the levels of physical activity in ECEC, a lack of homogeneity between measures was found to be a major confounding factor in the examination of this data and conclusions that could be drawn (O’Brien, Vanderloo, Bruijns, Truelove & Tucker, 2018). The review also noted that geographical and cultural differences may play a role in activity participation during childcare. For example, children in
South America were the least active, followed by North Americans, and Europeans, and children from the South Pacific were the most active. Two Canadian studies have found very low levels of moderate to vigorous physical activity (1.54 and 1.76 min/hour) during the childcare day (Temple et al., 2009; Vanderloo et al., 2014). 3-5-year-old children in these studies were participating in approximately 12 minutes of moderate to vigorous physical activity during a 7.5-hour childcare day (Temple et al., 2009; Vanderloo et al., 2014), significantly less than the 60 minutes of moderate to vigorous physical activity 5 year olds need each day. In terms of light physical activity, Temple et al. (2009) reported 18.75 min/hour and Vanderloo et al. (2014) reported total physical activity (17.42 min/hour); therefore, physical activity at light and moderate intensity may be sufficient to meet the 180 minutes children aged 3-4 need each day. Children in ECEC settings may be achieving sufficient or near to sufficient activity at any intensity, but may not be progressing towards achieving the 60 minutes of moderate to vigorous physical activity by the age of 5.

The generation of policies to promote physical activity in the childcare space has been examined as a potential mechanism to promote wide behaviour change. A number of studies have examined the existence of activity policies on the physical activity behaviours of children attending ECEC, as well as the frequency with which educators report offering opportunities for physical activity (Bower et al., 2008; Erinosho, Hales, Vaughn, Mazzucca, & Ward; 2016;). These studies have found mixed results, one study demonstrated that children were participating in less physical activity in centres with a physical activity policy (Erinosho et al., 2016) while another found weak, but significant, relationships between activity time and having a physical activity policy (Bower et al., 2008). Many of these studies shared the conclusion that the existence of policy without appropriate training to support the translation of policy into practice
may mean that well-intentioned policies exist in written form only (Erinosho et al., 2016; Wolfenden et al., 2011). This may be especially pertinent for physical literacy, including fundamental movement skills, as direct demonstration and instructor led activities appear to be important for the acquisition of movement skills, particularly object control skills (Barnett et al., 2016; Clark, 1995; Goodway & Branta, 2003). While educators are being asked to implement these activities, current educator training programs do not prioritize physical activity, physical literacy, or fundamental movement skills, therefore educators may not have the practical skills needed or confidence to implement activity related policies (Buckler & Bredin, 2018; Martinyuk & Tucker, 2014).

In response to the need for physical activity policies for ECEC, and mindful of the need for training for educators to implement these policies, the provincial government in British Columbia partnered with research agencies, and developed the AP standards and a capacity building intervention (Appetite to Play; Government of BC; 2016). In September of 2017, the AP standards were put into practice, and have since been enforced by licensing officers who assess licensed ECEC services to determine if they are meeting all provincial standards outlined in the Community Care and Assisted Living Act and the Child Care Licensing Regulation documents. The AP standards, outlined in Table 3.1, provide direction for physical activity time (both indoor and outdoor), physical literacy and fundamental movement skill opportunities throughout the day, and screen time. In tandem with the release of these standards, Appetite to Play was launched and consists of training via an in person workshop and/or e-learning modules, as well as physical and online resources and support, that focus on healthy eating and physical activity in the early years reflective of the AP standards.
Table 3.1.
Eight standards of practice for active play in BC child care centres

<table>
<thead>
<tr>
<th>Director of Licensing Standard of Practice for Active Play (AP Standards)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ensure a minimum of 60 minutes per day of outdoor active play (indoor active play is acceptable when weather is poor or outdoor physical space is limited). Active play may be accumulated through 15 minute portions of time throughout the day or continuously.</td>
</tr>
<tr>
<td>2. Licensees and employees must be aware of and incorporate fundamental movement skills and injury prevention into all active play activities.</td>
</tr>
<tr>
<td>3. A licensed preschool care program must ensure the minimum outdoor active play corresponds with the length of time the preschool program is offered: 1-2 hours, 20 minutes; 2-3 hours, 30 minutes; 3-4 hours, 40 minutes.</td>
</tr>
<tr>
<td>4. All licensed child care programs must limit screen time (TV, computer, electronic games) to 30 minutes or less a day.</td>
</tr>
<tr>
<td>5. Licensees and employees must limit prolonged sitting activities (in a stroller, high chair, board games, crafts) and schedule frequent short bursts of activity for one to two minutes.</td>
</tr>
<tr>
<td>6. Employees must demonstrate appropriate modelling of active play activities and screen time.</td>
</tr>
<tr>
<td>7. The licensee must develop and implement an active play policy to engage children in daily active play, consisting of unfacilitated play and facilitated games and activities. This policy should also be shared with parents/families.</td>
</tr>
<tr>
<td>8. The licensee must develop and implement a screen use policy to guide employees in the use of screen time activities. This policy should also be shared with parents/families.</td>
</tr>
</tbody>
</table>

This study is a nested qualitative study, within a larger quasi-experimental evaluation of the provincial capacity building workshop, Appetite to Play, and uptake of the AP standards. This is a three-year prospective study monitoring policies and practices in ECEC settings provincially that may be influenced by release of AP Standards. To complement the survey methodology of the provincial evaluation, the current qualitative study explores in greater depth educators’ perceptions of creating and implementing physical activity skill, and screen time policies in a variety of childcare settings. Specifically, the purpose of this study was to examine
educators’ perceived challenges and successes in implementing the new AP standards in licensed ECEC settings, as well as to evaluate the perceived strengths and weaknesses of the provincial capacity building workshop in augmenting the application of these standards in licensed ECEC settings, as well as in alternative ECEC formatting (e.g. parent participation programs). Understanding how and why educators are or are not implementing required standards for physical activity is important in order to generate strategies to increase uptake of the standards. As well, this information will directly inform the capacity building workshop evaluation, to ensure the workshop is meeting the training needs of the province and to identify any needed modifications.

3.1 Methods

Data were collected via semi-structured telephone interviews. In the current study, telephone interviews allowed us to engage participants from all five provincial health authorities which would not have been possible if face to face interviews were conducted. There is evidence to suggest that telephone interviews provide comparable participant responses to face-to-face interviews with respect to the depth of data (Novick, 2008; Sturges & Hanrahan, 2004; Sweet, 2002). Additionally, telephone interviews may permit participants to express controversial feelings and increase their response rate, as there is no need to travel (Novick, 2008; Sturges & Hanrahan 2004; Sweet, 2002). The study was approved by the University of Victoria and University of British Columbia Harmonized Research Ethics Review Board.
3.1.1 Participants

Eligibility criteria were that participants had attended an Appetite to Play workshop and spoke English. A detailed description of Appetite to Play can be found in Appendix A. Participants indicated on their consent forms if they would be willing to be contacted for a telephone interview to answer questions on the challenges and successes they have had in utilizing the skills they learned in the workshop and in implementing the AP standards. A research assistant contacted participants via telephone to schedule an interview. Rolling recruitment continued throughout data analysis until a point where no new codes were being identified.

3.1.2 Procedure

A member of the research team (EJB) contacted participants at the time of the scheduled interview. A semi-structured interview guide facilitated the conversation. This interview guide is provided in Appendix B. Interviews were audio recorded and transcribed by trained research assistants. Interviewers took pen and paper notes in the case of technological issues or faulty recording. Participants were asked preliminary questions surrounding the type of work they do in childcare, if they work at a licensed childcare provider (centre or home based), and the ages of the children with whom they work. Interview questions were broken down into two sections, the first asking questions regarding the efficacy of the capacity building intervention and the related resources to which participants were given access, and the second surrounding the implementation of the AP standards. Questions regarding the AP standards were to be asked to licensed childcare providers only. However, two participants worked in fields related to training or implementation of licensing standards, and requested to answer the questions surrounding
licensing. Following transcription of the interviews, participants were sent a copy of the transcribed interview to check for accuracy.

### 3.1.3 Data Analysis

Data analysis was conducted in NVivo 12 (QSR International, Australia). Thematic analysis (Braun & Clarke, 2006) was conducted to identify childcare providers perceived challenges and barriers in implementing the AP standards and to evaluate what participants in the capacity building workshop felt were strengths and weaknesses of the initiative. Data analysis followed Braun and Clarke’s (2006) six steps of thematic analysis. First transcribed interviews were each read in completion to become familiarized with the data. Second, coding of each interview was done to generate initial codes. Third, hand-written notes regarding codes were generated to determine connections between codes and search for themes. While the primary research questions surrounded participants’ perceptions on the implementation of the AP standards, and the general evaluation of the efficacy of the capacity building workshop and related materials, concerns participants raised regarding larger scale physical activity or sedentary behaviour time issues were coded and included in the data analysis. Fourth, themes were reviewed to determine the validity of themes and if separate themes could be combined. For example, personal experience in physical activity, and the differences between how participants viewed their engagement in physical activity versus how they viewed other educators’ engagement linked together to form one theme. Fifth, themes were defined and named. Deeper reflection into the contents of each theme was conducted through generation of thematic summaries. For example, when generating the theme, *the importance of space*, the perceptions of positive and negative space were compared and contrasted to determine similarities between
these perspectives. Finally, results were documented within this paper. Results will also be documented in the larger evaluation of the capacity building workshop. Throughout data collection, analysis, and writing up of the manuscript the co-authors acted as ‘critical friends’ (Smith & Sparkes, 2016) to encourage deep exploration and alternative interpretations of the data.

3.1.3.1 Epistemology and Ontology

Traditionally qualitative research is grounded in a subjective epistemology with declared ontological assumptions (Whaley & Krane, 2011). As the questions employed in this research project were generated by the Appetite to Play research team to evaluate the workshop, as well as uptake of the AP standards, applying a specific epistemological and ontological perspective post-hoc would not be prudent. That said, I acknowledge that knowledge is co-constructed between the researcher and participant, and that there is no set truth out there, as each individual has a subjective perspective (Whaley & Krane, 2011). Merely asking questions of participants may bring forth new, previously unconsidered ideas. A primarily deductive analysis methodology was used due to the nature of this research project, which aimed to evaluate the provincial capacity building workshop. However, inductive analysis was used whenever possible. I remained flexible and open when analyzing the data to allow other ideas to become salient.
3.1.3.2  Rigor

Participants were provided an opportunity to review their interview transcript to ensure accuracy. Only one participant made any changes, and in this instance it was to correct a typographical error in the spelling of her place of employment. Ongoing discussion with my supervisory team occurred to challenge my conceptions and assumptions regarding the data. As highlighted by Smith and McGannon (2018), member checking, inter-rater reliability, and universal criteria do not enhance the validity, trustworthiness, or reliability in the way researchers originally claimed. One alternative offered is the use of critical friends, which was employed in this project to enhance rigor.

3.2  Results

3.2.1  Participants

Participants (n=23) were from five regional health districts and the majority (n=14, 60.9%) were employed in a licensed ECEC. All participants were female, reflective of the gendered nature of ECEC. Table 3.2 provides detailed participant demographics. Sixteen participants responded to questions regarding the capacity building workshop and the AP standards, and seven only to questions regarding the workshop. These seven participants reported working in non-licensed ECEC settings; therefore, they are not required to adhere to the AP standards and these questions would not be relevant to them. Analysis identified four major themes. Two themes were identified as both barriers and facilitators to implementing the AP standards: first, the importance of space and, second, personal experience. The third theme, absence of screens, identified notable agreement with and adherence to the screen time AP standard, as participants found this to be in line with their own existent philosophies. Finally, in
the fourth theme, *praise for the capacity building workshop*, participants provided positive responses to the capacity building workshop and intended to support implementation of the AP standards with the children they care for. Notably, very few (17%) participants provided any response to questions regarding fundamental movement skills or physical literacy, even with probing.

Table 3.2

*Participant employment characteristics*

<table>
<thead>
<tr>
<th>Participant characteristics</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of employment:</td>
<td></td>
</tr>
<tr>
<td>Licensed childcare</td>
<td>14 (60.9)</td>
</tr>
<tr>
<td>Group licensed childcare</td>
<td>9 (39.1)</td>
</tr>
<tr>
<td>Preschool</td>
<td>2 (8.7)</td>
</tr>
<tr>
<td>Family licensed childcare</td>
<td>3 (13.0)</td>
</tr>
<tr>
<td>Parent participation programming</td>
<td>4 (17.4)</td>
</tr>
<tr>
<td>Training and implementation</td>
<td>2 (8.7)</td>
</tr>
<tr>
<td>Other</td>
<td>2 (8.7)</td>
</tr>
<tr>
<td>Health region employed in</td>
<td></td>
</tr>
<tr>
<td>Fraser Health</td>
<td>3 (13.0)</td>
</tr>
<tr>
<td>Interior Health</td>
<td>2 (8.7)</td>
</tr>
<tr>
<td>Northern Health</td>
<td>6 (26.1)</td>
</tr>
<tr>
<td>Vancouver Coastal Health</td>
<td>5 (21.7)</td>
</tr>
<tr>
<td>Island Health</td>
<td>7 (30.4)</td>
</tr>
</tbody>
</table>

3.2.2 The Importance of Space and Equipment

The physical spaces that educators had available to them came up frequently as a barrier or a facilitator to meeting the AP standards with 63% of participants reporting on space. The availability of equipment was frequently cited as a facilitator to meeting the AP standards, with 47% of participants reporting on equipment. Participants with large outdoor areas, or access to gym space noted the importance of being able to utilize these areas when providing opportunity for physical activity experiences, and how access to quality indoor and outdoor space made
implementing the AP standards easier. Three sub-themes, high quality space, low quality space, and equipment were found within this higher order theme.

### 3.2.2.1 High Quality Space

High quality space was frequently cited as a facilitator to meeting the AP standards, and with participants referencing both indoor and outdoor spaces.

*We have not just great outside space, but we also have a recreation room and a gym. So I find that, especially for the active play portion, I find those things make it really easy to implement what we learned about in the training about how long – like 60 minutes of physical activity. And because we have that outside space and we have like rock climbing walls in the gym, I find it’s really easy to get a lot of active play throughout the day.* –Participant 17

For participants working in home-based ECEC often described the quality of their outdoor area in reference to nearby parks and playgrounds.

*I’m in a pretty neat location in that there is like four or five parks right within walking distance of me, which we always walk. I don’t drive the children anywhere. There’s also the big backyard.* –Participant 18

One of the training and implementation participants highlighted how she witnessed the importance of space from a broad perspective, seeing programs with a higher emphasis on outdoor time, or with higher quality indoor space, tending to be better able to demonstrate the AP standards.

*Well there’s some programs that are really embracing outdoor play, and particularly our – our outdoor based programs where the kids are outside the majority of the day. Those kids are getting a lot more active play than programs that are more indoor based. And those programs that have decent indoor activity space that exceed the minimum standard within the regulation, and have gross motor rooms. Those children tend to be much more active, as well.* –Participant 21

The majority of participants identified safe, spacious, indoor and outdoor play areas as important for meeting the AP Standards.
3.2.2.2 Low Quality Space

Participants with lower quality outdoor space highlighted this as a major barrier for meeting the minimum outdoor time mandated by the AP Standards. This was particularly salient when safety was a concern, as described by one participant:

_We have a big beautiful field, but there are still spots, like at the other end of the field – there’s no gate . . . I need to have a safer outdoor place, right now is what I’m working towards, but I do the best with what I can._ –Participant 19

This was echoed by a training and implementation participant, who highlighted that while the AP standards mandate outdoor active play time, adjacent outdoor space is not a requirement.

_For other programs that are standalone in a church that don’t have, you know as I was saying at the beginning, don’t have access to an adjacent outdoor play space; they have limited minimum, you know that meets minimum requirements; it’s going to be much more challenging for them, so they’re going to have to get a lot more creative._ –Participant 21

Participants with low quality space had greater difficulty meeting the AP Standards for outdoor play.

3.2.2.3 Equipment

Equipment was cited less frequently than space, but was brought up by almost half of all participants.

_I’ve got climbers and I have basketball hoops, and riding toys, and all kinds of – and a huge backyard that they can run around._ –Participant 5

_We have tires that they ... jump on, and move them around, if they stack them up and do things with ... the tires. They have a ... little climbing structure and encourage them to climb up and jump down._ –Participant 12

Participants discussed the importance of having and providing equipment, but allowing the children to play freely with the equipment.
I would make a tent out of tables and put the tarp over it, bring some wood in, and then the children just expand, you know, from there. –Participant 12

No participant indicated that they had a lack of equipment, only that the equipment available to them was helpful in engaging the children in activity.

3.2.3 Personal Experience

The majority of participants (68%) noted personal experience as a facilitator for implementing the AP standards. Key components of personal experience were long service as educators (e.g. 20-30+ years), experience raising their own children, having a positive role model (at work or in their personal lives), and general personal philosophies or practices that physical activity should be an integral part of the day. Under the umbrella of personal experience four sub-themes were identified: personal activity levels, existent practices, role models, and “other” educators.

3.2.3.1 Personal Activity Levels

One participant discussed her own high level of engagement in physical activity during the ECEC day:

I still do cartwheels in the gym with my kids. –Participant 19

3.2.3.2 Existent Practices

Throughout the interviews, a common theme emerged, that participants were already committed to practices and philosophies surrounding promoting physical activity in their
workplaces prior to the release of the AP standards and participation in the capacity building workshop, was evident. For example:

*We would – without the specific guidelines per se, it was stuff we were doing anyways. It wasn’t – there was no big aha oh yeah we’d better do this and oh we can’t do that. It really did align with my philosophy, so, it really wasn’t … so it was pretty much what I was doing, but now I’m more specific.* –Participant 18

### 3.2.3.3 Role Models

Several participants highlighted that former coworkers or mentors had played a role in developing their attitudes around implementing physical activity, which helped in implementing the AP Standards. For one participant, role models and her previous work were some of the pieces she found supportive of implementing the AP standards:

*And I had good role models myself, teaching me how to, you know, how to deal with children and so problem solve; and the importance of learning through play. And so the – so my work, the people I worked with and the education I had, and then people tell me I just have a, I’m natural with you know, with children, so I think all of the above.* –Participant 12

### 3.2.3.4 “Other” Educators

Approximately half of the participants indicated that while they felt they were implementing the AP standards, prioritizing incorporating them into scheduling, and that the standards aligned well with their own philosophies, they did not feel that all early years practitioners were doing so. For example, one participant highlighted that implementing the AP standards, particularly when coupled with the capacity building, should not be difficult.

*I think the – the planning and the systems that are there are – are 100 percent workable. You know if people are having a problem with it, they need to relook at their, how they’re approaching it because it’s so workable.* –Participant 13

Another participant highlighted that if the personal philosophies or attitudes of other educators did not align with the AP standards, then adherence was unlikely.
Well if they don’t want to do the workshops or the training, right, or they don’t want to be prepared. They don’t believe in it, right, then it’s hard to get them to implement it. –Participant 23

Participants went so far as to pass judgement on the lifestyles or fitness of other educators as a barrier to the implementation of the AP standards.

But if you’re not active you’re not going to be taking those kids out for a walk, or you know, doing activities if you’re out of breath and you want to just have a seat. –Participant 23

While all of the participants in the current study believed in the importance of the AP standards, there was a general consensus that not all educators had the same philosophy.

### 3.2.4 The Absence of Screens

All of the participants indicated that screen time was not a regular part of their ECEC day. All participants working in licensed childcare noted that there was no screen time at their facilities. Educators only used screens for safety or brief educational purposes, or for a rare “special occasion”. Participants noted that while absence of screen time was in practice prior to the new standards, they, or their supervisors, had generated a written or explicit screen time policy since the release of the AP standards. Participants highlighted that they did not believe screen time was necessary for young children. For example, one educator commented that

The screen time is written down now, but I mean I’ve never not had that in my mind ever, so you know like I don’t have screen time, we don’t have video games; we don’t have that stuff here. We don’t even have computers, so that’s just my philosophy, I don’t think the kids need all that, at the moment. So we just don’t have it period. So I had no problem following the new guidelines for that at all, it didn’t exist in the first place. –Participant 13

Another echoed a similar sentiment:

I don’t do screen time. The only time I use a screen is ... I have to do fire drills with my kids once a month ... so I simulate a fire drill sound on my iPad. I’ve shown the kids a video on the Cuttlefish. So I have only used it like for science type things if I need to show the kids – cause
they’re still visual at this age, I need to connect that and be explaining something. ... I don’t believe in screens under 12, really. –Participant 19

There was agreement amongst all participants that screens were not a necessary part of childcare, and most participants noted that screen time in childcare was not a part of their own personal philosophies. The use of screens was rare and typically educational; however, educators occasionally used screen time as a “treat” for children.

3.2.5 Praise for the Capacity Building Workshop

All participants expressed positive feedback on the capacity building workshop. The majority of participants did not find that the workshop was providing brand-new information, but instead a review and reminder of important knowledge, and additional activities and resources to add to their tool-kit for physical activity. This was particularly salient for participants, as they were aware of the need to be meeting the physical activity component of the new AP standards.

One participant noted the benefits of having this information reinforced:

So it wasn’t very difficult. I think for me it was, it’s all the stuff that’s kind of already in there, in your brain, but it’s really helped to get it reinforced, and with all the research and all that stuff. Like it just helps to hear it, again. –Participant 14

This was reiterated by another participant who praised the program for increasing her enthusiasm for physical activity:

This has spearheaded a lot of stuff for me, this Appetite to Play has kind of got me in the groove of – I don’t know lets do more physical activity things. Not that I – like I said, I’ve been like that way anyways, cause I’m a very active person myself. But its just kind of given me a nice practical avenue to get excited about it actually. –Participant 19

And another participant further emphasized how the workshop connected well with the new AP standards:

I think it was another addition to what I already knew, it was a nice – like I said, it’s a nice refresher, okay this is what the field’s about, this is what we’re supposed to do with the new
mandate coming in. Here are some of the policies we need to follow. So it was a nice – knowing from the training it was already at the back of the mind, but with Appetite to Play that’s why I – I encouraged the actual physical training right, like where the facilitator comes in, because it’s a nice reminder. –Participant 15

Overall, the capacity building workshop was well received by participants.

3.3 Discussion

The results of this study provide a better understanding of the barriers and facilitators to implementing physical activity and movement standards for ECEC. Identified barriers were primarily factors that individual educators may not be able to modify themselves (e.g. physical space, equipment), particularly if they are employees, whereas identified facilitators arose from personal characteristics and attributes the educators saw in themselves. There is a growing body of quantitative evidence that supports these findings (Bower et al., 2008; Erinosho et al., 2016; Gubbels, van Kann, Jansen, 2012; Weatherson, McKay, Gainforth & Jung, 2017). In relation to the larger evaluation project that this study is nested within, the results of this study do raise concern that the new AP standards are unlikely to have a tremendous impact on the implementation of physical activity and movement in ECEC. If physical space and equipment are associated with successful implementation of these standards, then government granting should look to improve and increase these resources in ECEC settings.

The physical spaces and equipment available to educators were a major factor in educator reported capacity to implement the AP standards. Educators found that having access to quality indoor spaces, particularly gymnasium style spaces, and to safe and spacious outdoor spaces were major facilitators to achieving the physical activity times outlined in the AP standards. Previous quantitative research has found that physical space is associated with time spent in activity, and our findings support this (Bower et al., 2008; Erinosho et al., 2016; Gubbels et al.,
In particular, the references to large indoor gymnasiums as a benefit to getting children active is supported by quantitative findings, where a significant positive correlation was found between the size of the indoor space and children’s physical activity levels (Gubbels et al., 2012).

Most of the participants highlighted their own personal experience as a major influencer in prioritizing physical activity time. This echoes previous research in elementary school teachers where participants highlighted personal experience or identifying oneself as a physically active person as a potential mediator to providing physical activity opportunities during the school day (Weatherson et al., 2017). Additionally, a survey of students training to become educators found that self-efficacy to facilitate physical activity was significantly higher when students were meeting the physical activity guidelines themselves (Martyniuk & Tucker, 2014). Given the known low-levels of physical activity amongst Canadians (Colley et al., 2011), this finding is concerning, as it is unlikely that the majority of educators are meeting the physical activity guidelines for adults. This also gives rise to questions of the physical literacy and fundamental movement skill proficiency of educators, particularly when coupled with the minimal response received to fundamental movement skill questions in the fourth theme. There is a need to explore if educators have the physical literacy and fundamental movement skill proficiency themselves, to support the development of these skills in the children with whom they work.

In direct contrast to their self-evaluations of having high motivation to achieve the AP standards, participants in this project felt they did not see equivalent motivation and behaviours in other early years’ practitioners, either within their own organization or at other organizations. The lifestyle choices of other educators were identified as a potential barrier to implementing the
standards, and similar findings were found in a study exploring the barriers and facilitators to implementing a provincially mandated daily physical activity time (30 min) during the elementary school day in British Columbia (Weatherson et al., 2017). For example, one participant in Weatherson and colleagues’ report stated

“I think some of them might feel that, I mean, if they don’t exercise, or they don’t, they’re not knowledgeable about healthy habits in their own life—‘cause lots of people aren’t knowledgeable— that they wouldn’t want to model it anyways in school” (p. 8)

If participants’ reflections on “other educators” are accurate, and inactive educators, who likely represent a significant portion of this population, are not promoting the AP standards, the question remains – how do we reach this audience not only for research purposes, but also for purposes of effectively implementing AP standards?

All participants were in consensus that screen time should not be a part of the regular childcare day. While there were references to the use of screens for educational purposes; these were reported to be short (e.g. 2-3 minutes) and/or infrequent (e.g. once every month or two). Overall, self-report indicated that participants were adhering to the AP standard of providing no more than 30 minutes of screen time per day, with the exception of a “party” every month or two. This is contrary to previous Canadian research that has shown that children in childcare spend significant periods of time in screen behaviours, and in some cases over 2 hours per day (Vanderloo, 2014). The use of screen behaviours in childcare may be because parental attitudes regarding screen-viewing are mixed, with research finding that parents may not have strong concerns over the amount of time children spend in screen behaviours, but instead focus their concerns on the content (He, Irwin, Bouck, Tucker, & Pollett, 2005). Parents may also view
screen time (i.e. television viewing) as a relaxing and potentially educational activity for their children (Hinkley & McCann, 2018). However, these parental views have not been verified in an ECEC context. Given that the participants in this study indicated that when screen time was used it was for similar purposes, there may be similar attitudes amongst educators about the potentially beneficial aspects of screen behaviours. Additionally, our participants self-reported that they were adhering to the screen time standard.

During the coding of the interviews, it was apparent that fundamental movement skills and/or physical literacy, one of the eight AP standards, were not at the forefront of educators’ minds. Over 80% of participants did not discuss fundamental movement skills or physical literacy, despite the reference to them in direct questions from the interviewer, and only two participants indicated they were providing any activities to develop fundamental movement skills. The early years are an important window for the development of fundamental movement skills, with children possessing the developmental capacity to perform these skills at a foundational level by age 6 years (Gallahue et al., 2012). A growing number of studies are finding that 3 to 5-year-old children are performing fundamental movement skills below age-anticipated norms (e.g., Hardy, King, Farrell, Macniven, & Howlett, 2010; LeGear et al., 2012). While participation in physical activity is thought to influence the development of movement skills, activity alone may not be enough to develop object control skills (Barnett et al., 2016), which should be of particular concern as object control skills may be more important for physical activity participation in adolescence than locomotor skills (Barnett et al., 2009). As fundamental movement skill proficiency appears to be a key modifiable influencer in physical activity participation, and educators do not appear to emphasize movement skill development when discussing their active play practices, placing a greater focus on exploring how best to ensure
skill development opportunities occur is necessitated. Incorporating movement skill development into pre-service training for educators, and mandating professional development training for practicing educators could be a key policy change to influence this.

Overall, the capacity building workshop was well received by participants. Participants regarded the workshop as a benefit for reinforcing existent practices and knowledge. The workshop was widely regarded as a way to “refresh” or “remind” educators of previous training they had received in physical activity during their education, professional development, or personal experiences. While participants indicated they were supportive of, and believed in the AP standards, the lack of response to questions and probing around physical literacy and/or fundamental movement skills indicates there may be significant work to do in the training of educators in these topics. Previous literature has indicated the need for professional development of early childhood educators in physical activity, and physical literacy (Buckler & Bredin, 2018; Martyniuk & Tucker, 2014) and it appears that the capacity building workshop may have positively supported the implementation of physical activity, but not physical literacy.

3.3.1 Limitations

A major limitation to this study is that there was likely a participation bias, as participants needed to self-enroll in the study on two occasions. First, they volunteered to participate in the capacity building intervention training session, Appetite to Play, and then selected to be contacted for a follow-up interview. Given the overwhelmingly positive responses to the need for high levels of physical activity in ECEC, the individuals who took part in the interview process were likely those who already placed high emphasis and value on physical activity in early childhood.
3.3.2 Implications

The findings of this research can inform future childcare policy on active play in a number of ways. A greater emphasis on physical literacy, and in particular fundamental movement skill development needs to be made, even in educators who are already “on board” with the provision of frequent physical activity opportunities. The long-term benefits of strong fundamental movement skills are well evidenced (Barnett et al. 2008; Barnett et al., 2009; Lubans et al. 2010; Robinson et al., 2015; Wrotniak et al. 2006); therefore, training educators to support the development of these skills should be considered a critical part of educator training. Additionally, while the participants in this study appeared to be enthusiastic about implementing the AP standards, they reflected that not all educators may share similar feelings. Continued exploration of the ECEC educator population is needed to determine the need for targeted interventions and/or training for educators who do not prioritize physical activity or its related constructs throughout the childcare day. Finally, if personal physical activity plays a significant role in providing activity opportunities during the childcare day, then implementing effective interventions to promote physical literacy amongst educators may be beneficial.
Chapter 4: Physical literacy in early childhood educators: Is there a relationship between educator physical literacy and intentions and behaviours to provide physical activity and physical literacy opportunities in the childcare day?

Participating in regular physical activity has been shown to have a wide range of physical and mental health benefits at all ages of life (Janssen & LeBlanc, 2010; Pedersen & Saltin, 2015), however, physical activity participation rates remain low (Colley et al., 2011; 2017). There are a multitude of influences (e.g. public policy, built environment, socioeconomic status, and age) on physical activity participation (Trost, Owen, Bauman, Sallis & Brown, 2002). Physical literacy, defined as the motivation, confidence, physical competence, knowledge and understanding to value and take responsibility for engagement in physical activity for life (Whitehead, 2013), may have a prominent role in predicting physical activity behaviour at the individual level, and conceptually has been identified as a potential determinant of health (Cairney et al., 2019a).

Early childhood, in particular the preschool years (3-5), appears to be influential for the formative development of many of the components of physical literacy, particularly physical competence (LeGear et al., 2012). An increasing number of Canadian children are spending time under the care of an early childhood educator (Friendly et al., 2015), with over 50% of parents of children under 5 reporting using childcare regularly (Sinha, 2014). This puts early childhood educators in a key position to promote health behaviours of the children for whom they provide care given evidence to suggest early childhood educators can influence health behaviours. A
systematic review examining correlates of children’s physical activity in ECEC found that few studies had examined the role of educators in promoting physical activity behaviour (Tonge et al., 2018). Of those studies, four of the seven found that educator behaviour, for example prompts or feedback regarding physical activity engagement, were associated with greater child participation physical activity during the ECEC day. These studies cannot provide causal links due to the cross-sectional nature of the data; however, other non-physical activity health behaviours have demonstrated somewhat promising results. For example, enthusiastic modeling of eating new foods increased the acceptance of these unfamiliar foods in children (Hendy & Raudenbush, 2000).

Unfortunately, early childhood educators in British Columbia receive little to no training in physical literacy and related constructs such as gross motor development, fundamental movement skills, and physical activity, but demonstrate high interest in professional development opportunities in this area (Buckler & Bredin, 2018). Previous research has demonstrated that children who attend a preschool with a greater percentage of early childhood educators with a college education versus those with fewer college trained educators participate in more physical activity, and the policies and practice of childcare centres is associated with time spent in physical activity and sedentary behaviours, although the extent to which policy is related to these behaviours is still unclear (Bower et al., 2008; Dowda et al., & Pate, 2004; Erinosho et al.; 2016). As well, the addition of structured movement time in a childcare setting improved the overall physical activity of children attending the centre (Palmer, Matsuyama, & Robinson, 2017). Training, policies, and scheduling appear to all play roles in the provision of physical activity time in childcare.

While a multitude of factors are associated with physical activity time in childcare, the
personal physical literacy of early childhood educators may be influential. To the best of our knowledge, no research has examined the physical literacy of early childhood educators to date. While the structural factors of training, policies and scheduling are related to physical activity behaviours in childcare, individual factors related to early childhood educators may also be important. It stands to reason that in order to provide appropriate physical literacy development opportunities to the children under their care, early childhood educators should be capable of modeling physical literacy. Likely, individuals with higher physical literacy may be more motivated to provide opportunities for development of physical literacy in others. There is qualitative and quantitative evidence in samples of elementary school teachers that indicate that personal value on physical activity, and personal physical activity behaviour, moderates the intentions of teachers to provide activity opportunities to their students (Faulkner, Reeves, & Chedzoy, 2004; Weatherson et al., 2017). In a sample of generalist elementary school teachers, those who were physically active and/or had positive physical self-perceptions held more positive attitudes and intentions to provide opportunities for physical education in their classes (Faulkner et al., 2004). Additionally, research done as a part of this dissertation (see Chapter 3) supports the notion that personal experience is influential on the provision of physical activity opportunities by early childhood educators.

While the relationship between physical activity and physical education teaching among generalist elementary teachers has been examined (e.g., Faulkner et al., 2004) research has yet to consider the physical literacy of educators. A recent systematic review examining existing studies that have reported physical literacy measurements identified 32 published studies that utilized a qualitative or quantitative measure of physical literacy (Edwards et al., 2018). Of the quantitative studies, only two incorporated adults as participants, and these were limited to the
physical domain. Robust examination of the holistic conceptualization of physical literacy is clearly missing from the literature at this point. Existent psychology and motor development research has examined concepts related to physical literacy, although not under that term. The current evidence suggests that the components of physical literacy, at least in isolation, influence physical activity. For example, relationships between motivation (Wilson, Rodgers, Blanchard, & Gessell, 2003), confidence as measured by self-efficacy (McAuley & Blissmer, 2000), physical competence (Barnett et al., 2009; Jaakkola, Yli-Piipari, Huotari, Watt, & Liukkonen, 2016) and increased participation in physical activity have all been found. Examination of physical literacy is still necessary in an adult population, both in terms of applying the concept to adults, and in relation to adults’ capacity to support children on their physical literacy journey.

4.1 The Current Study

A greater understanding of the physical literacy of early childhood educators is needed. From this, a determination of whether the physical literacy of educators is associated with their intentions and behaviours for providing physical activity and physical competence components of physical literacy (i.e. fundamental movement skill opportunities) for the children for whom they care should be undertaken. Finding which components of physical literacy are related to the provision of these opportunities, as well as whether there are gaps in the physical literacy of early childhood educators themselves, may help to inform professional development training for early childhood educators to improve the provision of physical literacy and physical activity opportunities during their work day. Enhancing these opportunities for young children has potential lifelong health benefits, given that more active preschoolers are more likely to have strong fundamental movement skills when they start formal schooling (Barnett et al., 2016), and
children with stronger fundamental movement skills are more likely to be active as adolescents (Barnett et al., 2009). Enhanced physical activity and physical literacy opportunities during early childhood education may create a “domino effect” resulting in greater physical activity, and therefore better health for these children for life.

Accordingly, the purpose of this project is to assess the physical literacy of early childhood educators, and determine which components of physical literacy are associated with their behaviours and intentions to provide physical activity and physical literacy opportunities to the children for whom they care. While there are multiple aspects of physical literacy examined within the literature (e.g. a lifelong/developmental process, movement with poise and economy) I elected to use the components as outlined by the definition (motivation, confidence, physical competence, knowledge, and understanding), plus physical activity behaviours for relative simplicity of data collection, and comparison with existent research (Edwards et al., 2018; Edwards et al., 2017). Recent evidence suggests that the examination of physical literacy as components, rather than a single construct, demonstrates the best statistical fit (Cairney, Clark, Dudley & Kriellaars, 2019c). It was hypothesized that early childhood educators who have higher physical literacy as measured by motivation, confidence, physical competence, knowledge, understanding, and physical activity behaviour are more likely to have higher intentions in providing activities to promote physical activity and physical literacy, and greater self-reported behaviour in providing these activities to children during their work day.
4.2 Methods

4.2.1 Participants

Participants were recruited from licensed early childhood education centres at which they were employed. All early childhood education centres were located on a large university campus. The majority of participants were employed at one large multi-centre early childhood education organization. Inclusion criteria was (1) current employment as an early childhood educator in British Columbia (2) on a full, part time or on-call basis, and (3) be 18 years of age or older. All participants provided signed, informed consent documents. Ninety-five participants signed informed consent forms, one participant elected to drop out due to a lack of time and returned their blank paperwork the following day, and one participant completed all components of the study except the movement skill assessment, also citing time as their reason.

4.2.2 Measures

Physical literacy, including motivation, confidence, physical competence, knowledge, and understanding, plus physical activity, was assessed. Additionally, educators’ intentions and behaviours in providing physical activity and physical literacy opportunities were also assessed. Existing tools with evidence of reliability and validity were used as frequently as possible. Figure 1 provides an overview of the measurements in relation to each component of physical literacy.
4.2.2.1 Demographics, Training, and Employment History

Participants completed a questionnaire designed for this study to generate demographic information and to learn about their background as an early childhood educator (see Appendix C).

4.2.2.2 Knowledge and Understanding

Knowledge was measured with a multiple choice questionnaire assessing knowledge of physical activity guidelines (e.g. “What is the recommended amount of physical activity adults need in a week?”) and the benefits of physical activity (e.g. “Strength training activities are associated with which of the following health benefits?”) that was designed for this study with consideration of the assessments included within the CAPL (Longmuir et al., 2015). The complete questionnaire can be found in Appendix D. The internal consistency of this measure was $\alpha = 0.02$. Due to the extremely low internal consistency of this assessment, and that no associations were found between it and any other variable (see Tables 4.4 and 4.5), this variable was dropped from the regression analysis. A Likert scale was used to assess understanding of safety measures to be taken during physical activity (e.g. helmet wearing when bicycling or skiing, and wearing a lifejacket when boating). The generation of these questions was influenced by the CAPL (Longmuir et al., 2015). The complete questionnaire can be found in Appendix D. Six questions were asked regarding the importance of safety equipment for adults (e.g. “Adults (anyone 18 years or older) should always wear a helmet when bicycling.”) and children (e.g. “Children and youth (anyone younger than 18 years) should always wear a helmet when bicycling.”). Possible responses ranged from strongly disagree (score of 1) to strongly agree (score of 5). This scale was dropped from analysis as the...
Figure 4.1. Tested relationships between intentions and behaviours and components of physical literacy
mean safety score was 4.8 (0.5) out of a potential 5 with almost all participants responding in strong agreement to safety measures during physical activity (high skewness (-5.3), and kurtosis (38.0)). Because of the lack of variance, no meaningful information could be drawn from this safety data; however, it is important to note that early childhood educators value safety during physical activity.

Understanding of the benefits of participation in regular physical activity was measured with the Outcome Expectations for Exercise Scale (Resnick, Luisi, Vogel, & Junaleepa, 2004). This assessment asks participants to respond to 9 statements regarding the benefits of participation in exercise, for example, “Exercise helps to strengthen my bones” and “Exercise makes me feel less tired”. Potential responses range from strongly disagree (score of 1) to strongly agree (score of 5). This measure, originally designed for use in older adults, has strong reliability, with an alpha coefficient of 0.89 in previous literature (Resnick, Zimmerman, Orwig, Furstenberg, & Magaziner, 2000) and 0.90 for this study.

4.2.2.3 Motivation and Confidence

The Behavioural Regulation in Exercise Questionnaire version 3 (BREQ-3; Markland, 2014) was used to assess motivation. The BREQ-3 is guided by self-determination theory and seeks to understand how intrinsically motivated individuals are to exercise (Markland, 2014). The BREQ-3 utilizes six subscales: amotivation, external regulation, introjected regulation, identified regulation, integrated regulation and intrinsic regulation, which represent a continuum of motivation becoming increasingly self-determined from complete lack of motivation to purely intrinsic motivation. Each subscale asks 4 questions. A Relative Autonomy Index (RAI) score was calculated by weighting subscale scores and summing according to the assessment protocol.
The RAI score has been criticized (see Chemolli & Gagne, 2014) as the different types of autonomy-control may not fall as neatly on a continuum as previous researchers have indicated. However, the authors of the BREQ-3 note that the use of the RAI may be necessary in the case of large statistical analyses such as in the present study. A Cronbach alpha was not reported for this variable due to the transformation of the scores.

The Self-Efficacy for Exercise Questionnaire was used to assess confidence (Resnick et al., 2004). This assessment asks 9 questions regarding how confident respondents would be to exercise regularly in difficult conditions, e.g. “if the weather was bothering you”, “if you had to exercise alone”, “if you felt tired”. Participants respond to each question on a 0-10 point scale, with 0 representing not confident, and 10 representing very confident. Previous validation research found an alpha coefficient of 0.92 (Resnick & Jenkins, 2000) and internal consistency for this measure in the current study was $\alpha=0.86$.

### 4.2.2.4 Physical Competence

The Test of Gross Motor Development 2nd Edition, an assessment of fundamental movement skills, was used to assess physical competence (Ulrich, 2000). Reliability and validity data exists only for children aged 3-10 years; however, a recent publication has validated the measure in adolescents (Issartel et al., 2017). Issartel et al., (2017) found a reduction of skills to just 7 of the 12 included in the test demonstrated a better model fit for an adolescent population; however, this was in an Irish population, and several of the skills they eliminated (e.g. strike, overarm throw) can create cultural limitations in a European population compared to a North American population due to the popularity of baseball (Cools et al., 2009). We elected to include all 12 skills, firstly because our research took place in North America. Secondly, our research
had two goals: to summarize the physical literacy of early childhood educators, and to determine if their levels of physical literacy are associated with the self-reported provision of physical activity and fundamental movement skill/physical literacy activities. Thirdly, reduction to these seven skills did not improve internal consistency ($\alpha = 0.33$ using Issartel and colleagues (2017) seven skills). Previously reported internal reliability of the TGMD-2 is $\alpha = 0.85$ for the locomotor subscale and is $\alpha = 0.88$ for the object control subscale (Ulrich, 2000). For this study, locomotor subscale (run, gallop, hop, leap, horizontal jump, and slide) internal consistency was $\alpha = 0.30$, and was $\alpha = 0.59$ for the object control subscale (strike, dribble, catch, kick, overarm throw, underhand roll).

### 4.2.2.5 Physical Activity

Physical activity was measured using accelerometers and through a self-report questionnaire. Accelerometers do not capture all physical activity (e.g. water-based activities) and do not provide any context to in regards to physical activity type. The self-report measure used asks about leisure time physical activity only, and therefore may help delineate if participants are obtaining significant occupational versus leisure time activity.

Accelerometer-derived physical activity was assessed with PiezoRx (StepsCount, Canada) pedometers, which have been validated in comparison to accelerometers for measuring step counts ($r = 0.88$), moderate to vigorous physical activity ($r = 0.70$), and sedentary behaviours ($r = 0.93$) during a one-week time period (O’Brien, Wojcik, d’Entremont, & Fowles, 2018).

*Self-report physical activity* data were collected using the Stanford Leisure-Time Activity Categorical Item (L-CAT; Kiernan et al., 2013). The L-CAT is a one-item question to which participants select only one of six potential responses to describing their physical activity.
behaviour in their free time. Physical activity behaviours range from responses describing not engaging in “much physical activity” (score of 1) to engaging in physical activity five or more times per week in vigorous physical activity for a minimum of 30 minutes each session (score of 6; Kiernan et al., 2013). The L-CAT has demonstrated strong test-retest reliability ($r=0.80$, $p<0.001$) and adequate concurrent criterion validity with average pedometer steps (Kiernan et al., 2013).

4.2.2.6 Intentions and Behaviours for Physical Activity and Physical Literacy

Opportunities

Intentions and behaviours were measured through six Likert-scale questions designed for this research project. Questions were informed by guidelines reported by Ajzen (2013) and were designed to reflect the Canadian physical activity guidelines for the early years, which indicate that children aged 2-4 years should participate in 180 minutes of physical activity at any intensity progressing towards 60 minutes of energetic play every day (Tremblay et al., 2018). The three behaviour questions were stated as: I provide opportunity for the children I work with to: (1) participate in 180 minutes of physical activities every day, (2) participate in 60 minutes of energetic play every day, (3) learn and develop movement skills every day. The three intention questions were stated as: I intend to provide opportunities for the children I work with to: (1) participate in 180 minutes of physical activities every day, (2) participate in 60 minutes of energetic play every day, (3) learn and develop movement skills every day. Participants had five responses to select from for each question ranging from strongly disagree (a response of 1), to strongly agree (a response of 5), with undecided (a response of 3) in the neutral position. Cronbach alphas for behaviours and intentions questions were relatively low, 0.42 and 0.60,
respectively. This resulted in examination of each variable in isolation.

4.2.3 Procedures

Recruitment and consent procedures took place in the participant’s place of work. A member of the research team provided consent documents, questionnaires, and a pedometer to the participant. First, consent was obtained, then participants were provided instructions on pedometer wear. Participants were instructed to wear the pedometer on the left or right hip, in line with the mid-thigh attached to the waistband of the pants or belt, and participants were instructed to not place the pedometer in a pocket, and not attach it to a loose belt. Pedometers were to be removed for sleeping, water-based activities, and contact sports. Participants were scheduled for a motor skill assessment, and were asked to complete all surveys, as well as a physical activity readiness questionnaire (PAR-Q+; Warburton, Jamnik, Bredin & Gledhill, 2011), prior to the day of their skill assessment. PAR-Q+ responses screened participants for existent injuries or health conditions, and five participants (5.3%) did not complete all movement skills of the TGMD-2 due to existent injuries. Participants met research team members in a large gym space, to complete their motor skill assessment. Motor skill assessments were video recorded to ensure reliability of analysis and scored by a reviewer trained in assessment of the TGMD-2. A subset of assessments (20%) was scored by a second reviewer. Inter-rater correlation scores were 0.87 for locomotor subtests and 0.73 for object control subtests, both above the accepted minimum of 0.70 for the TGMD-2 (Ulrich, 2000).

4.2.4 Statistical Analysis

Pedometer step data was cleaned prior to analysis. Days with less than 1000 steps or
more than 40000 steps were considered invalid days, and participants with less than 5 valid days were excluded from data analysis (Mitchell et al., 2018).

All statistical analysis was carried out with IBM SPSS Statistics version 24 (IBM Corp, USA). All descriptive statistics were reported with means and standard deviations. Data were tested for normality, and if data were non-normally distributed, identified through tests of skewness and kurtosis, log transformation was conducted. Average steps per day and locomotor skill subscores were log transformed. Two sets of Pearson correlations were run between each behaviour and intention variable, and the 7 measures of physical literacy. A linear regression was run to determine which components of physical literacy (i.e. motivation, confidence, physical competence, understanding, and participation in physical activity) predict each of the 3 intentions and 3 behaviours of early childhood educators around providing physical activity, physical literacy, and fundamental movement skill opportunities. We controlled for age and years worked in childcare to account for any effects of experience. A minimum of 10 participants per predictor is needed to run a linear regression (VanVoorhis & Morgan, 2007), which our participant sample fulfills. A diagram showing the relationships assessed using correlations and regression can be found in Figure 1. We elected to not control for the false discovery rate as this research was exploratory in nature; therefore, we did not want to ignore potential relationships for future research (Goeman & Solari, 2011).

4.3 Results

Participant demographic, training and experience data are provided in Table 4.1. This includes mean and standard deviation for participant age, years worked as an early childhood educator, and years worked in current position; and number and percentage of group for gender,
### Table 4.1

Demographic, occupational and previous training for participants

<table>
<thead>
<tr>
<th>Age (years), mean (SD)</th>
<th>38.0 (10.1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>89 (94.7%)</td>
</tr>
<tr>
<td>Male</td>
<td>5 (5.3%)</td>
</tr>
<tr>
<td><strong>Current ECE Certificate to practice held</strong></td>
<td></td>
</tr>
<tr>
<td>Basic</td>
<td>16 (17.0%)</td>
</tr>
<tr>
<td>Infant and Toddler</td>
<td>43 (45.7%)</td>
</tr>
<tr>
<td>Children with Special Needs</td>
<td>2 (2.1%)</td>
</tr>
<tr>
<td>Infant and Toddler and Children with Special Needs</td>
<td>22 (23.4%)</td>
</tr>
<tr>
<td>ECE Assistant</td>
<td>3 (3.2%)</td>
</tr>
<tr>
<td>Did not respond</td>
<td>8 (8.5%)</td>
</tr>
<tr>
<td><strong>Years worked as an ECE, mean (SD)</strong></td>
<td></td>
</tr>
<tr>
<td>11.0 (8.5)</td>
<td></td>
</tr>
<tr>
<td><strong>Years worked in current position, mean (SD)</strong></td>
<td></td>
</tr>
<tr>
<td>6.5 (7.1)</td>
<td></td>
</tr>
<tr>
<td><strong>Age of children at current position</strong></td>
<td></td>
</tr>
<tr>
<td>0-1.5 years</td>
<td>6 (6.4%)</td>
</tr>
<tr>
<td>0-3 years</td>
<td>26 (27.7%)</td>
</tr>
<tr>
<td>3-5 years</td>
<td>27 (28.7%)</td>
</tr>
<tr>
<td>Multi-age</td>
<td>34 (36.1%)</td>
</tr>
<tr>
<td>Did not respond</td>
<td>1 (1.1%)</td>
</tr>
<tr>
<td><strong>Completed pre-service training in physical activity</strong></td>
<td>47 (50.0%)</td>
</tr>
<tr>
<td><strong>Completed pre-service training in FMS</strong></td>
<td>47 (50.0%)</td>
</tr>
<tr>
<td><strong>Completed pre-service training in physical literacy</strong></td>
<td>17 (18.1%)</td>
</tr>
<tr>
<td><strong>Completed professional development training in physical activity</strong></td>
<td>23 (24.5%)</td>
</tr>
<tr>
<td><strong>Completed professional development training in FMS</strong></td>
<td>16 (17.0%)</td>
</tr>
<tr>
<td><strong>Completed professional development training in physical literacy</strong></td>
<td>8 (8.5%)</td>
</tr>
</tbody>
</table>

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Note: ECE=early childhood educator, FMS=fundamental movement skills
current early childhood educator certificate to practice held, age of children at current position, completion of pre-service training in physical activity, fundamental movement skills, or physical literacy, and completion of professional development in physical activity, fundamental movement skills, or physical literacy. The majority of participants (94.7%) were female, and most held post-basic early childhood educator certification (71.2%). Few participants worked in infant settings, caring for children under 18 months (6.4%). Half of all participants indicated they completed pre-service training in physical activity and fundamental movement skills (50% each), and a small portion of participants indicated they had completed pre-service training in physical literacy (18.7%). A smaller percentage of participants indicated completion of professional development training in physical activity (25%), fundamental movement skills (17%), and physical literacy (8.5%).

Summary descriptive statistics for physical literacy measures can be found in Table 4.2, including motivation, confidence, physical competence, knowledge, understanding, and physical activity behaviour. Physical literacy component, assessment measure, mean, standard deviation, and possible score range on each assessment item are all reported. Average step count over the 7-day period is reported in Table 4.2, 61% of participants achieved an average of 10,000 steps/day, considered the minimum for obtaining health benefits from activity (Le Masurier, Sidman & Corbin, 2003; Tudor-Locke & Bassett, 2004). Understanding (as measured by the Outcome Expectations for Exercise Scale) was high with a mean of 4.2/5, and the remaining assessments of physical literacy were moderate to low. Mean and standard deviation for each of the motivation subscores out of a possible 4 points from the BREQ-3 are amotivation = 0.30 (0.55), external regulation = 0.66 (0.74), introjected regulation = 1.88 (1.02), identified regulation = 2.95 (0.74), integrated regulation = 2.25 (1.13), intrinsic regulation = 2.71 (0.91). Summary
Table 4.2
Mean and standard deviation of physical literacy components for early childhood educators

<table>
<thead>
<tr>
<th>Physical Literacy Component</th>
<th>Assessment Measure</th>
<th>Mean (SD)</th>
<th>Possible Range Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motivation</td>
<td>BREQ-3</td>
<td>11.5 (6.4)</td>
<td>-24 - 24</td>
</tr>
<tr>
<td>Confidence</td>
<td>Self-efficacy for exercise</td>
<td>5.0 (1.9)</td>
<td>0 - 10</td>
</tr>
<tr>
<td>Knowledge</td>
<td>Quiz of physical activity knowledge</td>
<td>2.9 (1.2)</td>
<td>0 - 6</td>
</tr>
<tr>
<td>Understanding</td>
<td>Outcome expectations for exercise</td>
<td>4.2 (0.6)</td>
<td>1 - 5</td>
</tr>
<tr>
<td>Physical activity (measured)</td>
<td>Average steps/day</td>
<td>11832 (4744)</td>
<td>1000 - 40000</td>
</tr>
<tr>
<td>Physical activity (self-report)</td>
<td>L-CAT</td>
<td>3.4 (1.2)</td>
<td>1 - 6</td>
</tr>
<tr>
<td>Physical competence (locomotor)</td>
<td>TGMD-2 locomotor subscale</td>
<td>39.0 (4.0)</td>
<td>0 - 48</td>
</tr>
<tr>
<td>Physical competence (object control)</td>
<td>TGMD-2 (object control subscale)</td>
<td>36.7 (6.2)</td>
<td>0 - 48</td>
</tr>
</tbody>
</table>

Descriptive statistics for behaviours and intentions to provide physical activity and physical literacy activities to the children the participants work with including mean, standard deviation, minimum and maximum can be found in Table 4.3. Overall, behaviours and intentions were relatively high with low variance, means ranged from 4.2-4.5 out of 5, and standard deviations ranged from 0.6-0.8.

A significant correlation was found between self-reported behaviour to provide 180 minutes of physical activity and 60 minutes of energetic play every day (r=0.36, p<0.01). Correlations between self-reported behaviour to provide 180 minutes of physical activity and to provide physical literacy activities/fundamental movement skill (r=0.05) and to provide 60 minutes of energetic play and to provide physical literacy activities (r=0.16) were not significant (p>0.05). Correlations between intention to provide 180 minutes of physical activity (r=0.37, p<0.01) and 60 minutes of energetic play and between 180 minutes of physical activity and
Table 4.3
Mean, standard deviation, and range for behaviour and intention question responses

<table>
<thead>
<tr>
<th></th>
<th>Mean (SD)</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviour, provide 180 min physical activity/day</td>
<td>4.2 (0.8)</td>
<td>1 – 5</td>
</tr>
<tr>
<td>Behaviour, physical activity, 60 min energetic play/day</td>
<td>4.3 (0.7)</td>
<td>3 – 5</td>
</tr>
<tr>
<td>Behaviour, physical literacy activities every day</td>
<td>4.3 (0.6)</td>
<td>3 – 5</td>
</tr>
<tr>
<td>Intention, provide 180 min physical activity/day</td>
<td>4.3 (0.8)</td>
<td>1 – 5</td>
</tr>
<tr>
<td>Intention, physical activity, 60 min energetic play/day</td>
<td>4.5 (0.6)</td>
<td>3 – 5</td>
</tr>
<tr>
<td>Intention, physical literacy activities every day</td>
<td>4.5 (0.6)</td>
<td>3 – 5</td>
</tr>
</tbody>
</table>

intentions to provide physical literacy activities ($r=0.29, p<0.01$) were significant. As well, intention to provide 60 minutes of energetic play and to provide fundamental movement skills/physical literacy activities was significantly correlated ($r=0.38, p<0.01$).

Correlations between physical literacy components can be found in Table 4.4. Many significant correlations were found. Motivation and self-efficacy ($r=0.55$), motivation and understanding ($r=0.64$), motivation and self-report of physical activity (0.39), self-efficacy and understanding ($r=0.54$), self-efficacy and measured physical activity ($r=0.36$), self-efficacy and self-report of physical activity ($r=0.40$), understanding and self-report of physical activity ($r=0.30$), and self-report and measured physical activity ($r=0.46$) were all positively correlated at the $p<0.01$ level. Motivation and measured physical activity ($r=0.22$), understanding and locomotor skills ($r=0.22$), understanding and measured physical activity ($r=0.22$), and locomotor and object control skills ($r=0.25$) were all positively correlated at the $p<0.05$ level.
Table 4.4
Correlations between components of physical literacy

<table>
<thead>
<tr>
<th></th>
<th>RAI</th>
<th>SEE</th>
<th>Knowledge</th>
<th>OEE</th>
<th>Locomotor (log transform)</th>
<th>Object Control</th>
<th>Steps (log transform)</th>
<th>L-CAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAI</td>
<td></td>
<td>0.55**</td>
<td>-0.02</td>
<td>0.64**</td>
<td>0.19</td>
<td>0.04</td>
<td>0.22*</td>
<td>0.39**</td>
</tr>
<tr>
<td>SEE</td>
<td></td>
<td>-0.09</td>
<td>0.54**</td>
<td></td>
<td>0.11</td>
<td>-0.09</td>
<td>0.36**</td>
<td>0.40**</td>
</tr>
<tr>
<td>Knowledge</td>
<td></td>
<td>0.02</td>
<td></td>
<td>-0.04</td>
<td>0.08</td>
<td>-0.14</td>
<td>0.03</td>
<td></td>
</tr>
<tr>
<td>OEE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.22*</td>
<td>0.11</td>
<td>0.22*</td>
<td>0.30**</td>
</tr>
<tr>
<td>Locomotor (log transform)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.25*</td>
<td></td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Object Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steps (log transform)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.46**</td>
</tr>
</tbody>
</table>

PA=Physical activity, RAI=relative autonomy index, OEE=outcome expectations for exercise, L-CAT=Leisure Time Categorical Item

**=significance at the p<0.01 level, *=significance at the p<0.05 level
Correlations between behaviours and intentions to provide physical activity and physical literacy activities can be found in Table 4.5. Self-reported provision of physical literacy and/or fundamental movement skills activities and understanding were significantly correlated ($r=0.24$, $p<0.05$). Intentions to provide 60 minutes of energetic play were positively correlated with understanding (as measured by the Outcome Expectations for Exercise Scale; $r=0.24$, $p<0.05$). Intentions to provide physical literacy and/or fundamental movement skills activities and understanding were positively correlated ($r=0.28$, $p<0.01$). Intentions to provide physical literacy and/or fundamental movement skills activities and object control skills were negatively correlated ($r=-0.24$, $p<0.05$).

Regression results between the six self-reported intentions and behaviours and components of physical literacy can be found in Tables 4.6-4.11. A significant main effect was found between intentions to provide fundamental movement skill and/or physical literacy activities daily and components of physical literacy, controlling for age and years worked as an early childhood educator, as identified in Table 4.11. Significant main effects were found between understanding and self-reported behaviour to provide fundamental movement skill and/or physical literacy activities daily and understanding and intentions to provide 60 minutes of energetic play daily, as identified in Table 4.8 and 4.10, respectively. Contrary to hypothesis, a significant main effect was found between object control skills and intentions to provide fundamental movement skills and/or physical literacy activities every day; individuals with lower object control skills reported higher intentions to provide fundamental movement skills and/or physical literacy activities every day, as identified in Table 4.11. No other relationships between variables were identified.
4.4 Discussion

The purpose of this exploratory study was to examine the physical literacy of a sample of employed early childhood educators. Physical literacy was measured using a component approach, which current research indicates is the most statistically sound (Cairney et al., 2019c). Second, this study aimed to determine which aspects of physical literacy predicted self-reported behaviours and intentions to provide physical activity and physical literacy activities (specifically physical competence activities) to children under their care. Early childhood educators demonstrated low to moderate scores for the majority of physical literacy measures. Exceptions to this were understanding (measured by outcome expectations for exercise) which was high, and physical activity with the majority of participants meeting minimum daily step counts of 10,000/day on average (Le Masurier et al., 2003; Tudor-Locke & Bassett, 2004). Physical literacy measures did not predict the majority of behaviours or intentions to provide physical activity or physical literacy activities. Understanding was the exception to this, with significant correlations found between understanding and self-reported provision of physical literacy and/or fundamental movement skills activities, intention to provide 60 minutes of energetic play, and intentions to provide physical literacy and/or fundamental movement skills activities. Regression analysis demonstrated similar findings with significant main effects found between understanding and self-reported behaviour to provide fundamental movement skill and/or physical literacy activities daily and understanding and intentions to provide 60 minutes of energetic play daily. Educators had high understanding of the benefits of physical activity for themselves, which was associated with their intentions and behaviours to provide these movement activities to children for whom they care.

On the measure of physical activity knowledge, participants scored an average of 2.9 out
of a potential 6 points. Questions encompassed knowledge of physical activity guidelines, benefits of physical activity, and intensity of physical activity. Low knowledge of physical activity guidelines is not necessarily an impediment to being physically literate. A previous intervention that sought to improve physical activity knowledge in a general adult population in efforts to increase behaviour was successful in increasing knowledge, but this did not correspond to an increase in activity behaviour (Young, Haskell, Taylor & Fortmann, 1996). Given that the measurement of knowledge utilized in the current study was created for the purposes of this study, and demonstrated low internal consistency, validation of a knowledge tool in adults is needed to better understand this component of physical literacy.

The physical literacy component of understanding was measured using the outcome expectations for exercise scale. While using this scale in order to measure understanding of physical activity is an atypical use of the scale, the questions asked in the measure (e.g. Exercise makes my mood better in general, Exercise give me a sense of personal accomplishment, Exercise helps to strengthen my bones) are in line with our interpretation of Whitehead’s definition of physical literacy where understanding relates to one’s capacity to value and take responsibility for physical activity (Whitehead 2010; 2013). This is furthered by Whitehead (2013) with the explanation that physical literacy includes “an understanding of the principles of embodied health, with respect to fundamental aspects such as exercise, sleep and nutrition” (p.30). Having a positive sense of the outcomes of physical activity is a key component of physical literacy. The participants in this study had high outcome expectations (4.2 out of 5) for exercise with little variability (sd=0.6).

Motivation, as measured by the BREQ-3’s relative autonomy index was moderate. Participants’ responses for the three subscales of identified, integrated, and intrinsic motivation
for exercise were higher than the three subscales of amotivation, external regulation, and introjected regulation, resulting in an overall positive score of 11.5. Interestingly, intrinsic motivation had the highest average response compared to the other five subscales. Intrinsic motivation is central to self-determination theory, where participants engage in a behaviour for the inherent satisfaction of participation in the activity (Ryan & Deci, 2000). Intrinsic motivation is considered the most meaningful for behaviour change or adherence to a behaviour (Ryan & Deci, 2000). This result indicates that motivation for exercise in this sample is more self-determined. Confidence, as measured by self-efficacy for exercise scale was moderate, with responses averaging 5.0 out of a possible 10. For this study, self-regulatory self-efficacy was employed (Bandura, 1990; Maddux, 1995). Self-regulatory self-efficacy is the confidence one has in their ability to engage in exercise when faced with challenges (e.g. poor weather, illness, injury), whereas task self-efficacy is the confidence one has in their ability to meet the task demands of a given exercise (e.g. walk uphill for 20 minutes at a prescribed pace) (Bandura, 1990; Maddux, 1995; Rodgers, Hall, Blanchard, McAuley & Munroe, 2002). Task self-efficacy may be an alternative conceptualization of physical literacy confidence; however, this does present measurement challenges. As physical literacy in its nature employs an individual approach, each individual will likely have varying task self-efficacy for different physical activities or exercises, but may have overall high self-regulatory self-efficacy to be active. The task self-efficacy one may have for a given physical activity task may be high, for example confidence in their ability to maintain a specified speed during a cycling class. However, the same person’s task self-efficacy for an alternative activity may be low, for example confidence in their ability to maintain a specified speed while running on a treadmill. Overall, this individual may have high confidence in the ability to be active, but low confidence for participation in
certain physical activities.

Physical competence as measured by the locomotor and object control subscales of the TGMD-2 was relatively low. Object control skills were slightly lower than locomotor skills, although this finding is typical in a female population (Hardy et al., 2010). The TGMD-2 provides percentile scores for children aged 3.0-10.9 years; therefore, generating accurate percentile scores for the current population is not possible. That said, if the participants in this study had been in the maximal age range the TGMD-2 allows (10.9 years), the mean locomotor subscore would place them in the 16th percentile, and the object control subscore would place them in the 16th percentile for females, and the 5th percentile for males (Ulrich, 2000). While these percentile scores bear no functional meaning, it does raise the question of whether early childhood educators are able to accurately demonstrate fundamental movement skills when providing opportunities for the children they work with to learn these skills. There is evidence that demonstration can act as a rate enhancer when acquiring new skills - that is to say, those that view demonstrations early in learning are more likely to take on more accurate movement patterns than those that hear verbal skill instructions alone (Horn, Williams, Hayes, Hodges & Scott, 2007).

While there is evidence from a motor behaviour perspective that expert demonstrations alone may not be the most effective tool for learning new skills (Darden, 1997), this should be considered in the context that fundamental movement skills are foundational skills, and being deemed an expert is not a prerequisite to have the capacity to achieve proficiency in these basic skills. Previous studies of preschool aged children in Canada demonstrate TGMD-2 scores significantly below that of this early childhood educator population. LeGear and colleagues (2012) found child locomotor skills of 25-27, and object control skill scores of 19-22. In the
current study, the mean locomotor skill was 39.0 and object control was 36.7. The difference in skill competency between preschoolers in other research and the early childhood educators in this study may be sufficiently large for “accurate enough” demonstrations to occur in a population that is new to these skills. Ultimately, determining if the skill proficiency of early childhood educators influences the longitudinal learning of movement skills in an early childhood population needs to be tracked over time to determine if a relationship exists, and if so in what direction.

The majority of participants achieved an average of 10,000 steps per day. A minimum of 10,000 steps per day has been associated with increased likelihood of meeting adult physical activity guidelines of 150 min of moderate to vigorous physical activity per week (Le Masurier et al., 2003). As all participants were employed on a large university campus with potentially significant walking distances between parking or public transportation and places of employment, this may facilitate greater steps per day. Additionally, participants may engage in meaningful step counts during their work day, as the early childhood educator profession is not a physically inactive job, and those with active jobs are more likely to reach 10,000 steps each day (McCormack, Giles-Corti & Milligan, 2006). Self-report leisure time activity, as measured by the L-CAT, resulted in a moderately active average score of 3.4. Scores of 3 and 4 translate roughly to moderate physical activity where respondents rate themselves as regularly participating in activity of ~3.0-5.9 METs (Kiernan et al., 2013). An L-CAT score of 4 is consistent with physical activity guidelines of 150 minutes per week; therefore, participants on average ranked themselves as not quite meeting physical activity guidelines in their leisure time (Kiernan et al., 2013). Therefore, it stands to reason that a meaningful portion of the activity measured by pedometers was either active transportation or workplace physical activity.
When considering the interrelationships between physical activity behaviour and the components of physical literacy, motivation, confidence, and understanding of physical activity were all significantly correlated with pedometer step counts; however, locomotor and object control skills were not. These findings may indicate that the psychological and cognitive elements of physical literacy are more influential in predicting physical activity behaviour in adults than physical competence and knowledge. However, this finding should be interpreted with caution, as the measures used for these components have been previously correlated with physical activity behaviour in an adult population, and other measures (i.e. knowledge, physical competence) were developed for the research project without prior validation of outcome scores, or not typically used in an adult population. We can postulate however, that fundamental movement skills may not be the best predictor of physical activity in a population that may be participating in workplace or active transportation physical activity. More work is needed to explore the interrelationships between physical literacy components as highlighted in a recent review article (Cairney et al., 2019a).

There were very few relationships between the components of physical literacy and behaviours and intentions to provide physical activity or physical literacy activities on a daily basis. It should be noted that as they were designed, the questions asking about physical literacy likely directed participants to consider only the physical competence component of physical literacy. A relationship was found between understanding (as measured by Outcome Expectations for Exercise) and a) intentions to provide opportunities for 60 minutes of energetic play daily and b) providing fundamental movement skills/physical literacy activities on a daily basis. These relationships suggest that educator understanding of the importance and benefits of physical activity may be related to the promotion of physical activity and physical literacy in an
ECEC setting. A relationship between object control skill proficiency and intentions to provide fundamental movement skills/physical literacy activities on a daily basis was found, but in the direction contrary to the hypothesis. Given this, our findings are surprising. The relationship between intentions to provide physical literacy/fundamental movement skills and object control skills was not expected but could be due to the low internal consistency of the measure.

The primarily null findings of the correlation and regression analyses for intentions and behaviours could be due to the limited variance in response to these questions. Average responses for intentions and behaviours were near maximal with small standard deviations, and response ranges for 4 of the 6 questions were only from the middle response (3) to the maximal response (5). This high response range could be due to a number of factors. The majority of the participants were employed by one large childcare organization, with overarching philosophies and policies that all individual centres within the group must follow. If the philosophies and policies prioritize physical activity and physical literacy, the early childhood educators may be more likely to report high behaviours and intentions to implement these activities, regardless of their personal physical literacy. Evidence is mixed regarding the relationship between physical activity policy on the measured physical activity of children attending childcare (Bower et al., 2008; Erinosho et al., 2016; Gubbels et al., 2012). However, given the small number of studies, continued exploration of the moderating effect of policy (e.g. schedule, physical space) on physical activity should be considered, and initial exploration of the effects of policy on fundamental movement skills and physical literacy should be undertaken. Perhaps, physical literacy and its individual components only affect intentions and behaviours when childcare centres do not have a policy on physical activity and literacy. Additionally, participants self-reported behaviour, and intentions, which could have resulted in a positive bias in responses. If a
self-report bias does not exist, and the responses are a true representation of the frequency at which participants are providing opportunities for physical activity and/or physical literacy the responses are not reflective of the quality of these opportunities. Questions remain about how much physical activity children are engaging in during these opportunities, or how well these opportunities are developing fundamental movement skills or physical literacy in the children for whom they care. Measurement of child physical activity behaviour and observation of daily childcare practices is needed to determine if self-reported intentions and behaviours to provide these opportunities translates into physical activity and engagement in physical literacy activities.

4.4.1 Strengths and Limitations

This study represents a unique contribution to the literature, in being the first to examine the physical literacy of early childhood educators, and the relationship between individual physical literacy and intentions and behaviours to provide physical activity and physical literacy activities to children attending childcare. Objective measures of physical activity and several components of physical literacy were used. An adequate sample size was recruited. All statistical analyses were determined *a priori*.

Limitations of this study include the use of self-report measures, and the sample of participants who all work in the same narrow geographic region, and the majority of whom who work for a single employer. Additionally, the questions asking about intentions and behaviours to provide fundamental movement skills/physical literacy activities were relatively narrow and did not speak directly to the provision of activities designed to improve the range of components of physical literacy including motivation, confidence, knowledge, and understanding. Additionally, the sample may have been biased towards an active population, as the majority of
participants were achieving significant daily physical activity (mean of >10000 steps/day).

Significant issues with measurement items make the capability to draw conclusions difficult. The locomotor and object control subscales had low internal consistency, which could indicate they are not sufficiently reliable and/or valid for assessing fundamental movement skills in adults. As well, the two measurement items for knowledge, which were generated for this research study, were dropped due to low internal consistency. Finally, the intention and behaviour questions had to be analyzed separately as the questions did not have high enough internal consistency to be analyzed as a composite score comprised of the separate items. Further research needs to be conducted to create reliable assessment tools for the psychological components of physical literacy in adults.

4.4.2 Conclusion

Overall, the physical literacy of this sample of early childhood educators was moderate when assessed using pre-existing tools, although they were physically active. Future work needs to establish a valid and reliable measure of knowledge for adults. With the exception of understanding, there does not appear to be a relationship between the majority of physical literacy components and educator self-reported behaviours and intentions to promote physical activity or physical literacy activities in children attending regular childcare. If replicated with reliable tools, this study may indicate that increasing the personal physical literacy of early childhood educators may not be necessary to effectively train them to promote physical activity and physical literacy in the children with whom they work. Further exploratory work is needed to determine if self-reported behaviours and intentions results in greater quality movement experiences for children attending childcare, and if those experiences result in greater physical
activity and physical literacy in these children. Higher physical activity and physical literacy all have the potential to benefit the health of children, directly and through their reciprocal relationships with each other (Barnett et al., 2016; Cairney et al., 2019a; Carson et al., 2017b; Lubans et al., 2010; Robinson et al., 2015; Tremblay et al., 2017). Accordingly, promoting these behaviours should be of high priority in an early learning setting. In order to generate this change, training opportunities for early childhood educators may not need to focus on the development of educator physical literacy, and may be able to focus on training educators to provide opportunities to support the development of physical literacy of children in their practice.
Chapter 5: Conclusion

The overall purpose of this dissertation was first, to quantitatively and qualitatively examine how training ECEC educators in physical activity and physical literacy, impacts their capacity to implement programming in these areas, and second, to quantitatively examine the physical literacy of ECEC educators and determine if their physical literacy is associated with educator provision of physical activity physical literacy activities. A series of three studies was undertaken. The first study examined the characteristics of successful training programs that aimed to improve the physical activity and/or physical literacy provided by educators to children in an ECEC setting. The second study qualitatively assessed the barriers and facilitators educators face in implementing physical activity standards mandated by the government. The third study quantified the physical literacy of educators and determined if there was a relationship between educator physical literacy, and their self-reported behaviours and intentions to provide physical activity and/or physical literacy activities on a daily basis. Table 5.1 provides a summary of these studies and their main conclusions. Findings suggest that educators are trainable in the promotion of physical activity and physical literacy, but factors outside of the control of educators may impede the successful implementation of activities in these areas with the children in their care. Findings further suggest that the physical literacy of educators may not play a substantial role in their intentions and self-reported behaviours to promote physical activity and/or physical literacy in the children for whom they care. However, confirmation of these findings is needed as several of the measurement tools had low internal consistency. Further investigations are required to confirm these results with direct observations or measurements of children’s engagement in physical activity and/or physical literacy activities in
childcare centres without policies in physical literacy or without attached outdoor spaces. This dissertation suggests that training interventions should focus on providing educators with the skills needed to engage children for whom they care in physical activity, and physical literacy. As well, training interventions may not need to focus on the development of the physical literacy of educators themselves.

Table 5.1

*Summary of main findings from dissertation body chapters 2-4*

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Objective</th>
<th>Design</th>
<th>Sample</th>
<th>Main Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Systematically review the current evidence to determine what are the characteristics of successful interventions that aimed to teach educators how to implement physical activity and/or physical literacy activities with the children they care for</td>
<td>Systematic review</td>
<td>43 papers, with data from 41 studies</td>
<td>Educators have the capacity to be trained to promote physical activity participation and physical literacy development. Training programs should utilize theory to develop program plans, and provide booster sessions to educators. Fidelity of interventions should be objectively assessed.</td>
</tr>
<tr>
<td>3</td>
<td>Describe barriers and facilitators educators face when implementing provincial guidelines for active play, and if a capacity building workshop was beneficial in implementing these guidelines</td>
<td>Qualitative</td>
<td>23 participants from provincial capacity building workshop</td>
<td>Personal experience was identified as a major facilitator to implementing activity standards, and physical space and resources were major barriers. Greater exploration of the attitudes of educators towards fundamental movement skill development and</td>
</tr>
</tbody>
</table>
In the systematic review presented in Chapter 2, results demonstrated that educators have the capacity to be trained to promote physical activity and physical literacy in the children they care for in ECEC settings. However, the provision of booster sessions or ongoing support for educators may enhance the likelihood of program success. As well, training programs require objective evaluation, with researchers or non-affiliated evaluators providing site visits, rather than relying on educator self-reports alone, to ensure fidelity. Reviews cannot draw strong conclusions about the efficacy of an intervention, if the extent to which the participants adhered to the intervention is unknown. As the majority of the interventions in the systematic review did not objectively assess study fidelity, it is unknown if adherence was high. Qualifying low or high adherence could be considered, in order to understand what influences educators to implement a program. Continued research is needed in this area with an emphasis on high-quality, low-risk of bias research intervention designs.
In a qualitative analysis of the barriers and facilitators educators face in implementing mandated policy in physical activity and physical literacy, Chapter 3 demonstrated that the educators view their own internal attitudes as a major facilitator to implementing physical activity and movement policy in the ECEC day, and that external factors, such as physical space and appropriate equipment, may prevent the provision of these activities. Discussion around fundamental movement skills was notably absent from responses from participants, despite explicit questions regarding the implementation of skill development activities. A qualitative study, specifically examining attitudes around physical literacy or fundamental movement skills, is warranted to probe further into if and how educators value and prioritize the development of these areas. The population sampled placed high value on physical activity, and emphasized that not all educators shared this attitude. Research should work to determine if educator attitudes vary in a larger sample, or a sample of educators recruited outside of a physical activity initiative. Beyond this, researchers should examine if this variation in attitude influences implementation of activity policy.

Chapter 4 was a cross-sectional analysis of the physical literacy of educators, and a correlative analysis of educator physical literacy and self-reported intentions and behaviours to provide opportunities for physical activity and/or physical literacy during the ECEC day. This study demonstrated that in general, the physical literacy of educators is moderate when assessed using existing measures (e.g. Self-Efficacy for Exercise, the Behavioural Regulation in Exercise Questionnaire). Due to measurement issues, certain components of physical literacy, including fundamental movement skills, cannot be classified into a low, moderate or high ranking. Understanding was relatively high in educators. Additionally, physical activity behaviour was in line with physical activity guidelines. The majority of participants were, on average, meeting
daily step recommendations of 10,000 per day (Tudor-Locke & Bassett, 2004; Le Masurier et al., 2003). Understanding, as measured by Outcome Expectations for Exercise, was high, with average scores indicating that participants “agreed” with the outlined statements. Overall, educator physical literacy had little relationship with educator self-reported behaviours and intentions to provide children in ECEC opportunities to engage in physical activity and physical literacy, with the exception of understanding. Incorporating information on the importance and benefits of physical literacy and physical activity for educators themselves into programs that train them on the implementation of physical activity and physical literacy activities in ECEC may be important. These results should be confirmed with objective assessments of educator provision of activities in ECEC, and longitudinal observation of engagement and measured improvement in these movement behaviours in the children attending ECEC.

The results of these three studies provide direction for policy and research in the areas of physical activity and physical literacy in an ECEC setting. Educators are trainable in physical literacy and physical activity, indicating that the implementation of high quality training programs in these movement behaviours should be effective. Focusing on the physical literacy of educators themselves may not be critical, but strategies to engage educators who place low emphasis on the importance of physical activity may need consideration.

5.1 Policy Recommendations

Generation of policy to mandate training for educators in physical activity and physical literacy is required. Survey research in BC and Ontario provides evidence that the respective governments do not currently mandate training in these regions. In BC, over 60% of survey respondents indicated they had not completed a course in physical activity, motor skill
development, or motor-skill acquisition during their educator training (Buckler & Bredin, 2018). In Ontario, over 70% of respondents indicated they had not taken a course in physical activity or physical education (Martyniuk & Tucker, 2014). Mandated training should be incorporated into pre-employment training programs and provided as professional development courses once educators are already in the field. Requiring training at the education and professional development level would provide the booster sessions or “refreshers” that the systematic review (Chapter 2) and qualitative participants (Chapter 3) identified as important. Mandating training on physical activity and physical literacy builds upon the existent framework educators’ work within, where the development of the whole child is considered (BC Ministry of Health, 2018).

Providing training on these important, health promoting movement behaviours is well within the anticipated practice of the early childhood educator. The revised Early Learning Framework, which guides the practice of educators throughout BC, identified physical activity as an opportunity to engage children in developing well-being and belonging (BC Ministry of Education, 2018). Recently, the BC government announced greater funding to support the training and professional development of educators (Government of British Columbia, n.d.). Health promotion researchers should capitalize on this timely initiative by calling for prioritization of training educators in movement behaviours. Incorporating competencies in physical activity, and physical literacy for trainee and practicing educators would likely have a significant impact. This is particularly salient, given previous research that indicates low levels of confidence and competence of educators to provide opportunities for engagement in physical activity, fundamental movement skills and physical literacy (Buckler & Bredin, 2018; Martyniuk & Tucker, 2014).
As outlined in Chapter 2, educators have the capacity to be successfully trained in the promotion of physical activity and physical literacy. If training is to be mandated for educators in these areas, several recommendations can be made for the creation of future training programs for educators in physical activity and/or physical literacy. Training programs should focus on providing ongoing support to educators. Ongoing support could take the form of booster sessions or continued support from a trained professional, but from a sustainability perspective, it may be more scalable to create communities of practice where educators can share and discuss strategies to incorporate physical activity and physical literacy into the childcare day may be more scalable. However, future research should confirm if communities of practice result in similar behaviour changes as booster sessions. A theoretical or philosophical framework should underpin training programs, as programs with such a framework were more likely to be successful. The reliance on a framework may provide a greater evidence base to develop programming, as well as a practical roadmap for implementers, and guide ongoing evaluation of programming.

As educators do not work in a vacuum and function under the physical and financial constraints of the ECEC settings in which they work, policy is needed to ensure the physical spaces ECEC centres exist within are of a high enough quality to ensure optimal physical activity participation. Larger indoor and outdoor play spaces that educators and children can be access easily and safely are needed, and this is supported by previous research (Gubbels et al., 2012). Currently in BC, ECEC licensing standards mandate outdoor play areas include a minimum of 6 m² of space for each child (Community Care and Assisted Living Act, 2018). These standards vary provincially, with Alberta requiring 4.5m² of outdoor space per child, Ontario requiring 5.6m² per child, and Nova Scotia requiring 7m² per child (Ontario Ministry of Education, 2018;
Province of Alberta, 2019; Province of Nova Scotia, 2019). Whether this space is sufficient to promote physical activity is unknown. Gubbels and colleagues (2012) did not provide size measurements, but rather rated play spaces on a scale of 0-10, where 0 equated to no play space, and 10 was a large play space. A positive correlation was found between larger play spaces and time spent in physical activity during the ECEC day (Gubbels et al., 2012). Quantifying the optimal size of play space to help children accumulate physical activity throughout the day should be undertaken. Then, a policy to mandate this play space size should be generated and implemented. As ECEC centres work under budgetary constraints, government funding will be needed to ensure new facilities can afford to create sizable place spaces, and help existing facilities retrofit to meet these guidelines.

5.2 Future Research Directions

Several gaps in the literature remain unanswered, and the results reported in this dissertation point to the pursuit of several new research questions. Further research is needed in a number of areas. These include examining if the personal values of educators influence their provision of movement behaviour opportunities; if intentions and behaviours to provide fundamental movement skill development opportunities translate to greater skill development; if educators can be trained in non-physical competence elements of physical literacy; what barriers exist in adhering to new training and/or policy; if and how race, ethnicity, gender, and sex may be influencing physical activity and physical literacy for educators and the children they care for; and if existent training interventions are scalable. Physical literacy is an emerging area of study, particularly when analyzed from a measurement or behaviour change perspective (Cairney et al.,
Given this, there is significant room for further research to determine what influences the physical literacy journey of young children.

Research is needed to determine if there is a population of educators who do not prioritize physical activity and related concepts, and consider how best to target them. In Chapter 3, personal beliefs about physical activity were identified as an important motivator for the sample of educators that were interviewed; however, this conflicted with the findings of Chapter 4, where educator physical literacy was not associated with self-reported intentions and behaviours to provide physical activity or physical literacy activities. This group of educators identified that they placed high value on physical activity, but that other educators they interact with in the field do not. A sample of elementary school teachers provided similar data (Weatherson et al., 2017). This participant bias may also exist in the sample of educators assessed in Chapter 4. The majority of participants were meeting daily recommended step counts indicating that they may also have been a sample that placed high value on physical activity. Results presented in Chapter 4 may not generalize to less physically active educators. Engaging a sample of educators who are less physically active, or place low value on physical activity participation may yield significantly different results, as they may have lower intentions and behaviours to provide opportunities for physical activity and physical literacy to the children for whom they care. Recruiting this population would likely need to be done through a strategy that does not mention physical activity or related concepts, as they may self-exclude from these types of research studies. If this population does exist to the extent described by the participants in Chapter 3, they may present as a group of educators with the most potential to change their childcare practice to incorporate more physical activity and physical literacy opportunities.
Questions remain regarding the capacity of educators to effectively promote the development of movement skills in the children with whom they work. Educators provided minimal to no response to questions related to the implementation of fundamental movement skills described in Chapter 3, and in Chapter 4, results demonstrated low levels of fundamental movement skills of educators. While educators did express high self-reported intentions and behaviours to provide opportunities for the development of physical literacy and fundamental movement skills described in Chapter 4, this does not mean that their intentions and behaviours translate to high-quality movement learning experiences for the children for whom they care. Rigorous and objective assessment of what educators report to be quality skill development activities is needed. Beyond this, do these activities result in skill acquisition for the children who participate in them? Fundamental movement skills represent one component of overall physical literacy, and these questions extend further into the holistic assessment and improvement of overall physical literacy.

There is still very limited evidence as to what physical literacy looks like in a preschool-age population. Only very recently has an assessment of physical literacy for this age group been released (Cairney et al., 2018b). Because of this, it is difficult to ascertain if educators have sufficient knowledge and capacity to start young children off on this important journey. As identified in Chapter 2, the systematic review, only one study included changes in physical literacy outside of physical competence as an outcome, and even then, researchers did not use the term physical literacy. Physical literacy is much more than physical activity behaviour and fundamental movement skill proficiency, with psychological components of motivation and confidence, and cognitive components of knowledge and understanding. Future studies need to examine if educators are capable of promoting the development of physical literacy. With the
development of a physical literacy assessment in this age group (Cairney et al., 2018) such studies are likely to emerge in the future, and the development of effective training in this area should be undertaken.

Providing quality, mandated training is critical; however, if educators are not adhering to new training protocols, training will not translate into behaviour change for children attending ECEC. Chapter 2 identified that more successful training interventions utilized objective assessment of fidelity. If educators are not adhering to the intervention program, as measured through objective fidelity assessments, qualitatively examining what is impeding this adherence is necessary. Training programs need to be accessible to educators, and possible for them to implement. Recalling the findings of Chapter 3, the barriers educators faced in implementing policy-mandated activity standards were typically outside of the control of the educator, and related to physical space or access to equipment. This supports the findings of other research in childcare and school environments, which identified the importance of space and resources (Bower et al., 2008; Gubbels et al., 2012; Weatherson et al., 2017). Educators may face similar challenges when implementing a physical activity or physical literacy intervention they are newly trained on and being able to adapt effectively to the specific daycare setting they are working in. Finally, research should examine if large-scale training for educators, such as Appetite to Play, can improve these activities such that children participate in greater physical activity, or their skill development trajectory increases beyond that of a child receiving typical care.

When generating interventions and training programs in physical literacy and physical activity for educators, researchers should reflect on Dudley and colleagues’ (2017) four pillars of physical literacy policy, particularly the power structure of movement. Assurances need to be put
into place to prevent populations who are marginalized from facing additional barriers to physical activity participation. Recent Canadian evidence suggests that there are differences between 8-12 year-old boys and girls on components of physical literacy (Tremblay et al., 2018). There is also evidence that there are differences in the physical activity behaviours, and fundamental movement skill capacities of boys and girls (Garriguet et al., 2016; LeGear et al., 2012; Robinson, 2010). As well, research indicates that ethnicity and cultural background may influence movement skill proficiency (Adeyemi-Walker, Duncan, Tallis, & Eyre, 2018; Hardy, Reinten-Reynolds, Espinel, Zask & Okely, 2012). A systematic review examining the correlates of fundamental movement skills found a paucity of evidence examining the role of ethnicity, indicating this is an area of high need for future research (Barnett et al., 2016). Incorporating measures of these variables is needed to ensure training and interventions to support physical literacy are not unfairly biased towards some groups. Further research is needed to determine what power structures may influence physical activity and physical literacy at the early childhood education level, and what solutions can be put into place to prevent them.

Implementing training on a large-scale presents challenges beyond that of a small-scale research intervention. Chapters 2 and 3 provide evidence that educators are trainable in physical activity, and physical literacy; however, to be effective at a population level these interventions will need to be “scaled-up”. Scaling up of interventions can reduce their efficacy. A systematic review examining the scale-up of evidence-based obesity interventions compared results from initial randomized controlled studies, and then secondary larger-scale versions of the same intervention program, found significantly smaller effect sizes in the second, larger studies (McCrabb et al., 2019). McCrabb and colleagues (2019) highlighted that this reduction could be due to the larger-scale programs having to make a greater number of concessions in the
implementation of the intervention. One such example of this is a change in intervention leader, or trainer, who in a smaller intervention is typically a member of the research team or a field expert, but in a large-scale intervention may need to be an individual trained solely for this scaled up programming. This reduction in trainer expertise may reduce the quality in the training that educators receive.

5.3 Concluding Remarks

The early years appear to play a key role in the development of physical activity and physical literacy. Formative physical activity experiences may play a pivotal role in setting the positive or negative trajectory of the physical literacy journey. These movement behaviours reciprocally influence each other, and improvement in any area has the potential to spill over into the promotion of the other areas. ECEC educators are an important point of contact in early childhood development, and have the potential to change the physical literacy trajectory of the children for whom they care. Government organizations need to mandate evidence-based training for educators in physical activity and physical literacy in order for educators to provide effective opportunities for children to develop these important movement behaviours. Positive movement experiences for all children enrolled in ECEC could set the stage for engagement in a lifetime of health-promoting physical activity, and truly embodied engagement in physical activity for life.
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Appendices

Appendix A

Appetite to Play provides in-person and e-learning workshops. In person workshops are 3-hours in length and typically offered outside of typical working hours (e.g. on weekends or in the evening). Approximately half of the workshop is dedicated to physical activity and physical literacy topics, and half to nutrition and healthy eating. Workshop content includes instruction from a workshop leader, group discussion, and participation in sample physical activity, physical literacy, and nutrition activities that can be undertaken in an ECEC setting. Physical activity and physical literacy content includes an introduction to the AP Standards, with information on how to incorporate adherence to the standards into the childcare day and how participants can provide documentation to licensing officers to evidence adherence to the standards. Nutrition content includes best practices for meal time, and how to plan healthy meals and snacks in an ECEC setting. Participants receive a handbook, as well as links to online Appetite to Play resources. The workshop can be used for professional development hours for licensed early childhood educators. Additional details regarding the workshop, as well as access to online resources and training can be found at: http://www.appetitetoplay.com
Appendix B

Workshop Participant Interview Guide

You are invited to participate in the Early Years Capacity-Building Evaluation because you participated in an Appetite to Play workshop and/or expressed your interest in participating in an interview. The purpose of this study is to evaluate whether the implementation of new professional development opportunities and recommended physical activity [PA] and healthy eating [HE] practices for early years child care has an impact. The purpose of the interview is to better understand the broader context of PA and HE in the early years settings. Every effort will be made to ensure any identifying information obtained through this study will be kept confidential. This interview will be audio-taped and transcribed. In order to keep your information safe, the data will be uploaded to a secure network drive accessible only to the research study staff. To protect your anonymity, your name will not be used in the transcribed copy of the discussion. After we transcribe the audio recording, we will contact you via email and ask if you would like to review the interview transcript for accuracy. This is an optional activity but we like to do this so that we can make sure we have not misrepresented what you said.

After the transcription is complete, the audio file will be destroyed and the electronic file stored on the secure network drive. Only members of our research team will have access to the audio-tapes and transcription. Transcripts without identification may be kept for up to five years following publication of the study.

Participation in this study is completely voluntary. You may choose not to answer an interview question for any reason. You may also withdraw from the study at any time. If you wish to leave the study during the interview, your contributions will be removed upon your request. Please review the letter of informed consent. If you have any questions do not hesitate to ask. By continuing you have agreed to participate in this interview.

Since you’ve taken an appetite to play workshop we just wanted to ask about how it’s been going. We want to talk about the healthy eating and physical activity recommended practices, and then more specifically about appetite to play and the Director of Licensing Standard of Practice - Active Play (DOLSOP). We’ve also sent you a graphic with the recommended practices and the DOLSOP standards as a reminder.

Interview questions

A. Are you part of a licensed childcare facility? If so, what type of license? (note: if not licensed skip interview questions 7-10)

1. After reflecting on the healthy eating and physical activity recommended practices in the graphic we sent you, how is it going to address the recommended practices and meet the standards?
a. What stage are you at in your implementation of the recommended practices? (develop a physical activity policy, screen time policy, implementing outdoor play, etc.?)

b. How have the resources supported implementation of the recommended practices?

c. What has made it easy?
   i. Has implementation of any of the recommended practices been easier than others?

d. What has made it hard?
   i. Has implementation of any of the recommended practices been harder than others?

2. Could you describe your level of use of the Appetite to Play resources?
   a. Have you gone on the website?
   b. Have you done an e-learning module?
   c. Have you done a self-assessment?
   d. Have you used a planning tool?
   e. Have you subscribed to the e-newsletters?
   f. Have you tried what you learned in the workshops?
   g. Why haven’t you used some of these resources?

3. Have you used the information from the workshop or Appetite to Play resources in your interactions with parents?
   a. What supported your interactions with parents?
   b. Did anything make it difficult to interact with parents?

4. How would you describe the response of other early years practitioners (coworkers, managers/staff, friends, etc.) to the Appetite to Play initiative?
   a. What is the reach?
   b. What is the enthusiasm?

5. What supports do you feel are essential to the success of the Appetite to Play initiative moving forward?

6. Do you visit any websites or groups for ideas or discussion about physical activity or healthy eating in the early years? If so, do you have some examples you could share with us?

------------------------If participant is from a facility without a license skip to q.11------------------------

Now we want to talk about the Director of Licensing Standard of Practice - Active Play (DOLSOP).

In BC, the Community Care and Assisted Living Act’s child care licensing regulation (CCLR) and Director of Licensing Standard of Practice (DOLSOP) set the requirements for all licensed child care facilities. The DOLSOP for active play includes 8 standards of practice. These are aligned with the recommended practices taught in the Appetite to Play training. On the graphic I sent you the recommended practices are on the left and the DOLSOP standards of practice are on the right.
7. Thinking about the DOLSOP, how easy or difficult is it to adopt and implement them in your facility. *Probe:* get participant to think in terms of ease of use, complexity, whether it aligns with values of their facilities or their own values, whether they perceived benefits by adopting them etc.

8. What factors within your facility have made it easy or difficult to adopt and implement the DOLSOP at your centre? *Probe:* think broadly about structural support or lack of it which can have affected adoption and implementation of the DOLSOP (e.g., capacity, resources, supportive climate, commitment to change, or any other environmental factors)

9. To what extent can childcare providers adopt and implement the DOLSOP whether they have the skills and experience to do this and what has helped to support providers in their implementation? *Probe* about providers own experience and skills to adopt the DOLSOP and whether attendance to workshop has helped them implement the DOLSOP.

10. When was your site reviewed by the BC director of licensing and when is your next review? To what extent do those reviews help your site to implement the DOLSOP?

11. Do you have any other comments?

12. In recognition of your time and contribution to this evaluation, you will be entered in to a draw to receive one of two $50 gift cards. What is the best way to contact you if you win?
Appendix C

Demographics and Training

Birth month and year:
Gender: Country of Origin:
Ethnicity: Date of arrival in Canada:
What level of ECE Licensure do you currently hold (e.g. 5 Year with Infant and Toddler)?

How many years have you worked as an ECE?

How many years have you worked at your current position?

What is the age range of the children at the centre you currently work at?

When you were undertaking your training as an ECE did you receive training in promoting physical activity? Yes or No
Please provide details:

When you were undertaking your training as an ECE did you receive training in gross motor skill development (e.g. throwing, jumping)? (Do not include fine motor skill development) Yes or No
Please provide details:

Have you heard of the term “physical literacy”? Yes or No
When you were undertaking your training as an ECE did you receive training in physical literacy? Yes or No
Please provide details:

Since completing your ECE training, have you participated in any professional development in physical activity promotion? Yes or No
Please provide details: (e.g. topics of courses, length of courses, location of courses)

Since completing your ECE training, have you participated in any professional development in gross motor skill development (e.g. throwing, jumping)? (Do not include fine motor skill development)?
Yes or No
Please provide details: (e.g. topics of courses, length of courses, location of courses)

Since completing your ECE training, have you participated in any professional development in physical literacy? Yes or No
Please provide details: (e.g. topics of courses, length of courses, location of courses)

Are you aware of the Standard of Practice for Active Play that came into practice September 2017? If yes, can you describe any specific aspects of the standard?
Are you aware of the Canadian 24-Hour Movement Guidelines for the Early Years (0-4 years)? If yes, can you describe any specific recommendations within the guidelines?
Appendix D

Knowledge and Understanding about Physical Activity

Please circle the correct answer.

1. What is the minimum amount of physical activity adults need in a week?
   a. 60 minutes  
   b. 90 minutes  
   c. 150 minutes  
   d. 180 minutes

2. What is the minimum amount of physical activity children aged 2-4 years need in a day?
   a. 60 minutes  
   b. 90 minutes  
   c. 150 minutes  
   d. 180 minutes

3. Which of the following is an example of moderate intensity physical activity?
   a. Running  
   b. Riding a bicycle  
   c. Cross country skiing  
   d. Yoga

4. Strength training activities are associated with which of the following health benefits?
   a. A stronger heart  
   b. Improved bone health  
   c. Lower blood pressure  
   d. Healthier lungs

5. Physical activity that improves health is most broadly defined as:
   a. Planned and purposeful exercise  
   b. Any and all movements from the time we get out of bed until we go to sleep at night  
   c. Going to the gym to lift weights or use the cardio machines  
   d. Any active movement that increases the heart rate and breathing (e.g. raking leaves, swimming)

6. Physical activities such as running, bicycling, and cross country skiing are associated with which of the following health benefits:
   a. Improved bone health  
   b. Healthier heart and lungs  
   c. Increased strength  
   d. Improved body composition
Please circle the number that you feel best represents you.

7. Adults (anyone 18 years or older) should always wear a helmet when bicycling.

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8. Children and youth (anyone younger than 18 years) should always wear a helmet when bicycling.

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9. Adults (anyone 18 years or older) should always wear a lifejacket or personal floatation device (PFD) when boating.

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11. Adults (anyone 18 years or older) should always wear a helmet when participating in winter sports such as downhill skiing or snowboarding.

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12. Children and youth (anyone younger than 18 years) should always wear a helmet when participating in winter sports such as downhill skiing or snowboarding.

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