

**Associations between community early years program participation and child  
developmental outcomes: a community-based study**

by

Amanda Renee Kwan

B.Sc., The University of British Columbia, 2015

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

THE DEGREE OF

MASTER OF SCIENCE

in

The Faculty of Graduate and Postdoctoral Studies

(Population and Public Health)

UNIVERSITY OF BRITISH COLUMBIA

(Vancouver)

April 2020

© Amanda Renee Kwan, 2020

The following individuals certify that they have read, and recommend to the Faculty of Graduate and Postdoctoral Studies for acceptance, the thesis entitled:

Associations between community early years program participation and child developmental outcomes: a community-based study

---

Submitted by     Amanda Kwan     in partial fulfillment of the requirements for

the degree of     Master of Science    

---

in     Population and Public Health    

---

**Examining committee:**

Brenda Poon, School of Population and Public Health (SPPH)

---

Supervisor

Martin Guhn, School of Population and Public Health (SPPH)

---

Supervisory Committee Member

David Tindall, Department of Sociology

---

Supervisory Committee Member

Eva Oberle, School of Population and Public Health (SPPH)

---

Additional Examiner

## **Abstract**

**BACKGROUND:** The early environments that children are exposed to can contribute to their development across multiple areas from physical to emotional health. In particular, centre-based programs have been shown to be associated with positive developmental outcomes for children such as improved language, vocabulary, and pre-academic skills. Qualicum, BC provided a unique opportunity to explore this relationship because of its community-wide initiative to track children's program attendance. The purpose of this study is to examine the Qualicum community case in depth to better understand program use and determine if exposure to community early years programs is associated with developmental outcomes of children by Kindergarten.

**METHODS:** Data were drawn from a linked database containing children's community early years program attendance ('Goose Trax' repository) and developmental outcome data (Early Development Instrument (EDI) database). Of the 1,464 children (0-5 years old) represented in the linked database, 212 participated in community early years programs. Network analysis to explore program attendance ties and regression analyses to determine associations between participation and developmental outcomes were performed. Program participation, dosage of attendance, diversity of attendance, and popularity of attendance (centrality) were studied as potential contributors to developmental outcomes (EDI scores).

**RESULTS:** Network analysis showed how certain programs were central to the structure of program networks, although no pattern emerged that related centrality to EDI scores.

Participation in community early years programs was associated with child development overall, which in this context refers to development across 5 different domains (physical, social, emotional, language, and communication), and development in the social and emotional

domains. Models accounted for roughly 10% of the variability in EDI scores. Dosage, diversity, and centrality measures were not found to have an association with EDI scores.

DISCUSSION: More needs to be understood about the contextual factors surrounding community early years programs and their potential effects on child development. The findings from this study provide some insights into the potential impacts of differential participation in community early years programs on child developmental outcomes at the population level. Further research is needed to support these findings.

## **Lay summary**

Early child development is a key contributor to health and social well-being. The early environments children are exposed to can contribute to their level of development across multiple domains, including physical, social, emotional, language and communication. Exposure to community-based programs during the early years (0-6 years) may supplement the home environment by providing children with greater social and learning opportunities. Despite this potential, little is known about the structure of programs that support families with young children or their effectiveness in enhancing child developmental outcomes. This study revealed how certain programs were critical within the network. It showed participation in community early years programs was associated with advantages in child development overall and for the social and emotional domains. No additional advantage were seen for children who attended programs more frequently, attended a greater number of programs or attended more popular programs.

## **Preface**

This thesis is the original intellectual product of the author, Amanda Renee Kwan, and was written with the supervision and guidance of a supervisory committee consisting of Dr. Brenda Poon, Dr. Martin Guhn and Dr. David Tindall. The secondary data analysis reported in Chapters 2-3 is covered by the UBC Behavioural Research Ethics Board, #H18-02835. Sections of this thesis may be submitted for publication in peer reviewed journals.

## Table of contents

<b>Abstract</b> .....	iii
<b>Lay summary</b> .....	v
<b>Preface</b> .....	vi
<b>Table of contents</b> .....	vii
<b>List of tables</b> .....	ix
<b>List of figures</b> .....	x
<b>Acknowledgments</b> .....	xi
<b>Chapter 1: Introduction and literature review</b> .....	1
Introduction.....	1
Literature review .....	3
A relational approach to development .....	3
A social system: social ecological theory .....	4
A social network: social network theory and analysis .....	7
Influences of children’s program participation on health and developmental outcomes.....	10
Influences of early childhood education and care (ECEC) participation on health and developmental outcomes.....	12
Effects of dosage (ECEC).....	13
Influences of community early years program participation on health and developmental outcomes .....	14
Effects of dosage (community early years programs).....	16
Areas for further exploration.....	17
Methodological considerations .....	18
The present study .....	19
<b>Chapter 2: Methods</b> .....	21
Context for the study.....	21
Data sources .....	22
Analytic sample .....	24
Participants.....	24
Community early years programs in the GT database .....	24
Measures .....	26
Analytic approach .....	29
<b>Chapter 3: Results</b> .....	32
Descriptive data .....	32

Does the network structure of children’s program attendance relate to child developmental outcomes? .....	35
Does children’s participation in community early years programs influence their developmental outcomes by Kindergarten? .....	41
Do certain factors associated with children’s program participation including dose of programs attended, diversity of programs attended, and popularity of programs attended (centrality) influence child developmental outcomes by Kindergarten? .....	45
<b>Chapter 4: Discussion</b> .....	48
Network patterns .....	48
Community early years program participation .....	51
Factors associated with program participation .....	55
Study strengths and limitations .....	57
Implication of findings .....	59
Future directions .....	61
<b>Conclusion</b> .....	62
<b>References</b> .....	63
<b>Appendices</b> .....	75
Appendix A: additional program information .....	75
Appendix B: additional summary tables .....	76



## List of tables

Table 1: Community early years programs available by year .....	25
Table 2: Descriptives of categorical independent variables .....	34
Table 3: Descriptives of continuous dependent variables.....	34
Table 4: Descriptives of continuous independent variables by year (GT group) .....	35
Table 5: Summary measures of network cohesion (2-mode program attendance networks) .....	36
Table 6: Program centrality measures and average EDI scores.....	40
Table 7: Multiple regression analysis predicting overall EDI score.....	42
Table 8: Multiple regression analysis predicting domain EDI score .....	44
Table 9: Multiple regression analysis predicting overall EDI score for Year 1 .....	47
Table 10: Descriptives of community early years programs .....	75
Table 11: Multiple regression analysis predicting overall EDI score for Year 2 .....	76
Table 12: Multiple regression analysis predicting overall EDI score for Year 3 .....	77

**List of figures**

Figure 1: Social ecological framework to health adapted for early child development ..... 6

Figure 2: Conceptual diagram of direct and indirect program effects on child developmental outcomes adapted from Anderson et al., 2003..... 12

Figure 3: 1-Mode network diagrams of common child attendance for a) Year 1: September 2007 – August 2008; b) Year 2: September 2008 – August 2009; and c) Year 3: September 2009 – August 2010 ..... 38

## **Acknowledgments**

I am grateful to everyone who has provided support and encouragement throughout this process.

A special thank you to Michele Wiens and Lisa Chen for their commitment and enthusiasm towards this extension of ‘Goose Trax’ and for their help in bringing the components of this project together;

To my friends and colleagues at the Human Early Learning Partnership (HELP), especially Scott Emerson and Chris Atchison, for bringing joy and laughter to this experience;

To my committee, Dr. Martin Guhn and Dr. David Tindall, for the opportunities to learn from their vast methodological knowledge;

To my supervisor and mentor, Dr. Brenda Poon, for always being kind and encouraging. It has been a privilege working on her team and I am extremely grateful for the opportunities and experiences that have pushed me this far; and

Finally, to my friends and family for their ongoing support; and to my husband, for everything he’s done to make this journey possible.

# **Chapter 1: Introduction and literature review**

## **Introduction**

The purpose of this study is to acquire a better understanding of ways that children's participation in formal early learning environments, and in particular community early years programs, may contribute to children's developmental outcomes. Increasing knowledge of the network of early years programs that supports families with young children and also patterns of children's participation in these programs may provide new insights into how communities promote healthy child development through their community programming.

The early environments children are exposed to define the early experiences that shape their development. Whether a child exists in a thriving and stimulating environment or in a depleted and neglectful one can set the trajectory for a course of outcomes that extend well beyond childhood. Early child development has been shown to impact a wide range of health and social outcomes from school success or failure, antisocial behaviour, teen pregnancy, obesity and heart disease, diabetes, mental health, and premature morbidity and mortality (Anderson et al., 2003; Arteaga et al., 2014; Hertzman, 2009).

The early years are characterized by sensitive periods of development when the brain is especially responsive to sensory stimuli and patterns of activity. Sensitive periods are defined by increased neural plasticity in the brain (Daw, 1997; Early Years Study, 1999). After these sensitive periods of development, the brain is unable to absorb and respond as effectively to early experiences (Halfon & Hochstein, 2002; Hertzman & Power, 2003). This suggests why age-specific experiences during the early years are critical for shaping development and the trajectory of outcomes that span the life course.

Over the past 15 years, the province of British Columbia (BC) has seen population level measures of childhood vulnerability increase, such that one-third of young children are considered developmentally vulnerable by the time they enter Kindergarten (HELP, 2019). However, these rates are not consistent across the Province with some communities experiencing vulnerability rates as low as 13% while others are as high as 68% (HELP, 2019). These data are suggestive that some children are thriving in their current environments while others are being exposed to and experiencing a disproportionate number of challenges that may leave them developmentally vulnerable.

To address disparities in early child development, a common strategy among communities has been to supplement the early at-home environments of high-risk children with community intervention programs (Burger, 2010; Datta Gupta & Simonsen, 2016). The primary focus of these intervention programs has been on academic readiness, which includes early language, vocabulary and reading skills, pre-math skills, and readiness to learn. Interestingly, in BC, of the developmental domains, the language and cognitive domain has the lowest provincial rate of vulnerability at 10.6% (HELP, 2019). This suggests that if BC communities also tend to focus on academic readiness in their programming, one could speculate that those community environments may contribute to promoting the development of specific components within the language and cognitive domain.

In the sections that follow, I will provide an overview of the conceptual frameworks that guide this work and summarize relevant literature on the effects of children's participation in formal early learning environments on health and developmental outcomes. In the context of this study, I use the term "formal early learning environments" to refer to any community-based setting where children are cared for and supervised by trained personnel. Within this summary I

will highlight a subset of participation related factors – dosage of programs attended, diversity of programs attended, and popularity of programs attended - that may additionally contribute to children's health and developmental outcomes.

## **Literature review**

### **A relational approach to development**

Relational approaches have been widely used in sociology to study a wide range of phenomenon from power and leadership to social movements, interorganizational relations, and health practices. This approach focuses on the connections of everything (e.g., individuals, groups, organizations) to one another bounded by the social world in which they exist (Bourdieu et al., 1992; Emirbayer, 1997; Martin, 2003). It emphasizes the importance of understanding the spatial and temporal location of entities/transactors/actors in relation to others for understanding specific social processes or actions and their related outcomes. Social processes, including influencing and leveraging processes (e.g., adopting peer attitudes or behaviours, using social position to do something), are the emergent products of a dynamic system of unfolding relations (Bourdieu et al., 1992). Relational approaches have been most widely employed through the use of field theory, which frames social processes within external sociocultural and physical spaces or fields. Fields can be visualized as quasi-organisms, systems or structures in which interactive and power relations exist (Martin, 2003). This approach has allowed for a more comprehensive and multi-level understanding of relations across individuals (biological, psychological, cultural determinants) and society (Singh, 2019; Wilkinson, 1972). For example, research suggests that applying a relational or field-theoretic approach to understand health practices must look at the complex relationships between mental structures (e.g., perceived benefits & barriers, attitudes

towards change, self-efficacy) and objective structures (i.e., fields) that guide everyday health decisions (Veenstra & Burnett, 2014).

Field theory can serve as an umbrella term for multiple other frameworks that rely on relational thinking or methodology (Barman, 2016). In the context of understanding the system that supports families with young children, I will focus on the field of early years bound within a specific community. Within this field are the individuals and community organizations that share a relation to the early years (caring for or supporting young children). Understanding their objective positions within the system or field and interactions within the field network may isolate some of the complexity happening within this field of early years. In the following sections, I will summarize how social ecological and network theory are complementary to one another for understanding the field or system that supports families with young children.

### **A social system: social ecological theory**

A society is composed of many different social fields that can include groups of individuals, organizations and/or communities (Veenstra & Burnett, 2014; Wilkinson, 1972). Social fields and social ecology are both theoretical metaphors for characterizing social systems (Liu & Emirbayer, 2016). In this way, the social ecological model can be positioned within the field of early years.

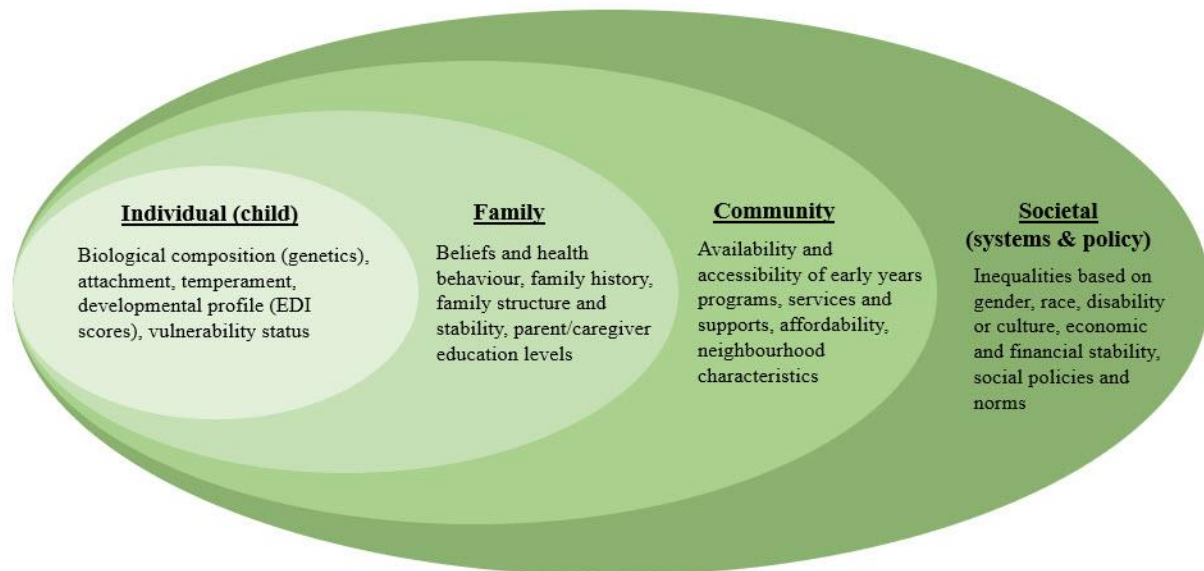
The social-ecological model is a widely referenced framework for understanding how different levels of the system (micro, meso and macro) work to impact health and developmental outcomes. It is particularly useful in addressing complex real-world problems because of its ability to consider both individual and environmental factors (Stojanovic et al., 2016). Studies have used this approach to better understand barriers to retention in clinical trials, challenges with implementing community health interventions (e.g., The trial of activity for

adolescent girls (TAAG), Better Beginnings, Better Futures) and engaging parent/caregivers, and factors that affect the transition periods for children entering school, their readiness for school and their resilience towards stress in school (Elder et al., 2007; Peters et al., 2010; Rimm-Kaufman & Pianta, 2000; Salihu et al., 2015; Ungar et al., 2013; Whittaker & Cowley, 2012).

Factors that contribute to human health or illness are the result of interactions between overlapping influences across the systems levels (Bronfenbrenner, 1979; Salihu et al., 2015; Stokols, 1996). Figure 1 below illustrates how contextual factors influencing children's developmental outcomes are nested within layers of complexity that range from those most proximal to the child, such as a biological makeup and attachment, to those most distal, such as government policies that govern housing and welfare. These nested factors include elements of the individual (e.g., sex, age, genetic attributes), the microsystems in which children are in direct contact (e.g., family, peers, community environments), the mesosystems in which multiple microsystems interconnect (e.g., child-parent, family-community environment interactions), the exo-system in which children are in indirect contact (e.g., parental workplace, health care system), and the macrosystem in which larger sociocultural factors exist (e.g., cultural ideology, social norms, laws) (Arteaga et al., 2014; Peters et al., 2010; Reynolds et al., 2011).



**Figure 1: Social ecological framework to early childhood health and development adapted from Määttä et al., 2016**



Over the last few decades, Canada and the United States have experienced systemic shifts that have impacted factors at all levels of this system. Investigating multi-level factors is particularly important because events in one setting have the potential to influence events in another (Bronfenbrenner, 1979). For example, demands for public education and non-maternal childcare have increased as a result of changing family structures and increasing numbers of women returning to the workforce (Rimm-Kaufman & Pianta, 2000; Sylva et al., 2011). In addition, society has become more heterogeneous, with communities becoming more racially, ethnically and gender diverse (Rimm-Kaufman & Pianta, 2000). These community level impacts have directly impacted the early environments children are exposed to, creating a greater need to understand contextual contributors to differential developmental outcomes. Use of the social-ecological model has allowed researchers to study child development in a way that accounts for complexity and the multiple levels of influences that are operating within the system to impact child development (Essa & Burnham, 2001; Gullo & Burton, 1992; Patel et al., 2016; Stokols,

1996). It has also allowed the study of multidirectional ties whereby a child's developmental profile may impact community decisions simultaneous to community decisions impacting a child's developmental profile. Finally, use of this model has provided opportunities to identify potential levers for change at various levels across the system. Understanding the complexity of the interconnected influences across the system is vital to understanding how to best support children and families and create circumstances conducive for children reaching their full developmental potential.

### **A social network: social network theory and analysis**

Although the social world is organized in fields that can span different systems levels or encompass an entire system, it functions as a network or series of interconnections between different actors. Understanding the interactions and relational exchanges between actors may provide insight into a unique dimension of the field. Using social network theory and analysis, the present study is able to explore the interactions within the micro and meso levels of the system, specifically around children's participation in community early years programs.

Social network theory focuses on exploring the structure between actors to explain how underlying patterns of connectivity can impact a certain phenomena, rather than focusing on the spatial relations of actors within a system (Breiger, 1974; Emirbayer, 1997; Liu & Emirbayer, 2016; Martin, 2003). Social network analysis introduces a comprehensive set of strategies to explore social structure and its effects across a variety of social ties. Broadly, social ties or relations can be grouped into similarities (location, membership, attribute), social relations (kinship, affective, cognitive), interactions or flows (Borgatti et al., 2009). Studies have used this approach to better understand how social structure can facilitate or constrain opportunities, behaviour and cognitions (Tindall & Wellman, 2001), specifically around the dynamics of social

groups (e.g., friendship/social support, cooperation, shared attitudes, beliefs and health behaviours) and human activity patterns (e.g., participation in environmental movements, online communities, and health promotion programs) (Baron & Tindall, 1993; Hindhede & Aagaard-Hansen, 2017; Mercken et al., 2010; Smiljanić & Dankulov, 2017). In the field of public health, studies have applied social network theory and analysis to better understand disease transmission, risk taking and health behaviour, and bullying in adolescents (Haye et al., 2010; Hall & Valente, 2007; Jeon & Goodson, 2015; Mercken et al., 2010).

There are many components of social networks that might be considered when exploring different health and developmental outcomes. Density, the proportion of network ties out of a theoretical maximum, is one of the most commonly used measures of network cohesion (Borgatti & Chair, 2009). Studies can use density measures to determine if the level of interconnectedness among nodes is associated with an outcome of interest. For example, Haas et al (2010) found self-rated health in adolescence was not associated with the density of their peer network. It was hypothesized that poor self-rated health would be associated with increased network density as a result of a shrinking network (Haas et al., 2010). In the context of this study, density was used as an indicator of network size (growing networks tend to have lower density) and tie strength (e.g., friendship).

At the nodal level (level of individual actors), centrality, a measure of structural importance, is the most widely studied concept (Borgatti et al., 2009). Centrality can be measured in a variety of different ways that depend on the type of data collected (i.e., the mode of data) and the questions of interest. Modes of data are determined by the number of types of actors in a matrix. A 1-mode matrix studies the relations among one set of nodes (e.g., individuals by friendship ties, organizations by collaboration ties) whereas a 2-mode matrix

studies the relations among two sets of distinct nodes (e.g., individual-by-event attendance, individual by group membership) (Borgatti et al., 2009). 1-mode data studies can use centrality to better understand the dynamics of a social group and how this might relate to health outcomes, behaviours and attitudes. For example, 1-mode network studies have looked at friendship, relationship and communication ties on body mass index, depression and suicidal behaviour, contraception use and knowledge of health information (Alvergne et al., 2011; Bearman & Moody, 2004; Ennett et al., 2006; O'Malley & Christakis, 2011). Most social network studies on health have tended to focus on relational ties between a single type of actor rather than on an affiliation network (2-mode data). 2-mode data studies can use centrality to understand how social structures relate to participation dynamics for both individual participants and the activities in which they participate. For example, one study found that participation in different conference events impacted the number of connections (new and existing) individuals made. Large events provided opportunities to increase the number of weak ties while smaller events allowed for the formation of stronger ties (Smiljanić & Dankulov, 2017).

Although social network theory and analysis have been widely adopted for public health research (Luke & Harris, 2007; Valente & Pitts, 2017), this approach has not yet been used to assess or inform community actions and interventions aimed at healthy child development. In the context of addressing childhood vulnerabilities, community efforts have focused on building collaborative partnerships that support the access and availability of programs, services and supports for families with young children (Burger, 2010; Datta Gupta & Simonsen, 2016). This focus highlights the need to further understand the interorganizational dynamics involved in the system and how they might impact health and developmental outcomes for children.

## **Influences of children's program participation on health and developmental outcomes**

Relational approaches, including social ecological and network theory, have been used to inform our understanding of the social system or field that influences childhood vulnerability. However, limited attention has been given to exploring how the connectivity and attendance of programs and services for families with young children contribute to vulnerability. In the sections below I will summarize how participation in different formal early learning environments has been shown to impact health and developmental outcomes for young children.

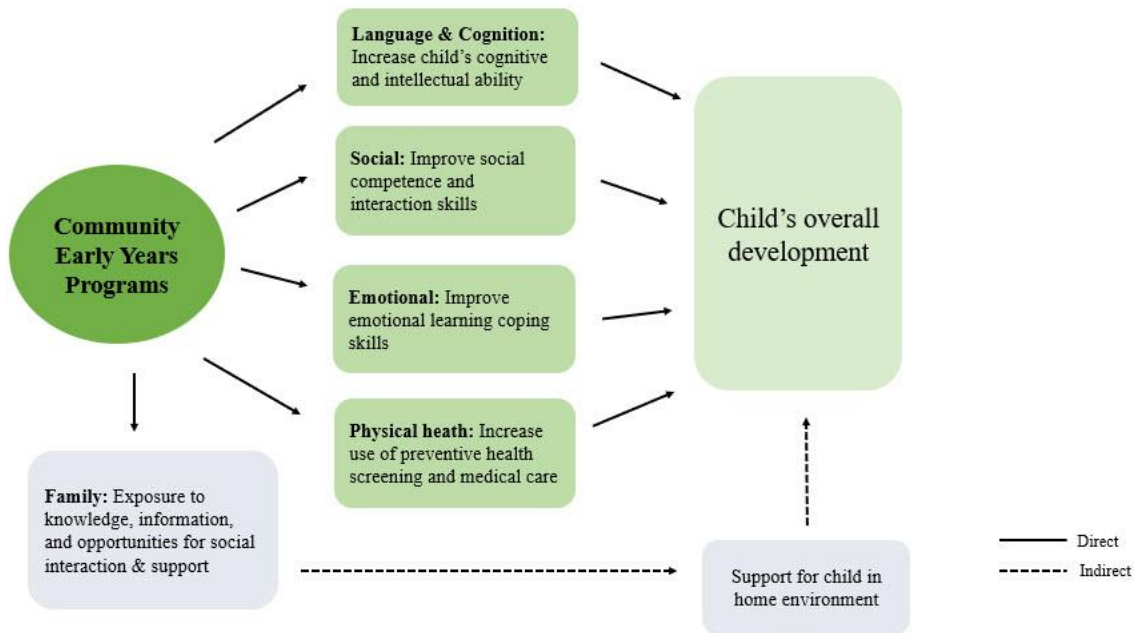
Although kindergarten has virtually become a universal experience for children in BC, attendance in formal early learning environments remains largely at the discretion of families. As a result, participation is largely variable and subject to family level determinants including family structure, financial stability, parental beliefs and feelings of inclusion (Harman et al., 2014). Formal early learning environments refers to both early childhood education and care (ECEC) and community early years program. I will use the term early childhood education and care (ECEC) to refer to programs and services attended by children under the age of 5 years without their parent/caregiver present. Most commonly, it will refer to childcare or preschool/pre-K environments. The term community early years programs refers to community-based programs that engage children under the age of 6 years with their parent/caregiver in a centre-based and socially interactive environment. These different child environments can differ greatly in their structure (i.e. curriculum), duration and location. For example, most community early years program last only a few hours on a drop-in basis while ECEC require half or full day registration. Although the focus of the current study is on understanding the impacts of participation in community early years programs, given the limited research in this area, I will also draw from ECEC studies for context and methodology. In fact, ECEC and community early

years programs may have similar mechanisms through which environmental exposures impact child health and developmental outcomes.

Figure 2 below illustrates the conceptual pathways through which community early years programs are thought to provide an advantage in development for children. Participating in community early years programs may directly target different domains of development by embedding learning into everyday environments where basic skills can be practiced (Rispoli et al., 2019; Stipek et al., 1998). Strengthening the development of specific domains (e.g., social, emotional) would presumably contribute to a child's overall development. Indirectly, attending community early years programs may provide parents/caregivers with knowledge, resources and support from community staff and other parents/caregivers (Anderson et al., 2003).

Parents/caregivers who are well connected to their peers and community may feel more comfortable asking for help when they need it, and more confident in their own care-taking abilities, which could help to promote a supportive and stimulating home environment for their child. In turn, this could contribute to the overall development and wellbeing of their child. This indirect pathway has been recognized as equally important for child development such that some intervention programs incorporate parental training as a core component. This can include one-on-one home visits or centre-based classes that focus on increasing the knowledge, training and skill sets of parent/caregivers (Campbell et al., 2012; Johnson & Walker, 1991; Tremblay et al., 1996; Vitaro et al., 2001).

**Figure 2: Conceptual diagram of direct and indirect program effects on child developmental outcomes adapted from Anderson et al., 2003**



**Influences of early childhood education and care (ECEC) participation on health and developmental outcomes**

Studies looking at ECEC influences on health and developmental outcomes most commonly look at preschool/pre-K participation and childcare effects. There is evidence in the literature that supports the association of structured and quality preschool with higher reading and mathematic skills and lower odds of vulnerability across different developmental domains (Goldfeld et al., 2016; Magnuson et al., 2007). These longitudinal studies conducted in the United States and Australia demonstrate the potential for preschools to improve developmental outcomes, especially for disadvantaged children. However, Magnuson et al. (2007) also found attendance in preschool was associated with higher externalizing behaviours such as aggression and lack of self control. In addition, the observed academic gains faded within the year while the externalizing behaviours persisted. Several studies have looked at preschool effects on disadvantaged, high-risk subpopulations. Both the High Scope/Perry Preschool Project and

Child-Parent Center Preschool Project sampled underprivileged African Americans and found more favourable long-term outcomes for those children who attended preschool. These long-term outcomes included lower rates of school dropout, substance abuse, teenage pregnancy, welfare dependence and criminality (Arteaga et al., 2014; Schweinhart, 2013; Schweinhart et al., 2005).

Consistent with studies looking at preschool/pre-K effects, evidence within the literature also suggests that childcare is associated with positive outcomes for pre-academic skills, including pre-math, language and memory ability, and negative outcomes for behavioural skills (Belsky et al., 2007; NICHD ECCRN, 2006; Sylva et al., 2011). Hansen & Hawkes (2009) suggested that an increase in behaviour problems associated with participation in childcare could be the result of children having to compete for attention from a shared caretaker or children being less securely attached to their primary caregiver at home.

### **Effects of dosage (ECEC)**

While much of the literature identifies types of centre-based care as having positive benefits on health and developmental outcomes, questions remain around the long-term mechanisms and whether there are ways to avoid a fade out phenomenon where positive outcomes dissipate. One line of inquiry has been to investigate the length of exposure by looking at “dosage” or “intensity” of participation. Greater dosage of exposure has been suggested to influence the strength and sustainability of positive effects (Shah et al., 2017). “Who enrolls and how much they attend” (Patel et al., 2016, p. 50) remain critical unanswered questions for early years research. Recently conducted dosage studies have been limited by their sample size and variability in data.

Research looking into dosage effects of ECEC have typically considered (1) the difference of “low” vs “high” dose to be one vs two years of attendance or (2) compared a



preschool attended group with a control group (no attendance). One study in Pennsylvania compared the differences in children who attended one year of preschool vs two, and found that for children living in poverty, those who completed two years of preschool scored higher on vocabulary and math skills, and had stronger executive function and memory skills by the second grade (Shah et al., 2017). Similarly, a study in Chicago found that for children from disadvantaged families, attending an additional year of high-quality preschool resulted in higher educational achievement and less criminality during early adulthood (Arteaga et al., 2014).

### **Influences of community early years program participation on health and developmental outcomes**

Empirical literature on the effects of community early years programs is scarce and tends to focus on specific intervention programs that target a disadvantaged or high needs group. These intervention programs often include different components including child-parent programs and educational classes or in-home knowledge sessions for parent/caregivers. There is limited research that evaluates universal programs or networks of programs aimed at promoting healthy child development.

Community early years programs provide environments conducive to learning, playing and interacting with peers, which may foster multiple aspects of development (Stagnitti et al., 2012). Studies looking at the effects of centre-based programs have shown promising results, although similar to studies on preschool, they have tended to focus on high-risk, low income or ethnic subpopulations of children. The Abecedarian and CARE early childhood education intervention programs provided centre-based programs alongside educational classes for families, and found that children who participated in the centre-based programs showed sustained cognitive development, educational performance and improved behaviours at age 21

(Campbell et al., 2012; Melhuish, 2004); and program participation in the ‘Learn to Play’ program was associated with increased language and social skills for children with recognized developmental disabilities (Stagnitti et al., 2012). Attendance in informal playgroups has also been shown to be associated with higher language and vocabulary scores for Aboriginal children in Australia (Williams et al., 2017). A large-scale example of an early years program intervention is Head Start, a centre-based intervention for families living below the poverty line in the United States. Studies of Head Start have shown significant gains in short-term reading and math test scores, increased likelihood of graduating high school and attending college, and higher earnings in early adulthood. However, there were discrepancies between ethnicities, with white participants seeing greater advantage over their non-white counterparts, and inconsistencies in long-term outcomes dependent on gender and race (Currie & Thomas, 1995; Garces et al., 2002; Youn, 2016).

One of the few studies that evaluated a universal prevention program was based in Ontario, Canada. The Better Beginnings, Better Futures initiative is a prevention focused project aimed at improving developmental outcomes for children, as well as improving outcomes for families and neighbourhoods. Programs and events across different community sites included toy libraries, playgroups for children, drop-in programs for games, craft activities and community outings, parent support groups and educational workshops (Peters et al., 2003). Results from this evaluation showed significant decreases in overanxious behaviours and increases in self-control and overall health among the participating children. Additionally, participation in the Better Beginnings, Better Futures programs resulted in a reduction of smoking and stressful life events, and improved marital satisfaction for parents/caregivers (Peters et al., 2003). However, there

were variations in outcomes dependent on neighbourhood. Although the three sites selected were in disadvantaged neighborhoods, the project itself was aimed at developing a universal approach.

### **Effects of dosage (community early years programs)**

Similar to ECEC, questions around how to sustain and optimize developmental advantages for children have emerged in relation to dosage of exposure to community early years programs/intervention programs. Studies on Head Start show that children who attended two years compared to one had increased vocabulary, literacy and numeracy skills by the end of Kindergarten (Youn, 2016; Zaslow et al., 2016). Studies have also looked at intervention programs or systems of supports using a more “fine-grained” approach, where investigators counted the number of cumulative hours to indicate the quantity of exposure. An English study found that children who participated in more centre-based care at 18 months performed better on cognitive and behavioural (e.g., engagement, emotional regulation) tasks (Sylva et al., 2011). The Toronto First Duty (TFD) project was developed to integrate early childhood community programs and services to more efficiently serve and support children and families (Patel et al., 2016). The study by Patel et al. (2016) looked at whether time spent in any of the TFD services could predict developmental outcomes as measured by the Early Development Instrument (EDI). Participant dose was considered the cumulative hours spent in any integrated service environment. Unlike many of the self reporting surveys used in other studies, data were collected through a centralized intake and tracking system. Findings from this study showed that more hours spent in integrated early childhood services was a significant predictor of three developmental domains: Physical health and wellbeing, language and cognitive development, and communication and general knowledge (Patel et al., 2016).

## **Areas for further exploration**

The current body of literature suggests that early exposure to formal early learning environments is a contributor to developmental outcomes in childhood, and health and social outcomes into adulthood. To advance the knowledge of environmental effects, studies have started to identify specific factors that may impact the strength and duration of associations. Dosage, quality (qualifications of care providers, quality of instruction, quality of interactions), structure (child-to-care-provider ratio, group size, structure of daily activities) and process (responsiveness of care provider, cognitive and language stimulation, health and safety practices) are all factors that have been considered in relation to participation (Brownell & Drummond, 2018; Dowsett et al., 2008; Hansen & Hawkes, 2009). The sections above summarized how dosage of exposure has been explored in both ECEC and community early years programs/intervention programs. However, there are still many considerations that need to be explored, especially for community early years programs. The open and flexible structure of community early years programs (e.g., informal, drop-in) enables children to participate in a variety of different programs. This is a fundamental difference to ECEC where a child is likely to attend one childcare centre or preschool program at a time. The uniqueness of a multi-program system of support is it allows consideration of exposure to multiple and varied early learning environments. This raises questions around the impact that diversity of early environments may have on child developmental outcomes. A multi-program system of support also allows for consideration of connectivity and structure across the network of community early years programs. This raises questions around the impact that network structure and program popularity (centrality) may have on child developmental outcomes. In these way, program participation dynamics have not been widely explored in the literature.

## **Methodological considerations**

While there is a growing body of literature around the effects of formal early learning environments on health and developmental outcomes, there is a lack of consistency in how participation is measured. While some studies have strict guidelines for participation, for example the Perry Preschool centre-based program includes 5 half days of program plus weekly 90-minute home visits, others simply measure whether a program or preschool was attended (yes/no) and how many hours parents/caregivers estimate attendance to be (Schweinhart et al., 2005; Sylva et al., 2011; Williams et al., 2017). Similarly, the measures for outcomes vary for each study with some creating their own self-report survey instruments, others using verified measurement tools (e.g., mental development index, Renfrew word finding, Picture Peabody Vocabulary Test, Iowa Test of Basic Skills, EDI), and others using administrative data (e.g., school, health and legal records, and census data). These differences make comparisons across studies difficult, as does the diversity of participants across different studies. Although most studies focus on a subset of the population that is disadvantaged, this subset ranges from families who are low income and ethnic minorities to families of a child with special needs.

Given resource constraints (e.g., time and funding) and ethical challenges (e.g., it would be unethical to withhold programs and services to certain children who may want or need them), the studies of formal early learning environments and health outcomes have largely been observational or quasi-experimental in design. Many studies have used propensity score analysis to build in a control group or created their own controls using different levels of participation, as seen in dosage studies. The majority of studies use regression techniques to isolate the effects or predictive power of formal learning environments on the outcomes of interest. While this

analytic technique is able to identify statistical significance between variables, it is reliant on having strong control variables to reduce statistical noise.

In summary, the research supports that increased exposure to formal early learning environments may be associated with increased advantages in health and developmental outcomes for children, with the most pronounced effects for those from disadvantaged families. However, in relation to community early years programs, there are some notable gaps that may merit further exploration, including but not limited to the diversity and popularity (centrality) of programs children attend.

### **The present study**

The present study looks to deepen the understanding of how community early years programs influence child developmental outcomes. Specifically, it aims to add to existing literature by examining program attendance data (by session) for community early years programs targeted for the general population of children. This study also introduces a novel network approach to explore child developmental outcomes within the system of community early years programs that support families with young children. This thesis was guided by the following three questions:

Q1: Does the network structure of children's program attendance relate to child developmental outcomes?

Q2: Does children's participation in community early years programs influence their developmental outcomes by Kindergarten?

Q3: Do certain factors associated with children's program participation including dose of programs attended, diversity of programs attended, and popularity of programs attended (centrality) influence child developmental outcomes by Kindergarten?

## **Chapter 2: Methods**

### **Context for the study**

Located on Vancouver Island in BC, the community of Qualicum is well-known for its sandy beaches, hiking and biking trails, and unique coastal small-town charm. Qualicum offers a variety of natural recreational activities, making it both a popular tourist and retirement destination. As a result, the community has experienced population growth of approx. 4% from 2011-2016 (Government of Canada, 2017a, 2017b). The Qualicum area can be divided into four neighbourhoods with two prominent towns, Qualicum Beach and Parksville, located 15 kms from one another. Despite their proximity, the neighbourhoods differ slightly in their composition and demographics. Compared to Qualicum Beach, Parksville has a considerably higher population (20,000 compared to 8,000) and population density (1080 per square km compared to 497 per square km). Additionally, the median income of households is 9% lower than Qualicum Beach and 15% lower than the provincial median (Government of Canada, 2017a, 2017b).

Although the community of Qualicum has a smaller population of children (approx. 7% age 0-14 years ) compared to the rest of the province (approx. 15%), developmental vulnerability rates, as measured by the Early Development Instrument (EDI), have steadily increased. From 2008 – 2015 (Waves 3-6) vulnerability on one or more scales increased from 25% to 37% (HELP, 2020). During that period, the community established an intersectoral coalition and created over 20 innovative projects and services aimed at enhancing early learning experiences and opportunities for young children (HELP, 2006). Interestingly, the latest Wave of EDI data show that developmental vulnerability rates in the Qualicum community have decreased for the



first time since 2008, dropping from 37% to 31%. This puts Qualicum below the provincial average vulnerability rate of 33.4% (HELP, 2020).

‘Goose Trax’ (GT) is an early years initiative aimed at tracking the program attendance of children and their families in community early years programs. The GT initiative used swipe card technology that allowed parents/caregivers to simply and easily swipe into the community early years programs they attended. These data were then compiled and stored to create a database of program attendance from over 30 program and agency sites across three school years from 2007-2010. Tracking the attendance of young children and their families allowed the community to assess the use of the network of community early years programs. Having knowledge of current program participation provided the community opportunities to better understand how programs were being attended to determine where there was less participation relative to others in the community. These type of population level data on children’s developmental outcomes are unique and not available in most other provinces across Canada or countries world-wide (HELP, 2019).

### **Data sources**

Data for analysis were drawn from two sources: The GT repository and EDI database. These databases consisted of previously collected data; therefore, no additional or primary data collection was conducted.

1) The GT database is a centralized repository of program attendance data that were tracked for the GT initiative. This database contains a record of each program session attended - by day, time and location – for children who attended at least one community early years program in the Qualicum area between September 2007 and August 2010. The program attendance of 1514 children across 13 distinct programs were captured during this period. In

addition to program attendance data, information was collected about the child (e.g., sex, age) and their environments (e.g., home neighbourhood). Each program session was assigned a unique session ID number. These type of program attendance data are unique to the BC context.

2) The EDI database contains population level data on developmental outcomes for children across BC. Data have been collected in 3-year waves for each school district since 2001. The EDI is a short questionnaire administered by Kindergarten teachers to assess the age appropriateness of child development based on certain benchmarks (e.g., gross & fine motor skills, basic literacy) across different domains of development. These domains are described in detail in a subsequent section. The EDI database is designed to assess the trends and patterns of child developmental outcomes across populations. It can be used by school educators, government and researchers to identify the strengths and needs of children within a certain population or community, to inform and evaluate program decisions or policy, and to help explore and address new questions around social determinants of children's health and well-being (HELP, 2019). Within the EDI database, the current study looked at Waves 3-6, which correspond to data collection between 2007 – 2015. These were the relevant waves that corresponded to children (0-5 years) attending community early years programs from 2007-2010.

These databases were linked to create a new database where children's level of attendance in community early years programs was linked to their subsequent EDI scores. This linkage process was performed through Population Data BC (PopData), which adheres to strict data handling and privacy guidelines including the Freedom of Information and Protection of Privacy Act (FIPPA). The linkage process used mathematical linkage techniques to identify the same children across different files over time using their date of birth, sex, postal code, and school ID. Once the databases were linked, data were de-identified such that only the year of

birth and 3-digit postal codes remained. For analytic purposes, randomly generated participant ID numbers were used. Of the 564 children in the GT repository, 236 were linked with EDI data (42% linkage rate). This new and combined database was only accessible through PopData's secure research environment (SRE), which required multiple security measures including VPN software, username, passphrase and YubiKey.

## **Analytic sample**

### **Participants**

The sample for this study consisted of children who participated in the GT initiative during the 2007, 2008, and 2009 school years. Participation was voluntary with families self-selecting to have their child participate. That is, those who attended at least one community early years program in the Qualicum area between September 2007 and August 2010. This initial sample consisted of 1514 children. GT children were excluded from the study if they were not captured in a subsequent wave of EDI data collection, thus their program participation could not be linked to EDI scores. Children older than the age of 5 years during their program attendance were excluded from the sample to reduce the potential for reverse causality. As the control group, all children within the Qualicum area (school district 69) who were captured in comparable waves of EDI data (waves 3-6) were included. Any child missing at least one EDI score was additionally excluded from the study sample. The final sample consisted of 1464 children.

### **Community early years programs in the GT database**

Information about the community early years programs in the GT database contained the program name, and sessional location, day and time. Other sources of information, including existing websites and internet sources, were used to acquire additional background about each of

the programs (e.g., primary developmental focus, activities, costs etc.). Generally, programs operated under the Ministry of Education, public library, or not-for-profit community organizations. The programs can be categorized broadly into groups that focus on promoting certain aspects of development. For example, ‘Words on Wheels’ and ‘Mother Goose goes to School’ focus on language and literacy whereas ‘Munchkin Land’ and ‘Preschool Power Hour’ focus on physical health and motor skills. These developmental foci were determined based on assessment of the information sources listed above. Not all programs ran for the duration of the GT data collection (3 years) but many were available at multiple locations spanning different days and times. For analytic purposes, community early years programs were grouped together and represented by their single program name. For example, ‘Munchkin Land ’ represents the ‘Munchkin Land’ programs that took place at both the Qualicum Elementary and Building Learning Together Centre. The list of participating community early years programs is in Table 1 below, with detailed descriptions of each program in Appendix A on pg. 59.

**Table 1: Community early years programs available by year**

Community early Years Program	Year 1 (2007/08)	Year 2 (2008/9)	Year 3 (2009/10)
Cook up a Bedtime Story	x	x	
Dad's Night Out	x	x	x
Teaching from the Heart	x		
Words on Wheels	x		x
Mother Goose and Friends	x	x	x
Mother Goose goes to School	x	x	x
Munchkin Land	x	x	x
Our Special Child		x	
Browser Library			x
Preschool Power Hour			x
Qualicum Library			x
Parksville Library			x
Healthy Beginnings			x

## Measures

To help understand and better interpret the structure of program networks, three measures of program centrality were used: degree, eigenvector and betweenness. Centrality is a measure of structural importance across a group of actors. Generally speaking, degree centrality is a measure of the number of ties a node has; eigenvector centrality a measure of nodal importance based on direct ties; and betweenness centrality a measure of shortest path based on indirect ties (Borgatti & Chair, 2009). These measures of centrality were chosen because they highlight a variety of structural aspects that may be of interest for the community. For example, eigenvector centrality can speak to the kinds of families who attend certain programs. In the context of program attendance data, degree centrality tells us how many times a program was attended (program centrality) or how many programs a child attended (child centrality); eigenvector centrality tells us how central a program's attendees are (does the program attract children who attend many programs?); and betweenness centrality tells us the function of paths from child to child (does the program lie on the shortest path that connects two children?).

Demographic variables were drawn from the linked database. The set of control variables included in a model are critical to controlling for selection bias (Nieminen et al., 2013). That is, the possibility that some other child or family characteristic is related to both the developmental outcome and the decision to participate in community early years programs. Individual child level characteristics included sex, age (at EDI assessment) and English as a first language. Family level characteristics or variables at the microsystem level included home or school neighbourhood (Parksville, Qualicum Beach, rural Vancouver Island or other) and attendance in non-parental care on a regular basis. This last variable includes childcare in a formal (e.g. daycare) and informal setting (e.g., grandparents). If we consider childcare in a formal setting, it

makes conceptual sense that a child's regular attendance in daycare could affect the extent that they could attend additional programs within the community. Exposure to formal childcare environments can conceptually be thought of as similar to exposure to a community early years program, such that children have the opportunity to interact with their peers in a group environment. Although the environments may differ greatly in duration and depend on a number of variables not included (e.g., quality, education of care providers, child-to-adult ratio), it is also necessary to consider moderating effects. If we consider the environment of childcare and community early years programs similar, it would be important to consider whether childcare modifies the association between participation in community early years programs and developmental outcomes. As no childcare variable was available, 'non-parental care on a regular basis,' which includes formal and informal childcare, was used as an alternative to test for effect modification.

The primary explanatory variable was community early years program participation, which was considered as both a categorical (whether or not a child attended any community early years program) and continuous (the number of program sessions a child attended) measure. Other explanatory variables included the number of different programs attended and the popularity of programs attended (child eigenvector centrality).

The outcome variables for this study were EDI scores. The EDI is a population level measure of childhood vulnerability, with overall scores ranging from 0-50 and domain scores ranging from 0-10 based on teacher assessments of the appropriateness of a child's behaviour (Janus & Offord, 2007a). Higher scores indicate higher levels of development. EDI scores can be looked at both overall and by developmental domain: physical health and well-being, social competence, emotional maturity, language and cognitive development, and communication skills

and general knowledge. These developmental domains were determined through factor analysis that tested the psychometric properties of data from more than 16,000 children (Janus & Offord, 2007a). Additionally, the EDI has undergone psychometric testing in Canada to ensure it meets the required standards of an indicator of children's developmental outcomes and well-being. The EDI has demonstrated high internal consistency, with consistent parent-teacher and inter-rater reliabilities, as well as concurrent and convergent validity (Janus & Offord Centre for Child Studies, 2007; Janus & Offord, 2007b).

The physical health and well-being domain includes indicators of gross and fine motor skills, physical independence and readiness for the school day (HELP, 2019). Children who score high in this domain may exhibit high levels of energy during the day and coordination when playing. The social competence domain includes indicators of capacity for respect and responsibility, approaches to learning, and readiness to explore new things (HELP, 2019). Children who score high in this domain may exhibit self-confidence, eagerness to play with new things and respect for their peers. The emotional maturity domain includes indicators of prosocial and helping behaviours, hyperactivity and inattention, and aggressive, anxious and fearful behaviours (HELP, 2019). Children who score high in this domain may be attentive and obedient and often help or comfort their peers. The language and cognitive development domain includes indicators of basic and advanced literacy skills, numeracy skills, interest in math and reading, and memory (HELP, 2019). Children who score high in this domain may be able to write their own name, read complex words and simple sentences and remember things easily. Lastly, children who score high in the communication skills and general knowledge domain may exhibit the ability to tell a story, use language effectively and answer questions that show thought and knowledge. For the purpose of this analysis, all EDI scores (overall and by domain) were z-

standardized to make the interpretation more meaningful for those not familiar with the EDI as a measurement tool. Standardizing the outcome variable also creates results that can easily be used to compare against similar studies, which may in turn relay more practical importance to decision and policy makers (McCartney & Rosenthal, 2000).

### **Analytic approach**

To address the first research question, basic network tools and approaches were used. The program attendance data was converted into matrices of 1-mode data (program by common child attendance) and 2-mode data (programs by child attendance). For each year of program attendance, measures of network cohesion and centrality were calculated using the software package UCINET-6 version 6.665. Network diagrams were produced using the software package NetDraw 2.166. Program attributes included a program's developmental focus and the average EDI score of child attendees. The network measures and diagrams were primarily explored to identify descriptive patterns. Results were compared over the three school years to determine consistency.

To address the second and third research questions, a stepwise linear regression was performed using the linked data. Control variables were added in a block-wise fashion starting with those most proximal to the child and ending with the primary variable of interest. The order of variables was as follows: sex (male/female), age at EDI, English as a first language (Y/N), neighbourhood (home or school), non-parental care (Y/N), primary variable of interest (participation in community early years programs, dosage of attendance, diversity of attendance, popularity of attendance (centrality)). The primary variables of interest were participation in community early years programs as indicated by GT participation (Y/N), dosage of programs attended, diversity of programs attended, and popularity of programs attended (centrality). The



primary variables of interest were tested against a model with control variables independently and then together where appropriate. Any suspected effect modifiers were tested in a final model. The outcome variable was overall EDI score, and EDI scores by developmental domain where appropriate. A partial F-test was performed between each model to determine if the added variable was significant to the model. Variables with a p-value  $\leq 0.05$  were considered statistically significant and thus included in the final model. Regardless of their significance, variables with known effect on EDI were included for face-validity. These variables would be either known to influence child developmental outcomes (from existing literature) or conceptually understood to influence child developmental outcomes. For example, age and sex are two variables that are known to be correlated with EDI scores in the general population. Additionally, childcare (a component of the variable non-parental care on a regular basis) has been shown to have an effect on child developmental outcomes (Belsky et al., 2007; Hansen & Hawkes, 2009). The  $R^2$  for each model was calculated to assess the overall contribution to variability in outcome. If the final model showed that GT was significant correlated with overall EDI score, the model was run against the EDI scores for each developmental domain. This would allow for the examination of domain-specific differences.

All regression analyses were performed using the RStudio version 1.0.153 statistical software and the assumptions for a generalized linear model (GZLM) checked by looking at residual and predicted probability plots. The advantage of this approach is that it allows the relationship between the primary variable of interest and child outcome to be controlled with respect to other factors. However, this approach cannot speak to the isolated effects of community early years program participation (or other factors) on EDI scores. Rather this study seeks to identify an association that may speak to the relative contribution of early years

programming and related factors on child developmental outcomes. If used, the term “effect” refers only to the statistical nature of relations and should not be assumed as a causal relationship between variables.

## **Chapter 3: Results**

The following sections summarize the results from the network and regression analysis outlined in Chapter 2. A descriptive summary of the sample is first provided. Following that, results are detailed in the order of research questions.

### **Descriptive data**

As shown in Table 2-3 below, the demographic composition of the subsample of children who participated in community early years programs (part of the original GT initiative) did not appear to differ from the general child population in the Qualicum community. The sex distribution was roughly equivalent, almost all the children had English as a first and primary language, and 60-70% were in non-parental care on a regular basis. In addition, half of the children lived or attended school in the Parksville neighbourhood, a quarter in the Qualicum Beach neighbourhood and a quarter more broadly in Vancouver Island rural. Of the total sample, a few children were based in an outside neighbourhood, but they accounted for less than 0.05% of the sample population. Two sample t-tests and chi-squared tests were used to determine mean differences or variable association for all variables listed above. None were statistically significant as differences in the participants in GT vs non- GT, except for non-parental care on a regular basis. This means that whether a child attended community early years programs or not may be associated with whether they were in non-parental care on a regular basis (e.g., childcare).

When comparing child developmental outcomes (EDI scores), GT children had slightly higher mean EDI scores both overall and across all domains, and less variability with a smaller standard deviation both overall and across all domains. There was also variability across the developmental domains that was consistent in both samples. For example, for both samples,

participants had high mean scores with low variability in the physical health and wellbeing domain while they had lower mean scores and high variability in the communication and general knowledge domain. Two sample t-tests were performed to determine if mean differences were statistically significant. There was a significant difference in mean EDI scores for overall development and the domains social competence, emotional maturity, and language and cognitive development. P-values ranged from 0.01-0.02. The remaining domains physical health and well-being and communication and general knowledge did not show a significant difference in mean EDI scores with p-values of 0.12 and 0.07 respectively.

The subsample of GT children (N=212) represented 14.5% of the total sample (N=1464). Table 4 below summarizes their descriptives by year. The subsamples by year ranged from 151–161 child participants. Across the years, the average age and number of community program sessions attended was consistent with averages of 5.7 and ~11 respectively. It should be noted, however, that the variability in number of community early years program sessions attended was high with maximum numbers ranging from 38-92 sessions for the respective years. Although the mean number of sessions attended was quite similar, the deviance from the average was high meaning the distribution of program attendance varied widely across all three years. On average, children attended a least two different programs per year, with maximum values ranging from three to six across years.

**Table 2: Descriptives of categorical independent variables**

Variable		Total sample (N=1464)		GT subsample (N=212)	
		N	(%)	N	(%)
Sex of child	Male	755	51.6%	108	50.9%
	Female	709	48.4%	104	49.1%
1 <sup>st</sup> language English	English	1393	95.2%	207	97.6%
	Other	71	4.8%	5	2.4%
Non-parental care on a regular basis	Yes	882	60.3%	144	67.9%
	No	582	39.8%	68	32.0%
School Neighbourhood	Parksville	689	47.1%	113	53.3%
	Qualicum Beach	383	26.2%	47	22.2%
	Vancouver Island Rural	390	26.6%	52	24.5%
	Other	<5	<0.05%	0	0
Attended Community Early Years Programs (GT participant)	Yes	212	14.5%	-	-
	No	1252	85.5%	-	-

**Table 3: Descriptives of continuous dependent variables**

Developmental Domains (EDI range)	Total sample (N = 1464)				GT subsample (N=212)			
	Min EDI	Max EDI	Mean EDI	Std. Dev	Min EDI	Max EDI	Mean EDI	Std. Dev
Physical health and well-being (0-10)	2.31	10.00	8.32	1.53	3.85	10.00	8.46	1.37
Social competence (0-10)	0.38	10.00	7.93	2.07	2.00	10.00	8.21	1.88
Emotional maturity (0-10)	0.00	10.00	7.69	1.78	0.83	10.00	8.00	1.70
Language and cognitive development (0-10)	0.38	10.00	8.12	1.79	2.31	10.00	8.37	1.59
Communication and general knowledge (0-10)	0.00	10.00	7.42	2.63	0.00	10.00	7.70	2.45
Overall EDI (0-50)	5.74	50.00	39.48	8.12	18.16	50.00	40.74	7.38

**Table 4: Descriptives of continuous independent variables by year (GT group)**

Variable	Year 1 (N = 161)				Year 2 (N = 157)				Year 3 (N = 151)			
	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev	Min	Max	Mean	Std. Dev
Age at EDI (years)	5.14	7.01	5.68	0.29	5.13	7.01	5.68	0.29	5.13	7.01	5.68	0.30
Number of sessions attended	1	38	11.19	8.66	1	92	11.54	12.24	1	63	10.23	10.50
Child centrality (eigenvector)	0.01	0.15	0.07	0.03	0.00	0.13	0.03	0.03	0.00	0.16	0.07	0.03

**Does the network structure of children’s program attendance relate to child developmental outcomes?**

To answer the first research question pertaining to the potential impact of the program networks on child developmental outcomes, analyses were performed to understand network structure. The results illustrated in Table 5 below show program networks across the three years of data were similar in their network structure, each having low density and zero fragmentation. These measures of cohesion demonstrate the connectedness of actors within the network (organizations, programs or individuals) (Borgatti et al., 2018). In this context, density is a measure of the connectivity between child attendees and community early years programs. Of the theoretical maximum number of ties that can exist (e.g., if all children attended all programs), the networks show density of 21-29%. The zero fragmentation tells us that all community early years programs were attended by at least one child, and all children attended at least one community early years program. The average distance between nodes is consistent at ~ 2.6 across the three years, with the longest connections having 6 nodal ties or edges. This means that within these affiliation networks (2-mode) all programs or children can be connected within 6 nodal ties or edges for any given year.

**Table 5: Summary measures of network cohesion (2-mode program attendance networks)**

	<b>Density</b>	<b>Avg distance</b>	<b>Diameter</b>	<b>Fragmentation</b>	<b>Norm Distance</b>
Year 1	0.289	2.576	4	0	0.748
Year 2	0.246	2.575	6	0	0.751
Year 3	0.214	2.674	6	0	0.709

The network diagrams shown in Figure 3 below represent the common child attendance between community early years programs. The ties between programs indicate common attendance, with more prominent ties indicating stronger connections between programs. That is, a greater number of children attended both programs. For example, in Year 1 (Figure 3 a) the tie between ‘Munchkin Land’ and ‘Mother Goose goes to School’ is stronger than the tie between ‘Munchkin Land’ and ‘Dad’s Night Out.’ This indicates that a greater number of children attended both ‘Munchkin Land’ and ‘Mother Goose goes to School’ compared to those who attended both ‘Munchkin Land’ and ‘Dad’s Night Out.’ Programs are represented by nodes that vary in both colour and size. They are coloured according to their developmental focus and categorized according to the 5 developmental domains of the EDI. Programs that focus on the physical health and well-being, and the language and cognitive skills domains were most common, but some community early years programs also emphasized the social competence and emotional maturity domains of development. Each year consisted of programs that spanned at least three developmental foci, although the programs themselves may have differed. It should be noted that programs may have had more than one developmental focus (e.g., a program may emphasize language learning while also providing children opportunities for group social learning), but for the purpose of this analysis only the primary focus was considered.

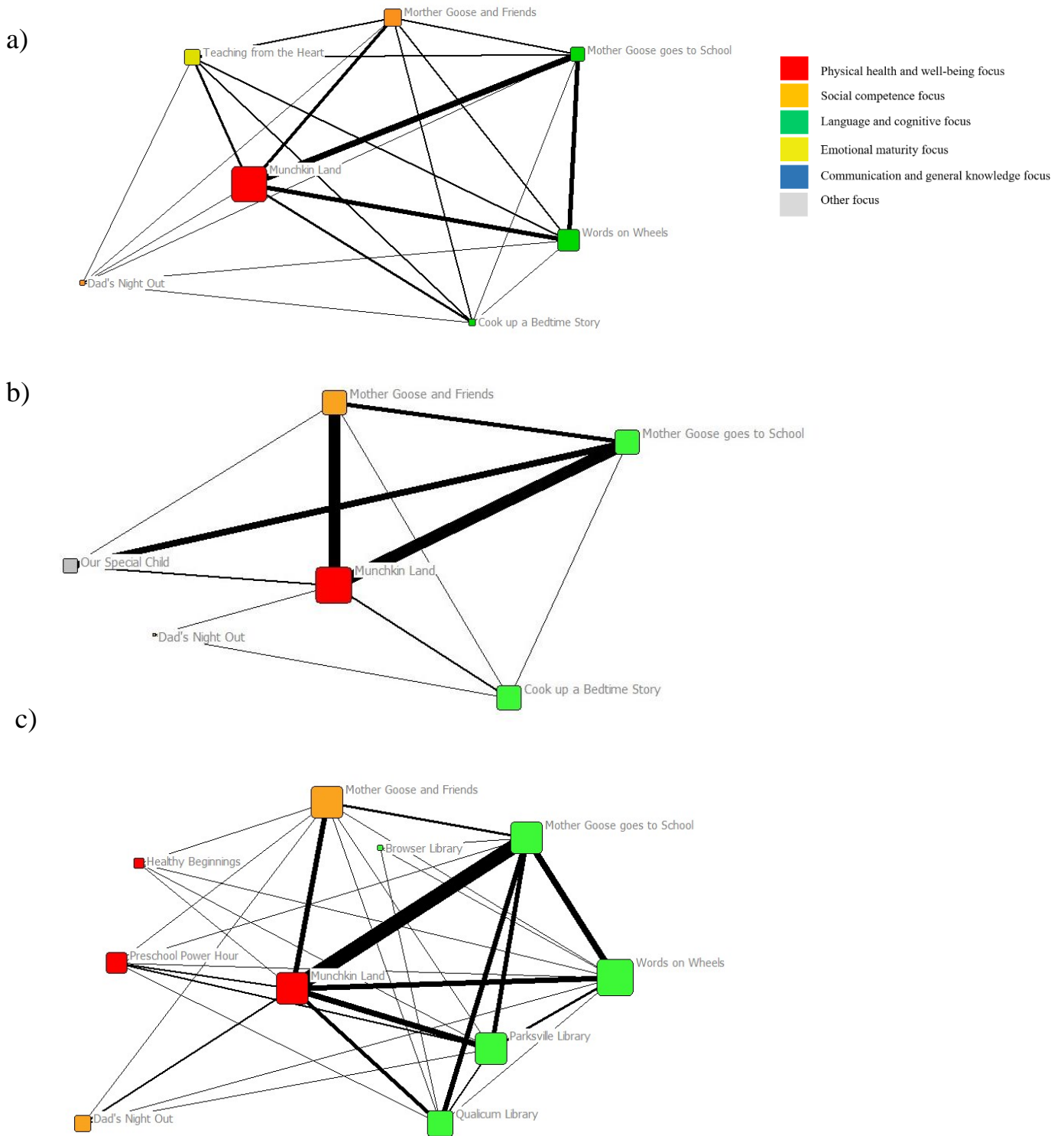
It did not appear that programs had stronger ties to those with the same developmental focus. Rather, it appears that the strength of tie was related to centrality. Degree centrality is represented in the diagrams by nodal size, such that programs with larger nodes had higher

attendance and were more popular within the community. The diagrams show that programs with higher degree centrality had a greater number of strong ties to other programs regardless of their developmental focus.

Although the identified trends were consistent across the three years of data, the diagrams vary according to their number of active programs. In year 1, 'Dad's Night Out' was a periphery program with low centrality and weaker ties. The remaining 6 programs had stronger connections to each other and to the central program 'Munchkin Land.' Year 2 had the fewest number of active programs, with only 3 centrally located. Year 3 had the greatest number of active programs, with stronger ties clustered around 'Munchkin Land' and the literacy focused programs.



**Figure 3: 1-Mode network diagrams of common child attendance for a) Year 1: September 2007 – August 2008; b) Year 2: September 2008 – August 2009; and c) Year 3: September 2009 – August 2010**



Turning to the question of whether network structure influences child developmental outcomes, Table 6 below summarizes the centrality measures for each community early years program and the average EDI score for each program's attendees both overall and by domain. In general, programs with high degree centrality also tended to have high eigenvector and betweenness centrality. This means that programs that were frequently attended attracted children who were active in the community (attended many programs) and sat on the shortest program path that connected two children. In year 1, 'Munchkin Land' was the program with the highest centrality measures and it had one of the top two highest average EDI scores overall and by domain (standardized values ranging from -0.03 to 0.01). However, 'Cook up a bedtime story' had one of the lowest centralities but also one of the two highest EDI scores overall and for the physical, social, and emotional domains (standardized values of 0.01, 0.03, 0.15 and 0.04 respectively). In year 2, 'Mother Goose and Friends' was within the top 3 most central programs and had the highest average EDI scores with standardized values ranging from 0.09 to 0.28. 'Munchkin Land' remained most central but had average attendee EDI scores very near the sample average, with standardized values ranging from -0.04 to 0.07. Again, 'Cook up a bedtime story' had one of the lowest network centralities but in year 2 it also had the lowest average EDI scores both overall and by domain (standardized values ranging from -0.72 to -0.02). In year 3, 'Munchkin land,' 'Mother Goose goes to school,' and 'Words on Wheels' had the highest centralities; however, there did not appear to be any notable pattern that related this to their average EDI scores. Overall, although some programs with the highest centralities in certain years had the highest average EDI scores, they could also have the lowest scores and values somewhere in between in other years. No definitive pattern emerged as there were too many

**Table 6: Program centrality measures and average EDI scores**

Year 1 Programs	N	Degree	Eigenvector	Betweenness	Average EDI Scores (z-score) <sup>1</sup>					
					Overall	PHY	SOC	EMO	LAN	COMM
Cook up a bedtime story	13	0.081	0.062	0.022	0.01	0.03	0.15	0.04	-0.03	-0.12
Dad's night out	5	0.031	0.029	0.001	-0.37	0.24	-0.46	-0.15	-0.72	-0.34
Teaching from the heart	42	0.261	0.3	0.079	-0.28	-0.10	-0.25	-0.39	-0.07	-0.27
Words on Wheels	64	0.398	0.41	0.251	-0.12	0.02	-0.12	-0.22	0.03	-0.13
Mother Goose and Friends	50	0.311	0.29	0.203	-0.23	-0.05	-0.21	-0.33	-0.06	-0.22
Mother Goose goes to school	36	0.224	0.235	0.08	-0.33	-0.09	-0.32	-0.42	-0.13	-0.30
Munchkin Land	117	0.727	0.773	0.63	0.01	0.01	0.01	0.01	0.07	-0.03
Year 2 Programs										
Cook up a bedtime story	10	0.064	0.06	0.018	-0.46	-0.14	-0.69	-0.72	-0.02	-0.24
Dad's night out	<5	0.006	0.006	0				n/a		
Mother Goose and Friends	47	0.299	0.343	0.159	0.17	0.11	0.11	0.11	0.28	0.09
Mother Goose goes to school	52	0.331	0.307	0.267	0.14	0.09	0.08	0.07	0.25	0.09
Munchkin Land	123	0.783	0.885	0.797	-0.01	-0.03	-0.04	0.00	0.07	-0.04
Our special Child	<5	0.025	0.019	0.013				n/a		
Year 3 Programs										
Brower Library	<5	0.007	0.006	0				n/a		
Preschool power hour	<5	0.026	0.021	0.001				n/a		
Qualicum library	24	0.159	0.175	0.03	0.01	0.06	-0.07	-0.04	0.19	-0.02
Dad's night out	5	0.033	0.04	0.001	-0.89	-0.53	-1.29	-0.61	-0.18	-0.86
Health Beginnings	<5	0.013	0.008	0.013				n/a		
Words on Wheels	56	0.364	0.376	0.174	-0.15	-0.15	-0.11	-0.18	0.00	-0.15
Mother Goose and Friends	27	0.185	0.171	0.083	-0.03	0.06	-0.15	-0.12	0.16	-0.03
Mother Goose goes to school	85	0.57	0.564	0.381	-0.07	-0.10	-0.08	-0.12	0.05	-0.03
Munchkin Land	98	0.642	0.65	0.472	-0.03	-0.06	-0.04	-0.05	0.01	0.01
Parksville Library	37	0.245	0.238	0.084	-0.10	-0.11	-0.12	-0.17	0.12	-0.11

<sup>1</sup> EDI scores were not calculated for programs with N < 5

inconsistencies within and between the years of data. There was also no emergent pattern between the developmental focus of programs and the corresponding domain-specific EDI score.

### **Does children's participation in community early years programs influence their developmental outcomes by Kindergarten?**

Early environments are fundamental in shaping the developmental outcomes of children (Reynolds et al., 2011). A possible way to supplement supports in the home environment is to provide community opportunities for early learning and development. To understand if community early years program participation is associated with child developmental outcomes by Kindergarten, a regression analysis was performed, with Table 7 below summarizing the results.

Model 1 acts as the control model containing the variables sex, age, neighbourhood and non-parental care on a regular basis. Both sex and age were significant. With respect to neighbourhood, being from the Qualicum Beach school neighbourhood was significant (p-value = 0.0001) while being from rural Vancouver Island or other neighbourhoods was not. This could be a result of the low subsample sizes across these other regions. Although non-parental care on a regular basis was not significant in the model (p-value = 0.52), it was included for face-validity. Drawing from the conceptual model for community early years programs on child developmental outcomes (see chapter 1, Figure 2), it is reasonable to think that non-parental care in a formal care setting (i.e., childcare) could provide a stimulating learning and social environment that could be equivalent to community early learning programs. If this is the case, the model would need to be adjusted for it regardless of significance. Lastly, 'English as a first language' was not found to be significant in the model (p-value = 0.54) and given its extremely low variability, with 95% of the children English speaking, it was excluded from all other

models. The control model accounted for roughly 10% of the variability seen in overall EDI score with the largest influences coming from gender, age, and school neighbourhood-Qualicum Beach.

**Table 7 : Multiple regression analysis predicting overall EDI score**

Independent Variables <sup>2</sup>	Model 1: Controls	Model 2: Primary variable of interest	Model 3: Effect Moderation
	$\beta$ (std. error)	$\beta$ (std. error)	$\beta$ (std. error)
Sex (0=M, 1=F)	0.58 *** (0.05)	0.58*** (0.05)	0.57*** (0.05)
Age	0.37*** (0.08)	0.37*** (0.08)	0.37*** (0.08)
School Neighbourhood – Parksville (reference)	-	-	-
School Neighbourhood - Qualicum	0.22*** (0.06)	0.22*** (0.06)	0.22*** (0.06)
School Neighbourhood – Other	0.18 (0.67)	0.21 (0.67)	0.21 (0.67)
Non-parental care on a regular basis (0 = not exposed, 1 = exposed)	0.03 (0.05)	0.02 (0.05)	0.04 (0.05)
Community early years program participation (0 = did not participate, 1 = participated)	-	0.18** (0.07)	0.28* (0.12)
Interaction between community early years program participation and non- parental care on a regular basis	-	-	-0.14 (0.15)
<b>R<sup>2</sup></b>	0.101***	0.105***	0.106***
<b>Adjusted R<sup>2</sup></b>	0.097***	0.101***	0.101***
<b>Sample Size (N)</b>	212	212	212

<sup>2</sup> English as a first language was not included as a covariate due to low variability  
 Statistical significance levels are indicated as \* $\leq 0.05$ ; \*\* $\leq 0.01$ ; \*\*\*  $\leq 0.005$   
 Regression coefficients are standardized

Model 2 includes the primary variable of interest, participation in community early years programs. The model also accounted for roughly 10% of the variability seen in overall EDI score. Similar to Model 1, sex, age and being from the Qualicum Beach neighbourhood were significant to the model. In addition, participation in community early years programs was significant within this model ( $p = 0.01$ ;  $\beta=0.18$ ). Using Cohen's (1988) widely referenced guidelines, this is considered a small effect size, where small, medium and large are considered roughly 0.20, 0.50 and 0.80 standard deviations respectively.

Lastly, model 3 includes a suspected effect modification term between community early years program participation and non-parental care on a regular basis. If children were exposed to non-parental care in a childcare setting, they may have been exposed to a similar environment as community early years programs and thus experienced similar developmental effects. By including the effect modification term, I was able to assess whether there was variability in overall EDI score for children who did not attend community early years programs or non-parental care (childcare), compared with those who did attend one of the community early years programs or non-parental care (childcare), compared with those who attended both community early years programs and non-parental care (childcare). Again, this model accounted for roughly 10% of the variability seen in overall EDI. The effect modification term was not significant, with a p-value that far exceeded the significance cut-off ( $p\text{-value} = 0.34$ ). Given the suspected effect modification did not show significance, it was not included.

The final model (model 2) included only the variables sex, age, neighbourhood, non-parental care on a regular basis and participation in community early years programs. Given participation in community early years programs was significant to overall EDI scores, the model was subsequently run against the EDI scores for each developmental domain. The results are

summarized in Table 8 below. Although all the models were significant, the GT variable was only significant in two domains: social competence (p-value = 0.03) and emotional maturity (p-value=0.003). For a child participating in community early years programs, on average we expect their social competence EDI score to be 0.16 standard deviations higher compared to a child who did not participate in any community early years programs, adjusted for gender, age, school neighbourhood and non-parental care on a regular basis. Similarly, for a child participating in community early years programs, on average we expect their emotional maturity EDI score to be 0.21 standard deviations higher compared to a child who did not participate in any community early years programs, adjusted for gender, age, school neighbourhood and non-parental care on a regular basis. It should be noted that the p-values for the remaining three domains ranged from 0.06-0.12 with both language and cognitive development, and communication and general knowledge sitting just above the significance cut-off.

**Table 8: Multiple regression analysis predicting domain-specific EDI score**

EDI domain	GT $\beta$ (std. error)	R <sup>2</sup>	Adjusted R <sup>2</sup>
Physical health and well-being (z score)	0.11 (0.07)	0.048***	0.044***
Social competence (z score)	0.16* (0.07)	0.076***	0.072***
Emotional maturity (z score)	0.21*** (0.07)	0.077***	0.073***
Language and cognitive development (z score)	0.13 (0.07)	0.092***	0.092***
Communication and general knowledge (z score)	0.13 (0.07)	0.113***	0.109***

Statistical significance levels are indicated as \* $\leq 0.05$ ; \*\* $\leq 0.01$ ; \*\*\*  $\leq 0.005$   
Regression coefficients are standardized

**Do certain factors associated with children’s program participation including dose of programs attended, diversity of programs attended, and popularity of programs attended (centrality) influence child developmental outcomes by Kindergarten?**

To understand possible factors associated with community early years program participation that may influence child developmental outcomes by Kindergarten, a series of regression analyses were performed looking at the dose of programs attended, the diversity of programs attended, and popularity of programs attended (centrality). Table 9 below summarizes the results.

Model 1 is the control model and contains the variables sex, age, school neighbourhood and non-parental care on a regular basis. Although only the sex variable was significant (p-value= 0.0001), the remaining 3 variables were included for face-validity (p-values range from 0.07-0.28). Again, the child-level variable ‘English as a first language’ had no statistical effect on EDI score (p-value = 0.48) and thus was excluded from all models. Despite only one variable being significant, the control model had a  $R^2$  value of 0.1000 and thus accounted for 10% of the variability seen in overall EDI scores.

Models 2 - 4 tested the effects of dosage of programs attended, diversity of programs attended, and popularity of programs attended (centrality) respectively. The overall models were significant and accounted for 9.4 – 10 % of the variability seen in overall EDI. However, the primary variables of interest were not significant, with dose of programs attended, diversity of programs attended, and popularity of programs attended (centrality) having p-values = 0.92, 0.10-0.73, and 0.33 respectively. The p-values for each variable far exceeded the significance cut-off of 0.05. Model 5 includes all three variables of interest. Similar to the models before it, it accounted for 9.7% of the variability seen in overall EDI, but none of the variables of interest were significant (p-values range from 0.17 to 0.54).



The null results seen in Table 9 below represent data from Year 1 (2007-2008) only. A summary of Years 2 and 3 can be found in Tables 11 and 12 of Appendix B on pg. 60-61. Similar to the results for Year 1, the three variables of interest were not significant to overall EDI, with p-values ranging from 0.30 to 0.85 in Year 2 (2008-2009) and 0.22 to 0.96 in Year 3 (2009-2010). The significant models accounted for 4.3 – 15.7% of the variability in overall EDI. Given the null findings, the models were not run against domain-specific EDI scores.

**Table 9: Multiple regression analysis predicting overall EDI score for Year 1**

<b>YEAR 1: Independent Variables<sup>3</sup></b>	<b>Model 1 - Controls</b>	<b>Model 2 – Session Number</b>	<b>Model 3 – Program Number</b>	<b>Model 4 - Centrality</b>	<b>Model 5 – All</b>
	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>
Sex (0 = M, 1 = F)	0.59*** (0.15)	0.59*** (0.15)	0.54*** (0.15)	0.58*** (0.15)	0.50*** (0.16)
Age	0.28 (0.26)	0.28 (0.26)	0.24 (0.26)	0.28 (0.26)	0.23 (0.27)
School Neighbourhood – Parksville (reference)	-	-	-	-	-
School Neighbourhood - Qualicum	0.20 (0.19)	0.20 (0.19)	0.22 (0.19)	0.21 (0.19)	0.20 (0.19)
School Neighbourhood - Rural	0.28 (0.20)	0.29 (0.20)	0.37 (0.21)	0.35 (0.21)	0.38 (0.22)
Non-parental care on a regular basis (0 = not exposed, 1 = exposed)	-0.30 (0.16)	-0.39 (0.16)	-0.32* (0.16)	-0.29 (0.16)	-0.35* (0.17)
Number of Program Sessions Attended	-	-0.0008 (0.01)	-	-	-0.01 (0.01)
Number of Different Programs Attended	-	-	Range 0.06- 0.73 (0.18- 0.98)	-	Range 0.23- 1.51 (0.24- 1.17)
Eigenvector Centrality (z score)	-	-	-	0.08 (0.08)	-0.09 (0.14)
<b>R<sup>2</sup></b>	0.128***	0.128***	0.147***	0.134***	0.159**
<b>Adjusted R<sup>2</sup></b>	0.100***	0.094***	0.096***	0.100***	0.097**
<b>Sample Size (N)</b>	161	161	161	161	161

<sup>3</sup> English as a first language was not included as a covariate due to low variability

Statistical significance levels are indicated as \* $\leq 0.05$ ; \*\* $\leq 0.01$ ; \*\*\* $\leq 0.005$

Regression coefficients are standardized

## **Chapter 4: Discussion**

Although community early years programs have the potential to impact developmental outcomes by impacting the environments that children are exposed to, little is known about their effectiveness. Few program environments have been evaluated at all, and existing evaluation studies have been subject to small sample sizes or subpopulations that make their conclusions ungeneralizable (Peters et al., 2003). By examining aspects of network structure and child program participation, I hoped to explain some of the contextual community factors associated with variability in EDI scores. The first research question explored the relationship between components of the program network structure and child development. The second question investigated whether participation in community early years programs were associated with child developmental outcomes, as measured by EDI scores at Kindergarten. Finally, the last question investigated whether certain aspects related to program participation, including dosage, diversity and centrality, were additionally associated with child developmental outcomes.

### **Network patterns**

Although the network analysis performed was largely exploratory and descriptive in nature, the results do shed some insights on the system of community early years programs that support children and families. Despite differences in the number of active programs, the networks had similar structural values (cohesion measures) across the years of data. This is because the core programs that uphold structure remained the same. That is, only the periphery programs with low centrality changed throughout the years. Although density measures were considered moderately low with values ranging from 20-30%, they were within the range we would expect for this type of program attendance data. Values greater than 75% - meaning all children on average would attend 5 programs per year - would be unrealistic and likely

unsustainable with the current system's capacity. However, it should be noted that the sample, and thus networks, represented only the children already connected to at least one community early years program. A network of program attendance considering the total child population in the Qualicum community would be significantly less dense and have many isolates (children not connected to any program). Given that disadvantaged and marginalized children are consistently less likely to participate in formal early learning environments (Magnuson et al., 2007), the current networks may not be representative or provide insights as to what program characteristics are likely to attract 'hard-to-reach' families.

The network diagrams illustrated the connective structure between programs based on common child attendance. Program homophily (the tendency for children or families to seek out programs that are similar to one another) was low, such that programs with the same developmental focus didn't attract the same children with any more frequency than central or popular programs did. The small sample size of programs may have contributed to not seeing stronger connections between developmentally focused programs, such that convenience or accessibility may have been more influential in the decision for families. To test this, greater program attribute data would have been needed. Alternatively, this could be determined by consulting with parents/caregivers to understand motives behind their program selection. Through one-on-one interviews, Harman et al. (2014) found that the decision for mothers to attend playgroups was dependent on a sense of belonging, validation and previous experiences.

Typically, studies on child development that consider network aspects examine 1-mode data with the individual as the nodal unit. The present study considered 2-mode attendance data whereby program and child centrality measures were distinctly different from one another. When looking for patterns across program centrality and EDI scores, the results showed central

programs had higher, average and lower EDI scores for program attendees compared to the overall GT group. Thus, no definitive pattern emerged that linked program centrality with average EDI scores of attendees. Central programs may provide children with exposure to more social interactions and learning opportunities, but they may also provide exposure to more chaotic and stressful environments. The mixed pattern of EDI outcomes is also reflected in the literature that shows formal early learning environments associated with both positive and negative developmental outcomes. Positive outcomes have included higher reading and mathematics skills at school entry, stronger language, communication and cognitive skills, and prosocial and social skills (Campbell et al., 2012; Goldfeld et al., 2016; Hansen & Hawkes, 2009; Magnuson et al., 2007; Schweinhart et al., 1993; Williams et al., 2017). Negative outcomes have included greater externalizing behaviours and less self-control (Belsky et al., 2007; Magnuson et al., 2007). The mixed results of the present study could be the result of multiple factors. First, a pattern may simply not exist between program centrality and average EDI scores. Alternatively, it may be that EDI score is dependent on some other program factor (e.g., quality) or family factor that impacts self-selection. For example, a central program may deter isolated families who feel socially intimidated or culturally different from the community.

Despite no emergent patterns between program centrality and EDI, program centralities alone can reveal a lot about the structure of the network and its potential impacts. Recall that eigenvector centrality in this context is the extent to which children who attended a program also attended other programs within the community. This may be important for understanding not only the flow of information through the network but also the characteristics of families who generally attend multiple community early years programs. In this context, betweenness centrality is a measure of how often a program intersects the path between two children. Higher

betweenness centrality indicates which programs have more control in passing and sharing information between groups of children (Borgatti, 2005). Although the networks didn't exhibit fragmentation, the programs with high betweenness centrality may act as bridges for information dissemination. For example, Munchkin Land consistently had the highest centralities within the network. This means that a large number of families who attended Munchkin Land also attended a variety of other programs. Participation dynamics in community events has shown large or popular events represent opportunities to establish new connections while participation in smaller or less popular events represent opportunities to establish stronger connections (Smiljanić & Dankulov, 2017). Families who attended a variety of programs may experience greater opportunities for connections (both weak and strong ) where information about programs or community events and/or social support may be exchanged.

### **Community early years program participation**

Results from the first series of regression analysis performed produced models examining the association between participation in community early years programs and developmental outcomes, as measured by EDI scores. Overall, the total amount of variability explained by the models was in the 10% range. Given the nature of the study, it was expected that  $R^2$  values would likely be small. It is commonly accepted that this type of observation/naturalistic study examines an isolated variable in the context of numerous other influences not considered or adjusted for (Sylva et al., 2011). These other unmeasured variables likely contributed to the small  $R^2$ . However, the  $R^2$  values were comparable with similar studies of formal early learning environments and health/developmental outcomes. For example, one similar study by Hansen & Hawkes (2009) used a series of regression models to determine the impact that different types of childcare had on child developmental outcomes. Across 3 outcomes measures, vocabulary,

school readiness and behaviour,  $R^2$  values ranged from 1 - 12%, 3 – 14% and 2 – 9% respectively (Hansen & Hawkes, 2009).

There are many different types of non-parental care that can include everything from childcare in formal groups (e.g., daycare, nurseries) or one-on-one (e.g., nannies, childminders) to child care in informal arrangements (e.g., by a grandparent or relative). Studies show that both the type and quality of care provided impact child developmental outcomes (Belsky et al., 2007; Hansen & Hawkes, 2009). In the current study, the effect modification that was suspected, based on conceptual understandings and initial descriptive statistics, between community early years program participation and non-parental care on a regular basis did not show significance. If childcare does modify program effects, this may not have emerged through a variable such as non-parental care on a regular basis, which combined different types of formal and informal settings and did not consider the quality of care.

From the final model we saw that girls on average had an overall EDI score 0.58 standard deviations higher than boys controlling for age, neighbourhood, non-parental care on a regular basis and participation in community early years programs. The literature is somewhat inconsistent in regard to gender differences at this stage, largely suggesting that boys and girls in the early years have similar cognitive and pre-academic skills (Magnuson et al., 2016). While meta-analysis show that there are potential differences across the language, social and emotional domains, the effect sizes tend to be small. According to the National Assessment of Educational Progress (NAEP), however, by grade school girls consistently outperform boys in reading and standardized tests (Magnuson et al., 2016). Multiple determinants, including program effects, could contribute to this variance. As expected, age was associated with EDI scores, such that older children had a developmental advantage and thus on average scored higher. Of the

neighbourhood differences, only the effect of being from Qualicum Beach were significant. This is consistent with what we would expect given the differential vulnerabilities at the neighbourhood level. Parksville consistently had vulnerability rates higher than Qualicum Beach with rates of 44% compared to 21% in Wave 6 of data (HELP, 2016). The non-significant and low effect size (0.03) for rural Vancouver Island compared to Parksville was also consistent with neighbourhood level vulnerability. Both neighbourhoods had high vulnerability rates and similar trends over time (HELP, 2016). Given limited neighbourhood level variables, it was assumed program effects were the same for children regardless of which neighbourhood they resided in, so no additional effect moderation was tested.

The primary variable of interest – community early years participation – showed significance in the final model. Children who attended community early years programs on average had an overall EDI score 0.18 standard deviations higher than those who did not attend these programs, controlling for sex, age, neighbourhood and non-parental care on a regular basis. Although considered small, the effect size is comparable with a similar study that measured the effects of pre-Kindergarten on math and reading performance (effect sizes range from 0.10-0.13), and aggression and self-control (effect sizes range from 0.09 -0.12) (Magnuson et al., 2007).

In the current study, community early years program participation was found to be significantly associated with increased overall EDI score, as well as the EDI scores for the social and emotional domains. Similar to the effect size for overall EDI, the effect sizes for the social and emotional domains are considered small by convention (Cohen, 1988). It should be noted that although only two domains were significant, the remaining domains were not far off; therefore it is cautioned how much interpretive weight to place behind the domain specific



results. Nevertheless, it can be speculated as to why program participation was more strongly associated with higher scores in the social and emotional domains. The subdomain items for social competence include responsibility and respect, approaches to learning, and readiness to explore new things. The subdomain items for emotional maturity include prosocial and helping behaviour, anxious and fearful behaviour, aggressive behaviour, and hyperactivity and inattentive behaviour (HELP, 2016). Many of these items are relevant to an interactive and social environment. One explanation for the domain-specific findings from the present study, may be that community early years programs provided a social environment that was able to create more interactive opportunities and learning experiences for children with their peers compared to their home environment with a primary caretaker (Rispoli et al., 2019; Stagnitti et al., 2012; Stipek et al., 1998). It would then make sense that children exposed to community early years program environments would have an advantage in development in the social and emotional domains.

The domain-specific results suggest that participation in community early years programs may be beneficial for children in the social-emotional domains of development. This contrasts with studies suggesting that formal early learning environments (e.g., childcare, preschool) may negatively influence these domains of development, as indicated by increased behavioural problems (Belsky et al., 2007; Magnuson et al., 2016). However, the literature is somewhat inconsistent with other research indicating no association between formal early learning environments and problem behaviour (Hansen & Hawkes, 2009). Empirical findings seem to differ based on study samples, methodologies, and measures. This suggests that the influence of formal early learning environments on child developmental outcomes is much more complex than simply “attended or not”, and warrants consideration of other potential influential factors.

These might include examining the quality of relationships (e.g., parent-child, teacher-child), quality of the home environment, and time spent in formal early learning environments (dosage consideration).

### **Factors associated with program participation**

Results from the second series of regression analysis performed produced models examining the association between a number of factors related to community early years program participation and developmental outcomes, again measured by EDI scores. The three factors examined were dosage of programs attended, diversity of programs attended, and popularity of programs attended (centrality). Although the models explained 12-16% of the variability in overall EDI score, the explanatory variables of interest were not significant across any year of data.

The null results for program dosage were not consistent with what was expected based on the literature, which suggested that greater dose of program intervention or an additional year spent in preschool programs were linked to stronger short and long term outcomes (Youn, 2016; Reynolds et al., 2011; Zaslow et al., 2016). However, in studies that showed associations, quality of formal early learning environments was often considered alongside exposure to such environments. This is especially important because certain aspects of quality have been shown to impact developmental outcomes for children (Peisner-Feinberg et al., 2001; Sylva et al., 2011). For example, Peisner-Feinberg et al. (2001) found that the quality of classroom practices was related to children's language and academic skills, and the closeness of the teacher-child relationship was related to children's overall cognitive and social skills. The present study was unable to control for quality measures across different programs, which may explain why the

results presented as null. That is, quality may be a mediating factor in program effectiveness on child developmental outcomes.

The question of diversity in program environments was largely exploratory given the limited research on this topic. However, the null results for diversity of programs attended were inconsistent with what was expected based on the program network structure. The 1-mode program network diagrams illustrated how different programs had different structural qualities and attributes (e.g., centrality, developmental focus). Exposure to different environments that nurtured different aspects of development (e.g., a play program on gross and fine motor skills; a social program on exploring new things) were thought to potentially contribute to some of the variability in child developmental outcomes. The null results may be explained by attribute factors not available with these data that impact self-selection. For example, if one location was more convenient, families without reliable transportation may opt to attend a program at that location based on proximity, rather than select a program solely based on a particular developmental focus. Similarly, compatibility with program scheduling (day/time) could be an attribute that impacts self-selection for families more than developmental focus.

The question of program popularity (child eigenvector centrality) on child developmental outcomes was also largely exploratory given the limited research in this area. It was thought that being connected to more central programs could be associated with higher EDI scores because popular programs attract many families, which provide increased opportunities for social interaction, exchange of information and/or social support. The null findings could be simply because program popularity (child centrality) is not an influential factor on child developmental outcomes or this could again be an issue of program quality mediating effects, and other attribute factors not part of the present study.

Despite the results of dose, diversity, and centrality not being significant contributors to differential EDI scores, that is not to say that they do not contribute to developmental outcomes at all. Further research is needed that includes a more diverse set of variables, which considers influences from across the different systems levels (e.g., family structure, parent/caregiver mental health, program size, staff qualifications, etc.). Given the potential challenges of collecting program attendance data, specifically for dosage considerations, special attention should be given to the process and potential implications of methodology on findings. One of the unique challenges that presents with collecting dosage data is defining the unit of exposure. For example, the current study used cumulative session attendance. Alternatively, the Toronto First Duty study used cumulative hours to determine dose of exposure (Patel et al., 2016). Although both studies used a tracking system for data collection, thereby eliminating certain recall and response biases, there may still be questions around the reliability of data collected and whether one unit presents a more accurate representation of program exposure. For example, in the current study a child who attended one session of a community early years program may have actively participated for 20 mins or 2 hours. Sessional attendance for both scenarios would have been recorded the same. Given the limited research on tracking community early years program participation for dosage data, there is currently no standard protocol or best practice for determining a suitable unit of exposure in dosage studies.

### **Study strengths and limitations**

Although the findings are not generalizable beyond the current community, the results shed some light on the potential impacts that participation in community early years programs may have on child developmental outcomes, which is currently a gap in the literature. The present study provides a first step in understanding the use of centre-based programs by families

with young children. One of the greatest strengths of the study was its unique session attendance data, which provided an unbiased measure of program exposure. Dosage studies looking at quantity of exposure in a unit smaller than a year typically rely on self-reported data from a primary caretaker, which is subject to a series of biases. Similarly, studies looking at developmental outcomes often relied on parental reports of child health and behaviour, which are again subject to a series of biases. The current study relied on tracked session attendance as well as a verified measure of development administered by trained educational staff. Lastly, this study used a novel network approach to understand program structure and connectivity as a component of the broader system or field. While the network analysis was largely descriptive and exploratory, it introduced a new methodological way of understanding the impacts of interconnected relations on developmental health that can be further explored in future studies.

The current study is limited by its observation/naturalistic nature, such that findings can not be considered causal. Similar to most studies on children's developmental outcomes, the findings showed an association between two variables. It should be reemphasized that use of the term "effect" in the above discussion refers only to the statistical nature of relations. To make conclusions about causality would require further investigation using prospective and quasi-experimental designs (e.g., demographically similar children sorted into program exposure groups varying from none to bi-weekly). The directionality of association is also a limitation. Given that no baseline data were available for children, the direction of association could not be determined. For example, it could be that children who attended programs experienced exposure to environments that nurtured their development thus positively influencing their EDI scores. Alternatively, it could be that families with children who exhibit developmental problems, such

as hyperactive and aggressive behaviour, were embarrassed or feared judgement and thus choose not to have their children participate in community early years programs frequently.

The final and perhaps largest study limitation was the availability of data. Analysis was based on secondary data and thus was limited to the variables of existing databases. Despite a social ecological approach, the available variables were somewhat limited in their span of the multiple systems levels, focusing only on the micro (individual and interpersonal) and meso levels. Unfortunately, this is common with few studies incorporating a comprehensive and holistic set of variables or characteristics into their models (Peters et al., 2003). The four control variables used in the present study did not comprise an exhaustive list of child, family and program level factors. Similar studies have included a far more comprehensive list of variables that include family level characteristics (e.g., maternal education, parental attitudes and behaviours (responsiveness, sensitivity, supportiveness), marital satisfactions and stressful life events) and community level characteristics (e.g., stability and qualifications of community staff, parent/caregiver ratings of satisfaction with care or staff) (Brownell & Drummond, 2018; Hansen & Hawkes, 2009; Peters et al., 2003; Rispoli et al., 2019).

### **Implication of findings**

There is a wealth of research that highlights early child development as a key social determinant of health across the lifespan. This alludes to the priority that community and policymakers should give to research on understanding how to provide environments that promote early learning, growth and sustained development (Brownell & Drummond, 2018). While I recognize and caution against extrapolating findings beyond this specific community context, findings from the current study can have practical importance for the community of Qualicum.

The GT initiative provided unique program attendance data that allowed patterns of access and use to be better understood. Linking the frequency of participation with developmental outcome data provided some insights into the impact that exposure to community early years program environments can have on child developmental outcomes. Findings from the current study suggested that participation in community early years programs was associated with an advantage in development for children by Kindergarten, both overall and for the social and emotional domains. However, these unique data have the potential to link with outcomes beyond early childhood to indicate health and social well-being across the lifespan. Similar studies focused on long-term outcomes have linked participation in formal early learning environments with data from school records (e.g., grade retention, special education needs, school achievement), health records (e.g., teen pregnancy, drug use, mental health needs), employment records (e.g., income, welfare dependence) and legal records (e.g., criminal activity) (Arteaga et al., 2014; Belsky et al., 2007; Campbell et al., 2012; Garces et al., 2002; Schweinhart et al., 2005). These studies have shown sustained benefits of formal early learning environments. For example, Schweinhart et al. (2005) found participation in preschool to be associated with higher rates of employment and higher employment income for adults in their fifties. This is suggestive of the continued value that collecting child program attendance data at the community level can have for future research and understanding.

The current study contributes to a growing body of literature that is suggestive of the value of understanding children's attendance in formal early learning environment. For the first time since Wave 3 (2007/2008), the Qualicum community has seen overall levels of vulnerability decrease, dropping from 37% to 31% (HELP, 2019). More needs to be understood about the potential community level drivers behind this. For Qualicum and other communities who may

wish to use or further develop a GT approach, a more comprehensive list of factors that span all systems levels should be considered during the early stages of planning.

### **Future directions**

Continuing to build knowledge about community early years programs and the characteristics that impact program effectiveness is key for decision makers at all levels of government, community and family. In this context, program effectiveness is the potential that programs have to impact child developmental outcomes. There could be valuable insights gained from further in-depth investigation of community early years program participation and also an expanded methodological scope for how it can be studied. Future research on program participation could incorporate a greater number of child, family, and program characteristics. This could additionally include looking at more diverse populations to determine if program effects are moderated by child or family level characteristics (e.g. cultural differences, parent/caregiver attitudes). Program effects could also be looked at to determine if program characteristics are moderators of effectiveness (e.g., quality, group size). Given the fade out effect seen in similar studies, future research could attempt to look beyond the early years to determine if program effects might contribute to health and social outcomes through childhood, adolescence, and adulthood. Building on the network components of the current study, future studies could examine other program attributes (other than developmental focus) that may be central in determining common program attendance. These could include frequency of scheduling, structure of session, accessibility of location, cost barriers and family attitudes, beliefs or opinions. Greater attribute data might provide a greater understanding of program characteristics that drive connectivity (common child attendance). Finally, future studies could examine if and how the structure of child/family networks influences program attendance.



Exploring networks of families who do and do not attend community early years programs could provide insights on whether structural network components or ties are related to children's developmental outcomes (e.g., do parent/caregivers who feel supported and engaged with other parent/caregivers tend to have children who show an advantage in development?). This type of information could help communities connect with 'hard to reach families' and more generally support the development and well-being of a greater range and diversity of children across their respective communities.

## **Conclusion**

Considering the importance of early life experiences on health and developmental outcomes (Hertzman & Power, 2003), more needs to be understood about the contextual factors surrounding community early years programs and their potential effects on child developmental outcomes. The current study showed participation in community early years programs was associated with advantages in overall development and development in the social and emotional domains. The current study highlighted the importance of support for future research in this area, given that early environments in communities show the potential to significantly impact child development at the population level.

## References

- Alvergne, A., Gibson, M. A., Gurm, E., & Mace, R. (2011). Social Transmission and the Spread of Modern Contraception in Rural Ethiopia. *PLoS One; San Francisco*, 6(7), e22515.
- Anderson, L. M., Shinn, C., Fullilove, M. T., Scrimshaw, S. C., Fielding, J. E., Normand, J., & Carande-Kulis, V. G. (2003). The effectiveness of early childhood development programs: A systematic review. *American Journal of Preventive Medicine*, 24(3, Supplement), 32–46.
- Arteaga, I., Humpage, S., Reynolds, A. J., & Temple, J. A. (2014). One year of preschool or two: Is it important for adult outcomes? *Economics of Education Review*, 40, 221–237.
- Barman, E. (2016). Varieties of Field Theory and the Sociology of the Non-profit Sector. *Sociology Compass*, 10(6), 442–458.
- Baron, S. W., & Tindall, D. B. (1993). Network structure and delinquent attitudes within a juvenile gang. *Social Networks*, 15(3), 255–273.
- Bearman, P. S., & Moody, J. (2004). Suicide and Friendships Among American Adolescents. *American Journal of Public Health*, 94(1), 89–95.
- Belsky, J., Vandell, D. L., Burchinal, M., Clarke-Stewart, K. A., McCartney, K., & Owen, M. T. (2007). Are There Long-Term Effects of Early Child Care? *Child Development*, 78(2), 681–701. JSTOR.
- Borgatti, S. P. (2005). Centrality and network flow. *Social Networks*, 27(1), 55–71.
- Borgatti, S. P., & Chair, C. (2009). *2-Mode Concepts in Social Network Analysis*. 21.
- Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2018). *Analyzing Social Networks*. SAGE.

- Borgatti, S. P., Mehra, A., Brass, D. J., & Labianca, G. (2009). Network Analysis in the Social Sciences. *Science*, 323(5916), 892–895.
- Bourdieu, P., Bourdieu, P. P., & Wacquant, L. J. D. (1992). *An Invitation to Reflexive Sociology*. University of Chicago Press.
- Breiger, R. L. (1974). The Duality of Persons and Groups. *Social Forces*, 53(2), 181–190.
- Bronfenbrenner, U. (1979). *The ecology of human development*. Harvard University Press.
- Brownell, C. A., & Drummond, J. (2018). Early childcare and family experiences predict development of prosocial behaviour in first grade. *Early Child Development and Care*, 0(0), 1–26.
- Burger, K. (2010). How does early childhood care and education affect cognitive development? An international review of the effects of early interventions for children from different social backgrounds. *Early Childhood Research Quarterly*, 25(2), 140–165.
- Campbell, F. A., Pungello, E. P., Burchinal, M., Kainz, K., Pan, Y., Wasik, B. H., Barbarin, O. A., Sparling, J. J., & Ramey, C. T. (2012). Adult outcomes as a function of an early childhood educational program: An Abecedarian Project follow-up. *Developmental Psychology*, 48(4), 1033–1043.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed). L. Erlbaum Associates.
- Currie, J., & Thomas, D. (1995). Does Head Start Make a Difference? *The American Economic Review*, 85(3), 341–364.
- Datta Gupta, N., & Simonsen, M. (2016). Academic performance and type of early childhood care. *Economics of Education Review*, 53, 217–229.

- Daw, N. (1997). *Critical Periods and Strabismus: What Questions Remain? | Ovid.* <https://occe-ovid-com.ezproxy.library.ubc.ca/article/00006324-199709000-00002/HTML>
- de la Haye, K., Robins, G., Mohr, P., & Wilson, C. (2010). Obesity-related behaviors in adolescent friendship networks. *Social Networks*, 32(3), 161–167.
- Dowsett, C. J., Huston, A. C., & Imes, A. E. (2008). Structural and Process Features in Three Types of Child Care for Children from High and Low Income Families. *Early Childhood Research Quarterly*, 23(1), 69–93.
- Elder, J. P., Lytle, L., Sallis, J. F., Young, D. R., Steckler, A., Simons-Morton, D., Stone, E., Jobe, J. B., Stevens, J., Lohman, T., Webber, L., Pate, R., Saksvig, B. I., & Ribisl, K. (2007). A description of the social–ecological framework used in the trial of activity for adolescent girls (TAAG). *Health Education Research*, 22(2), 155–165.
- Emirbayer, M. (1997). Manifesto for a relational sociology. *The American Journal of Sociology; Chicago*, 103(2), 281–317.
- Ennett, S. T., Bauman, K. E., Hussong, A., Faris, R., Foshee, V. A., Cai, L., & DuRant, R. H. (2006). The Peer Context of Adolescent Substance Use: Findings from Social Network Analysis. *Journal of Research on Adolescence*, 16(2), 159–186.
- Essa, E. L., & Burnham, M. M. (2001). Child care quality: A model for examining relevant variables. In *Advances in Early Education And Day Care* (Vol. 11, pp. 59–113). Emerald (MCB UP).
- Garces, E., Thomas, D., & Currie, J. (2002). Longer-Term Effects of Head Start. *The American Economic Review*, 92(4), 999–1012.

- Goldfeld, S., O'Connor, E., O'Connor, M., Sayers, M., Moore, T., Kvalsvig, A., & Brinkman, S. (2016). The role of preschool in promoting children's healthy development: Evidence from an Australian population cohort. *Early Childhood Research Quarterly*, 35, 40–48.
- Government of Canada, S. C. (2017a, February 8). *Census Profile, 2016 Census - Parksville [Population centre], British Columbia and British Columbia [Province]*.  
<https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=POPC&Code1=0626&Geo2=PR&Code2=59&SearchText=Parksville&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=0626&TABID=1&type=0>
- Government of Canada, S. C. (2017b, February 8). *Census Profile, 2016 Census - Qualicum Beach, Town [Census subdivision], British Columbia and British Columbia [Province]*.  
<https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/details/page.cfm?Lang=E&Geo1=CSD&Code1=5921023&Geo2=PR&Code2=59&SearchText=Qualicum%20Beach&SearchType=Begins&SearchPR=01&B1=All&GeoLevel=PR&GeoCode=5921023&TABID=1&type=0>
- Gullo, D. F., & Burton, C. B. (1992). Age of entry, preschool experience, and sex as antecedents of academic readiness in kindergarten. *Early Childhood Research Quarterly*, 7(2), 175–186.
- Haas, S. A., Schaefer, D. R., & Kornienko, O. (2010). Health and the Structure of Adolescent Social Networks. *Journal of Health and Social Behavior*, 51(4), 424–439. JSTOR.
- Halfon, N., & Hochstein, M. (2002). Life Course Health Development: An Integrated Framework for Developing Health, Policy, and Research. *The Milbank Quarterly*, 80(3), 433–479. JSTOR.

- Hall, J. A., & Valente, T. W. (2007). Adolescent smoking networks: The effects of influence and selection on future smoking. *Addictive Behaviors, 32*(12), 3054–3059.
- Hansen, K., & Hawkes, D. (2009). Early Childcare and Child Development. *Journal of Social Policy, 38*(2), 211–239.
- Harman, B., O'Connor, M., & Guilfoyle, A. (2014). Why mothers attend playgroup. *Australasian Journal of Early Childhood, 39*(4), 131–137.
- HELP (Human Early Learning Partnership), (2019). EDI BC. Early Development Instrument British Columbia, 2016-2019 Wave 7 provincial report. *University of British Columbia, Faculty of Medicine, School of Population and Public Health.*
- HELP (Human Early Learning Partnership), (2006). *Tracking and Enhancing a Community's ECD Assets Focus on Family Access, Usage, and Satisfaction.*
- HELP (Human Early Learning Partnership, (2020). *Early Development Instrument [EDI] report. Wave 7 Community Profile, 2019. Qualicum School District (SD69).* University of British Columbia, Faculty of Medicine, School of Population and Public Health.
- Hertzman, C. (2009). The state of child development in Canada: Are we moving toward, or away from, equity from the start? *Paediatrics & Child Health, 14*(10), 673–676.
- Hertzman, C., & Power, C. (2003). Health and human development: understandings from life-course research. *Developmental Neuropsychology, 24*(2–3), 719–744.
- Hindhede, A. L., & Aagaard-Hansen, J. (2017). Using Social Network Analysis as a Method to Assess and Strengthen Participation in Health Promotion Programs in Vulnerable Areas. *Health Promotion Practice, 18*(2), 175–183.

- Janus, M., & Offord Centre for Child Studies. (2007). *The Early Development Instrument: population-based measure for communities : a handbook on development, properties and use*. McMaster University.
- Janus, M., & Offord, D. R. (2007a). Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness\*. *Canadian Journal of Behavioural Science; Ottawa*, 39(1), 1–22.
- Janus, M., & Offord, D. R. (2007b). Development and Psychometric Properties of the Early Development Instrument (EDI): A Measure of Children's School Readiness\*. *Canadian Journal of Behavioural Science; Ottawa*, 39(1), 1–22.
- Jeon, K. C., & Goodson, P. (2015). US adolescents' friendship networks and health risk behaviors: a systematic review of studies using social network analysis and Add Health data. *PeerJ*, 3, e1052.
- Johnson, D. L., & Walker, T. (1991). A Follow-up Evaluation of the Houston Parent-Child Development Center: School Performance. *Journal of Early Intervention*, 15(3), 226–236.
- Liu, S., & Emirbayer, M. (2016). Field and Ecology. *Sociological Theory*, 34(1), 62–79. JSTOR.
- Luke, D. A., & Harris, J. K. (2007). Network Analysis in Public Health: History, Methods, and Applications. *Annual Review of Public Health*, 28(1), 69–93.
- Määttä, S., Ray, C., Roos, G., & Roos, E. (2016). Applying a Socioecological Model to Understand Preschool Children's Sedentary Behaviors from the Viewpoints of Parents and Preschool Personnel. *Early Childhood Education Journal*, 44(5), 491–502.

- Magnuson, K. A., Kelchen, R., Duncan, G. J., Schindler, H. S., Shager, H., & Yoshikawa, H. (2016). Do the effects of early childhood education programs differ by gender? A meta-analysis. *Early Childhood Research Quarterly, 36*, 521–536.
- Magnuson, K. A., Ruhm, C., & Waldfogel, J. (2007). Does prekindergarten improve school preparation and performance? *Economics of Education Review, 26*(1), 33–51.
- Martin, J. L. (2003). What Is Field Theory? *American Journal of Sociology, 109*(1), 1–49.  
<https://doi.org/10.1086/375201>
- McCartney, K., & Rosenthal, R. (2000). Effect Size, Practical Importance, and Social Policy for Children. *Child Development, 71*(1), 173–180. JSTOR.
- Melhuish, E. (2004). *A literature review of the impact of early years provision on young children, with emphasis given to children from disadvantaged backgrounds.*  
[https://www.researchgate.net/publication/228716263\\_A\\_literature\\_review\\_of\\_the\\_impact\\_of\\_early\\_years\\_provision\\_on\\_young\\_children\\_with\\_emphasis\\_given\\_to\\_children\\_from\\_disadvantaged\\_backgrounds](https://www.researchgate.net/publication/228716263_A_literature_review_of_the_impact_of_early_years_provision_on_young_children_with_emphasis_given_to_children_from_disadvantaged_backgrounds)
- Mercken, L., Snijders, T. A. B., Steglich, C., Vertiainen, E., & Vries, H. D. (2010). Smoking-based selection and influence in gender-segregated friendship networks: a social network analysis of adolescent smoking. *Addiction, 105*(7), 1280–1289.
- NICHD ECCRN. (2006). Child-care effect sizes for the NICHD Study of Early Child Care and Youth Development. *American Psychologist, 61*(2), 99–116.
- Nieminen, P., Lehtiniemi, H., Vähäkangas, K., Huusko, A., & Rautio, A. (2013). Standardised regression coefficient as an effect size index in summarising findings in epidemiological studies. *Epidemiology Biostatistics and Public Health, 10*(4).



- O'Malley, A. J., & Christakis, N. A. (2011). Longitudinal analysis of large social networks: Estimating the effect of health traits on changes in friendship ties. *Statistics in Medicine*, 30(9), 950–964.
- Ontario, Early Years Study (Reference group), McCain, M. N., Mustard, J. F., Canadian Institute for Advanced Research, Ontario, Premier, Ontario, & Minister Responsible for Children. (1999). *Early years study: final report : reversing the real brain drain*. Canadian Institute for Advanced Research. <https://www.deslibris.ca/ID/230273>
- Patel, S., Corter, C., Pelletier, J., & Bertrand, J. (2016). 'Dose-response' relations between participation in integrated early childhood services and children's early development. *Early Childhood Research Quarterly*, 35, 49–62.
- Peisner-Feinberg, E. S., Burchinal, M. R., Clifford, R. M., Culkin, M. L., Howes, C., Kagan, S. L., & Yazejian, N. (2001). The Relation of Preschool Child-Care Quality to Children's Cognitive and Social Developmental Trajectories through Second Grade. *Child Development*, 72(5), 1534–1553. JSTOR.
- Peters, R., Bradshaw, A. J., Petrunka, K., Nelson, G., Herry, Y., Craig, W. M., Arnold, R., Parker, K. C. H., Khan, S. R., Hoch, J. S., Pancer, S. M., Loomis, C., Bélanger, J.-M., Evers, S., Maltais, C., Thompson, K., Rossiter, M. D., & Collins, W. A. (2010). THE BETTER BEGINNINGS, BETTER FUTURES PROJECT: FINDINGS FROM GRADE 3 TO GRADE 9. *Monographs of the Society for Research in Child Development*, 75(3), i–176. JSTOR.
- Peters, R. D., Petrunka, K., & Arnold, R. (2003). The Better Beginnings, Better Futures Project: A Universal, Comprehensive, Community-Based Prevention Approach for Primary

- School Children and Their Families. *Journal of Clinical Child & Adolescent Psychology*, 32(2), 215–227.
- Reynolds, A. J., Temple, J. A., Ou, S.-R., Arteaga, I. A., & White, B. A. B. (2011). School-Based Early Childhood Education and Age-28 Well-Being: Effects by Timing, Dosage, and Subgroups. *Science*, 333(6040), 360–364. JSTOR.
- Rimm-Kaufman, S. E., & Pianta, R. C. (2000). An Ecological Perspective on the Transition to Kindergarten: A Theoretical Framework to Guide Empirical Research. *Journal of Applied Developmental Psychology*, 21(5), 491–511.
- Rispoli, K. M., Koziol, N. A., McGoey, K. E., & Schreiber, J. B. (2019). Parenting, childcare, and children's pre-kindergarten skills: exploring moderation by race and ethnicity. *Early Child Development and Care*, 189(6), 946–964.
- Salihu, H. M., Wilson, R. E., King, L. M., Marty, P. J., & Whiteman, V. E. (2015). Socio-ecological Model as a Framework for Overcoming Barriers and Challenges in Randomized Control Trials in Minority and Underserved Communities. *International Journal of MCH and AIDS*, 3(1), 85–95.
- Schweinhart, L. J. (2013). Long-term follow-up of a preschool experiment. *Journal of Experimental Criminology*, 9(4), 389–409. <https://doi.org/10.1007/s11292-013-9190-3>
- Schweinhart, L. J., Barnes, H. V., & Weikart, D. P. (1993). *Significant Benefits: The High/Scope Perry Preschool Study Through Age 27*. High/Scope Foundation.
- Schweinhart, L. J., Montie, J., Xiang, Z., Barnett, W. S., Belfield, C. R., & Nores, M. (2005). *The High/Scope Perry Preschool Study Through Age 40*. 21.
- Shah, H. K., Domitrovich, C. E., Morgan, N. R., Moore, J. E., Cooper, B. R., Jacobson, L., & Greenberg, M. T. (2017). One or two years of participation: Is dosage of an enhanced

- publicly funded preschool program associated with the academic and executive function skills of low-income children in early elementary school? *Early Childhood Research Quarterly*, *40*, 123–137.
- Singh, S. (2019). Science, Common Sense and Sociological Analysis: A Critical Appreciation of the Epistemological Foundation of Field Theory. *Philosophy of the Social Sciences*, *49*(2), 87–107.
- Smiljanić, J., & Dankulov, M. M. (2017). Associative nature of event participation dynamics: A network theory approach. *PLoS One; San Francisco*, *12*(2), e0171565.
- Stagnitti, K., O'Connor, C., & Sheppard, L. (2012). Impact of the Learn to Play program on play, social competence and language for children aged 5–8 years who attend a specialist school. *Australian Occupational Therapy Journal*, *59*(4), 302–311.
- Stipek, D. J., Feiler, R., Byler, P., Ryan, R., Milburn, S., & Salmon, J. M. (1998). Good Beginnings: What difference does the program make in preparing young children for school? *Journal of Applied Developmental Psychology*, *19*(1), 41–66.
- Stojanovic, T., McNae, H. M., Tett, P., Potts, T. W., Reis, J., Smith, H. D., & Dillingham, I. (2016). The “social” aspect of social-ecological systems: a critique of analytical frameworks and findings from a multisite study of coastal sustainability. *Ecology and Society*, *21*(3). JSTOR.
- Stokols, D. (1996). Translating Social Ecological Theory into Guidelines for Community Health Promotion. *American Journal of Health Promotion*, *10*(4), 282–298.
- Sylva, K., Stein, A., Leach, P., Barnes, J., & Malmberg, L.-E. (2011). Effects of early child-care on cognition, language, and task-related behaviours at 18 months: An English study. *British Journal of Developmental Psychology*, *29*(1), 18–45.

- Tindall, D. B., & Wellman, B. (2001). Canada as Social Structure: Social Network Analysis and Canadian Sociology. *The Canadian Journal of Sociology / Cahiers Canadiens de Sociologie*, 26(3), 265–308.
- Tremblay, R. E., Mâsse, L. C., Pagani, L., & Vitaro, F. (1996). From childhood physical aggression to adolescent maladjustment: The Montreal prevention experiment. In *Preventing childhood disorders, substance abuse, and delinquency* (pp. 268–298). Sage Publications, Inc.
- Ungar, M., Ghazinour, M., & Richter, J. (2013). Annual Research Review: What is resilience within the social ecology of human development? *Journal of Child Psychology and Psychiatry*, 54(4), 348–366.
- Valente, T. W., & Pitts, S. R. (2017). An Appraisal of Social Network Theory and Analysis as Applied to Public Health: Challenges and Opportunities. *Annual Review of Public Health*, 38(1), 103–118.
- Veenstra, G., & Burnett, P. J. (2014). A relational approach to health practices: towards transcending the agency-structure divide. *Sociology of Health & Illness*, 36(2), 187–198.
- Vitaro, F., Brendgen, M., & Tremblay, R. E. (2001). Preventive Intervention: Assessing its Effects on the Trajectories of Delinquency and Testing for Mediational Processes. *Applied Developmental Science*, 5(4), 201–213.
- Whittaker, K. A., & Cowley, S. (2012). An effective programme is not enough: a review of factors associated with poor attendance and engagement with parenting support programmes. *Children & Society*, 26(2), 138–149.
- Wilkinson, K. P. . (1972). A Field-Theory Perspective for Community Development Research. *Rural Sociology*, 37(1), 43–52.

- Williams, K. E., Berthelsen, D., Viviani, M., & Nicholson, J. M. (2017). Participation of Australian Aboriginal and Torres Strait Islander families in a parent support programme: longitudinal associations between playgroup attendance and child, parent and community outcomes. *Child: Care, Health and Development*, 43(3), 441–450.
- Youn, M. (2016). One Year or Two? The impact of Head Start enrollment duration on academic achievement. *KEDI Journal of Educational Policy*, 13(1), 85–112.
- Zaslow, M., Anderson, R., Redd, Z., Wessel, J., Daneri, P., Green, K., Cavadel, E. W., Tarullo, L., Burchinal, M., & Martinez-Beck, I. (2016). I. Quality Thresholds, Features, and Dosage in Early Care and Education: Introduction and Literature Review. *Monographs of the Society for Research in Child Development*, 81(2), 7–26.

## Appendices:

### Appendix A: Additional program information

**Table 10: Descriptives of community early years programs**

<b>Program Name</b>	<b># active years</b>	<b># of Locations</b>	<b>Locations</b>	<b>Description of Program</b>
Brower library	1	1	Other	Open access kids library
Cook Up A Bedtime Story	2	1	Parksville	Reading and story focused
Dads' Night Out	3	1	Parksville	Social opportunity for children with their fathers
Healthy Beginnings	1	1	Unknown	Unknown – nutrition and physical development focused
Mother Goose and Friends	1-3 <sup>4</sup>	8	Parksville, Qualicum Beach, Other	(Mother Goose general) Community-based group for children and families to engage with rhymes, songs, and social time that help to strengthen bonds and develop a network of peers
Mother Goose Goes to School	1-3 <sup>4</sup>	9	Parksville, Qualicum Beach, Other	Learning-through-play and language-enriched spaces for children and families. Part of the BC StrongStart program.
Munchkin Land	3	3	Parksville, Qualicum Beach	Unknown
Our Special Child	1	5	Parksville, Qualicum Beach	Unknown
Parksville Library	1	2	Parksville	Open access kids library
Preschool Power Hour	1	1	Parksville	Unknown – free play
Qualicum Beach Library	1	2	Qualicum	Open access kids library
Teaching from The Heart	1	1	Parksville	Unknown
Words on Wheels	1-2 <sup>4</sup>	30	Parksville, Qualicum Beach, Other (rural)	Early learning outreach program (bus) aimed at increasing early literacy skills for high risk children. Includes snack, playtime and circle time (songs and stories).

<sup>4</sup> Depending on location

**Appendix B: Additional summary tables**

**Table 11: Multiple regression analysis predicting overall EDI score for Year 2**

<b>YEAR 2: Independent Variables<sup>5</sup></b>	<b>Model 1 - Controls</b>	<b>Model 2 – Session Number</b>	<b>Model 3 – Program Types (#)</b>	<b>Model 4 - Centrality</b>	<b>Model 5 – All</b>
	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>
Sex (0 = M, 1 = F)	0.51*** (0.16)	0.51*** (0.16)	0.50*** (0.16)	0.51*** (0.16)	0.50*** (0.16)
Age	0.38 (0.27)	0.40 (0.27)	0.36 (0.28)	0.39 (0.27)	0.32 (0.28)
School Neighbourhood – Parksville (reference)	-	-	-	-	-
School Neighbourhood - Qualicum	0.15 (0.19)	0.16 (0.19)	0.15 (0.19)	0.15 (0.19)	0.13 (0.19)
School Neighbourhood - Rural	0.15 (0.20)	0.16 (0.20)	0.16 (0.21)	0.16 (0.20)	0.12 (0.22)
Non-paternal care on a regular basis (0 = not exposed, 1 = exposed)	-0.13 (0.17)	-0.11 (0.17)	-0.14 (0.17)	-0.14 (0.17)	-0.11 (0.17)
Number of Program Sessions Attended	-	-0.01 (0.01)	-	-	-0.01 (0.01)
Number of Different Programs Attended	-	-	0.03 (0.18) 0.20 (0.29)	-	0.26 (0.26) 0.60 (0.42)
Eigenvector Centrality (z score)	-	-	-	0.02 (0.08)	-0.07 (0.12)
<b>R<sup>2</sup></b>	0.084*	0.090*	0.086	0.084*	0.105
<b>Adjusted R<sup>2</sup></b>	0.053*	0.054*	0.043	0.047*	0.045
<b>Sample Size (N)</b>	157	157	157	157	157

<sup>5</sup> English as a first language was not included as a covariate due to low variability  
Statistical significance levels are indicated as \* $\leq 0.05$ ; \*\* $\leq 0.01$ ; \*\*\*  $\leq 0.005$   
Regression coefficients are standardized

**Table 12: Multiple regression analysis predicting overall EDI score for Year 3**

<b>YEAR 3: Independent Variables<sup>6</sup></b>	<b>Model 1 - Controls</b>	<b>Model 2 – Session Number</b>	<b>Model 3 – Program Types (#)</b>	<b>Model 4 - Centrality</b>	<b>Model 5 – All</b>
	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>	<b>β (std. error)</b>
Sex (0 = M, 1= F)	0.58*** (0.15)	0.57*** (0.16)	0.59*** (0.16)	0.58*** (0.16)	0.60*** (0.17)
Age	0.39 (0.27)	0.39 (0.27)	0.40 (0.27)	0.39 (0.26)	0.40 (0.27)
School Neighbourhood – Parksville (reference)	-	-	-	-	-
School Neighbourhood - Qualicum	0.17 (0.18)	0.17 (0.28)	0.17 (0.19)	0.18 (0.19)	0.17 (0.22)
School Neighbourhood - Rural	0.11 (0.22)	0.11 (0.22)	0.15 (0.22)	0.11 (0.22)	0.15 (0.23)
Non-paternal care on a regular basis (0 = not exposed, 1 = exposed)	-0.14 (0.18)	-0.15 (0.18)	-0.21 (0.18)	-0.14 (0.18)	-0.19 (0.19)
Number of Program Sessions Attended	-	-0.002 (0.01)	-	-	0.004 (0.01)
Number of Different Programs Attended	-	-	Range -1.23 – 0.21 (0.21- 1.00)	-	Range -1.47 – -0.02 (0.29- 1.38)
Eigenvector Centrality (z score)	-	-	-	-0.02 (0.08)	-0.004 (0.18)
<b>R<sup>2</sup></b>	0.101	0.102*	0.120*	0.101	0.121
<b>Adjusted R<sup>2</sup></b>	0.070	0.064*	0.157*	0.064	0.044
<b>Sample Size (N)</b>	151	151	151	151	151

<sup>6</sup> English as a first language was not included as a covariate due to low variability  
Statistical significance levels are indicated as \* $\leq 0.05$ ; \*\* $\leq 0.01$ ; \*\*\*  $\leq 0.005$   
Regression coefficients are standardized