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## Change in Preschoolers' Health-Related Quality of Life Following the Implementation of a Childcare Physical Activity Intervention

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A thesis submitted in partial fulfillment of the requirements for the degree in Master of Science

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## Abstract

Being active offers many physical and emotional benefits contributing to a higher health-related quality of life (HRQOL); however, this relationship remains unexplored among preschoolers. The purpose of this study was to examine the impact of the *Supporting Physical Activity in the Childcare Environment* intervention on preschoolers' HRQOL. Childcare centres were randomized to the experimental ( $n = 11$ ) or control ( $n = 11$ ) condition and preschoolers' HRQOL was measured using the parent-report Pediatric Quality of Life Inventory 4.0 (three subscales: physical, psychosocial, and total) at baseline and at 8-weeks. Three univariate ANCOVAs were conducted to compare HRQOL (experimental and control) pre- and post- intervention. Across all three subscales, preschoolers' HRQOL decreased in the experimental group, although no observed changes were statistically significant ( $p > .05$ ). Although these results were not significant, and surprising, additional research exploring preschoolers' HRQOL is necessary to clarify the impact of physical activity participation.

**Keywords:** Physical activity, health-related quality of life, preschooler, health promotion, childcare

## **Acknowledgements**

**Trish** – Thank you for your endless support over the past two years. You are a wonderful leader for our lab, and have helped me in countless ways succeed as a student as well as in life. It is a true testament to your character when you have students who come here for two years, and decide to stay for an additional four! I look forward to what the future brings for us as I continue on to my PhD!

**Leigh** – Thank you for your guidance and mentorship. Your continued assistance and patience answering questions regarding scholarship applications, courses, and everyday life helped me succeed in completing my Master's. I am truly grateful for your friendship, and I look forward to supporting you in all your future endeavors, as you have supported me.

**Molly** – Your continued support over the past two years has played an integral role in my success as a Master's student. Your kind words and endless advice is very much appreciated, and I am looking forward to continuing to work with you in the years to come.

**Dr. Shauna Burke and Dr. Andrew Johnson** – Thank you to my advisory committee for their continued support throughout the past two years. Your expertise in the field was extremely valuable and helped me succeed to where I am today.

**Mom, Dad, Amanda, and my extended family** – Thank you for continuing to support me in all that I do. I am grateful for your endless encouragement to continue with my education and study a topic I am extremely passionate about. No matter what I decide to tackle next, I know you will always be in my corner supporting me in any way that you can.

## Table of Contents

Abstract .....	ii
Acknowledgements .....	iii
List of Tables .....	vi
List of Appendices .....	vii
Chapter 1: Introduction.....	1
Benefits of Physical Activity for Preschoolers .....	2
Quality of Life .....	3
Quality of Life in Preschoolers .....	5
Recommended Levels of Physical Activity and Sedentary Behaviour .....	7
Physical Activity Levels of Preschoolers .....	9
Sedentary Behaviours of Preschoolers .....	11
The Childcare Environment .....	12
Evidence for Intervention .....	14
Purpose of Study .....	15
Chapter 2: Methods .....	17
Study Design and Recruitment .....	17
The SPACE Intervention .....	19
Instruments and Tools .....	21
Data Analysis .....	23
Chapter 3: Results .....	25
Participant Demographics .....	25
Preschoolers' HRQOL - Physical Health Summary Score .....	25

Preschoolers HRQOL - Psychosocial Health Summary Score .....	26
Preschoolers' HRQOL - Total Score.....	26
Chapter 4: Discussion .....	30
Limitations and Future Directions .....	36
Conclusion .....	38
References .....	40
Curriculum Vitae .....	70

## **List of Tables**

Table 1 - Preschooler Demographic Variables .....	27
Table 2 - Parent/Guardian Family Demographic Information.....	28
Table 3 - Means and Standard Deviations of HRQOL Subscale and Total Scores at Baseline and Post-Intervention .....	29

## **List of Appendices**

Appendix A - Ethics Approval .....	55
Appendix B - Letter of Information.....	56
Appendix C - Consent Form.....	59
Appendix D - Letter of Thanks: Pre-Intervention .....	60
Appendix E - Letter of Thanks: Post-Intervention .....	61
Appendix F - Pediatric Quality of Life Inventory 4.0 .....	62
Appendix G - Scoring Protocol of the Pediatric Quality of Life Inventory 4.0 .....	64
Appendix H - Parent/Guardian Demographic Questionnaire .....	67

## Chapter 1: Introduction

The health of Canadian preschoolers (i.e., 2.5-5 years) has become a major public concern, as childhood obesity is one of the most serious health challenges of the 21<sup>st</sup> century (World Health Organization [WHO], 2013). The prevalence of childhood obesity in Canada has inflated dramatically over the last three decades (Shields, 2005), and globally it is estimated that over 42 million children under the age of 5 years are overweight or obese (WHO, 2013). One of the major contributors to young children being overweight or obese is their low level of physical activity (Deckelbaum & Williams, 2001; Tremblay, Katzmarzyk, & Williams, 2002). Recent studies have shown that as few as 36% of Canadian 2-3 year olds and 44% of 4-5 year olds engage in regular daily physical activity (National Longitudinal Survey for Child and Youth, 2010). These low levels of physical activity are distressing, as this puts preschoolers at risk for numerous adverse health consequences (Temple, Naylor, Rhodes, & Higgins, 2009), including unhealthy body weight, diabetes, cardiovascular disease, osteoporosis, hypertension, and asthma (Strong et al., 2005).

In addition to the numerous physiological health benefits of physical activity participation, researchers have also shown a positive association with quality of life in varied child populations (Chen et al., 2005; Wang, Sekine, Chen, Yamagami, & Kagamimiro, 2008; Wu, Ohinmaa, & Veugelers, 2011). Wang and colleagues (2008) conducted a cross-sectional study ( $n = 9674$ ) to determine if children's lifestyles (i.e., physical activity behaviours, sleep, and dietary habits) at 3 years of age were associated with quality of life in their first year of junior high school (e.g., 12 years old). These researchers identified that all three components of the participants' lifestyle at 3 years of age affected their quality of life scores later in life. Outcomes from this study suggest the importance of intervening and establishing healthy behaviours early



in children's lives, as these lifestyle habits have the potential to impact children's quality of life in the future. Acknowledging the large proportion of Canadian preschoolers that attend childcare (Cleveland, Forer, Hyatt, Japel, & Krashinsky, 2008), and the powerful influence preschoolers' physical and social environment have on their physical activity levels (Dooris, Poland, & Kolbe, 2007), the childcare environment provides an ideal opportunity to intervene and adopt healthy physical activity behaviours.

## **Literature Review**

### **Benefits of Physical Activity for Preschoolers**

The overwhelming positive health benefits of participating in regular physical activity are well established (Penedo & Dahn, 2005; Warburton, Whitney Nicol, & Bredin, 2006), and researchers have shown that even children as young as 2 years of age can attain positive health effects from engaging in daily physical activity (Marcus et al., 2000). Specifically, participating in regular physical activity helps protect one from weight gain, developing heart disease, certain cancers and diabetes, as well as strengthens bones and muscles, and improves blood pressure (Timmons, Naylor, & Pfeiffer, 2007). Being physically active greatly impacts young children's health and development (Tucker, 2008), and Guo, and colleagues (1994), support the claim that obesity, as well as physical activity behaviours, which are established in early childhood tend to be carried forward throughout one's lifetime.

The benefits of physical activity are not limited to improved physiological markers for health. Participation in regular physical activity has also been linked to increased psychological and psychosocial health. Numerous studies have revealed that physical activity promotes the release of growth factors, which leads to the development of new cells and connections in the brain (Cotman, Berchtold, & Christie, 2007; White & Castellano, 2008). The establishment of

these new connections brought forth by physical activity lead people to perform better on tests of cognitive function and improve concentration skills. Specifically, children attain higher academic performances when they are more active (Donnelly et al., 2009; Reed et al., 2010; Stroth et al., 2009). In 2013, Lee and Hopkins conducted a systematic review ( $n = 8$ ) that highlighted the positive effects of physical activity on markers of mental health (e.g., cognitive and psychosocial functioning) for children younger than 19 years of age. Specifically, with increased aerobic physical activity, four studies highlighted improved academic and cognitive functioning (Donnelly et al., 2009; Hill, Williams, Aucott, Thomspn, & Mon-Williams, 2011; Reed et al., 2010; Shephard, 1996), two reported better attention (Fisher et al., 2011; Stroth et al., 2009), one found better creative capacity (Tuckerman, & Hinkle, 1986), and one reported greater self-esteem (Crews, Lachbaum, & Landers, 2004). Moreover, adolescents (aged 15-19 years) who engaged in more activity were less likely to be depressed, attempt suicide, and adopt risk-taking behaviours (Brown & Blanton, 2002). Being active increases blood flow to the brain, and also alters hormone levels within the body (i.e., raises norepinephrine and endorphin levels), which may reduce stress, improve mood, and create a calming effect after physical activity, resulting in improved academic achievement, and overall cognitive and social functioning (Fleshner, 2000; Morgan, 1994).

### **Quality of Life**

Quality of life, which refers to an individual's perception of their position in life in the context of the culture in which they live, is often used to measure a population's health. "It is a broad ranging concept affected in a complex way by the person's physical health, psychological state, level of independence, social relationships, and their relationships to salient features of their environment" (WHO Quality of Life Group, 1993; p. 3). In 1996, Rejeski, Brawley, and

Shymaker adopted the term health-related quality of life (HRQOL), which refers to all aspects of life that affect an individual's physical as well as psychosocial health (e.g., emotional, social, and school functioning). HRQOL is a subset of quality of life used to measure an individual's perception of their own health. It therefore, becomes an important element in determining the health benefits of various interventions for both researchers and patients.

Although limited, a few cross-sectional studies have demonstrated that children (aged 3-15 years) who are active on a daily basis are more likely to report higher HRQOL compared to those that are extremely sedentary (Chen et al., 2005; Wang et al., 2008; Wu et al., 2011). Lifestyle habits such as sleep duration, physical activity, and dietary patterns obtained via questionnaire data from 9,674 Japanese children at 3 years of age revealed a positive association with quality of life when the children were in their first-year of junior high school (12 years old; Wang et al., 2008). Bock et al. (2014), also found that children between the ages of 8-17 years who increased their physical activity levels after a lifestyle intervention had better HRQOL (measured via the Pediatric Quality of Life Inventory 4.0) compared to those children who did not improve their physical activity levels. Likewise using the same tool, obese children ( $n = 40$ ;  $M_{age} = 10.6$  years) following a 4-week group-based lifestyle intervention which included physical activity sessions, were found to have improved HRQOL immediately post-intervention, as well as at 6- and 12-month follow-up (Burke et al., 2015). More specifically, immediately post-intervention, participants had improved physical, social, and emotional HRQOL. Children's physical and social quality of life improved significantly from baseline to 6-month follow-up, whereas only their emotional quality of life was significantly higher at 12-months (Burke et al., 2015). Most recently, Gu, Chang, and Solmon (2016) examined the association between physical activity, physical fitness, and HRQOL among 201 school-aged children ( $M_{age} = 9.82$  years) in

one southern US school. Using pedometers as an objective measure of physical activity, and the Pediatric Quality of Life Inventory 4.0 to assess HRQOL, their study revealed a positive link between physical activity, fitness, and HRQOL. Specifically, when path analyses were conducted to evaluate the mediational relationships among physical activity, physical fitness, and HRQOL, steps per minute emerged as the significant predictor of both physical fitness ( $\beta = .23$ ,  $p < .01$ ) and HRQOL ( $\beta = .19$ ,  $p < .01$ ).

### **Quality of Life in Preschoolers**

In 2014, Hinkley and colleagues conducted a systematic review ( $n = 19$ ) exploring the relationship between physical activity, sedentary behaviours, and psychosocial well-being in children aged birth to 5 years. Although the term well-being has been commonly used interchangeably with the term quality of life in the literature, in the scope of this review, psychosocial well-being was defined as “the presence of higher levels of positive, and lower levels of adverse, psychological and social attributes of behaviour” (Hinkley et al., 2014, p. 183). Of the 19 studies identified, six examined physical activity behaviours and psychosocial well-being (Ebenegger et al., 2012; Fagot & O'Brien, 1994; Griffiths, Dowda, Dezateux, & Pate, 2010; Lindsey & Colwell, 2003; Yu, Ziviani, Baxter, & Haynes, 2010; Yu, Ziviani, Baxter, & Haynes, 2012), and mixed results were reported. Objectively measuring the physical activity levels of 450 preschoolers using ActiGraph accelerometry, Ebenegger et al. (2012), found positive associations between activity levels and measures of psychosocial well-being. A positive association between physical activity participation and better mental health was also found in a study conducted by Griffiths et al. (2010), in which parents completed the Strengths and Difficulties Questionnaire (SDQ) when their child was 5 years of age, along with reporting their child's sport participation. Children ( $n = 13,470$ ) who took part in sport beyond the school

setting had fewer emotional, conduct, peer, and hyperactivity problems, and more pro-social behaviours (Griffiths et al., 2010). However, the remaining four studies in Hinkley's systematic review, which considered active play or other active behaviours as physical activity indicators, reported null associations between physical activity and psychological well-being (Fagot & O'Brien, 1994; Lindsey & Colwell, 2003; Yu et al., 2010; 2012).

Although the findings from the above-mentioned studies are not conclusive, the positive association between engaging in higher levels of physical activity and improved HRQOL are not surprising, as children who are more active are less likely to report physical limitations in basic daily activities such as walking or playing (Gopinath, Hardy, Baur, Burlutsky, & Mitchell, 2012). Preschool-aged children (i.e., children 2.5-5 years) who are overweight or obese have been found to have significantly lower HRQOL scores compared to preschoolers of healthy weight, particularly in the physical functioning health domain (Kuhl, Rausch, Varni, & Stark, 2012). The excess weight these preschoolers carry may cause them to have more difficulty running, walking, participating in group sports, and lifting heavy objects (Cockrell Skinner, Perrin, & Steiner, 2010). As well, the social aspect of being active creates a link between activity participation and increased social reinforcement and desirability (Nieman, 2002). By being active within a group setting, children learn to cooperate, and work as a team in order to achieve a common goal (Taras, 2005). Children that are physically inactive are more likely to self-report feelings of loneliness and shyness, which affects their HRQOL score (Page & Tucker, 1994). Not being able to engage in group activities also makes preschool-aged children easy targets to be teased by their peers, which significantly affects their emotional and social functioning (Kuhl et al., 2012).

There have been many studies that document reduced HRQOL in adults and school-aged children in everyday life; however, there is less research in the preschool population. More specifically, while Kuhl et al. (2012) explored the association between obese preschoolers and HRQOL, there is a dearth of research exploring the relationship between physical activity participation and HRQOL among healthy preschoolers. It is well established in the literature that health habits formed in the early years of life carry forward into adulthood, which is why the preschool years represent an optimal time to intervene and institute healthy patterns (Guo et al., 1994). Having a higher quality of life in early childhood has been associated with preschoolers' positive social, emotional, and behavioural outcomes during later childhood (McCabe & Altamura, 2011; Sanson et al., 2009), as well as being inversely correlated with later depression, hostile behaviour, and aggressive interpersonal behaviour (Jones, Brown, & Aber, 2011; Meagher, Arnold, Doctoroff, Dobbs, & Fisher, 2009; Toumbourou, Williams, Letcher, Sanson, & Smart, 2011). By raising awareness about the impact physical activity has on preschoolers' immediate and future HRQOL, childcare practitioners, early learning stakeholders, policy makers, as well as parents, may be motivated to get preschool-aged children more active. Not only could physical activity interventions potentially serve to decrease obesity levels in this young cohort, but they could also improve overall HRQOL.

### **Recommended Levels of Physical Activity and Sedentary Behaviour**

To achieve the many health benefits associated with an active lifestyle, practitioners encourage preschoolers to engage in activity levels in line with the Canadian Physical Activity Guidelines for the Early Years. This guideline is an evidence-based recommendation built on literature that clearly demonstrates the need for children to incorporate physical activity into their daily lives (Tremblay et al., 2012a). According to these guidelines, preschoolers (aged 3-4 years)

should accumulate 180 minutes of physical activity at any intensity throughout the day (Tremblay et al., 2012a). Preschoolers' activities should help develop their motor skills, and progress towards 60 minutes of moderate-to-vigorous intensity physical activity (MVPA) as they near 5 years of age.

Sedentary behaviour, which is separate and distinct from simply a lack of physical activity, refers to “any waking behaviour in which an individual is expending less than 1.5 metabolic equivalents (METs) of energy while in the sitting or reclining position” (e.g., watching television, sitting, travelling; Sedentary Behaviour Research Network, 2012). In 2012, the Canadian Society for Exercise Physiology (CSEP) released the first Canadian Sedentary Behaviour Guidelines for the Early Years (aged 0-4) which recommends children aged 2-4 years limit their screen time to one hour per day (Tremblay et al., 2012b), and suggests avoiding prolonged sitting for more than one hour at a time.

In order to develop a healthy heart, lungs, and muscles, and to maintain a healthy body weight, young children need to meet the physical activity recommendations (Timmons et al., 2007) and avoid being sedentary for extended periods of time (Tremblay et al., 2012b). Although the health benefits associated with participating in regular physical activity are well known, there are still an alarming number of preschool-aged children who do not meet the minimum requirements for daily physical activity (Fisher et al., 2005; Pate, McIver, Dowda, Brown, & Addy, 2008; Temple et al., 2009; Tucker, 2008; Vanderloo et al., 2014), and who are extremely sedentary (Tremblay et al., 2012b; Vanderloo et al., 2014).

Unfortunately, many parents are under the impression that their preschoolers are achieving the recommended levels of physical activity required to receive health benefits (Sacheck et al., 2011). Moreover, parents have repeatedly expressed their reliance on childcare

staff and organized sports to provide their preschooler with the opportunity to be active, and accumulate the recommended 180 minutes of daily activity (Sacheck et al., 2011; Tucker, Irwin, Sangster Bouck, He, & Pollett, 2006). Yet, even when preschoolers and children are taking part in structured activities, such as soccer, dance, and physical education classes, they are not active for the entire duration of the structured activity. In one American study, children ( $n = 111$ ,  $M_{\text{age}} = 9.1$ ) who participated in a 50-minute session of soccer only accumulated 24% of the previously recommended 60 minutes of MVPA, and spent 49% of the match engaged in sedentary activity (Sacheck et al., 2011). In a softball practice, only 2% of children reached the recommended physical activity guidelines (Sacheck et al., 2011). Enrolling young children in organized sports provides them with an excellent opportunity to be physically active; however, preschoolers need to be afforded multiple opportunities to engage in active play everyday (inclusive of the daycare environment).

### **Physical Activity Levels of Preschoolers**

The preschool population has been identified as an extremely important cohort to study, as health habits established in the early years of life serve as both a protective and preventative measure to avoid negative health outcomes in childhood and beyond (Campbell & Hesketh, 2007). Seven Canadian studies have been published to date, which explore the physical activity levels of preschoolers (Colley et al., 2013; Goldfield et al., in press; Obeid, Nguyen, Gabel, & Timmons, 2011; Temple et al., 2009; Tucker & Irwin, 2008; Vanderloo et al., 2014; 2015). For example, Tucker & Irwin (2008), assessed the physical activity levels of preschoolers in London, Ontario through parent reports ( $n = 140$ ), and found only 55% of participants engaged in 60 minutes of daily physical activity. This is disheartening given that studies that typically rely on parental report have the tendency to overestimate preschoolers' physical activity levels,



suggesting activity levels may be even lower than previously reported (Bates, 2006; Pate et al., 2008).

In contrast, and in order to achieve more valid estimates, Colley et al. (2013), used Actical accelerometers for 7 consecutive days (with a 60 second epoch length) as part of the Canadian Health Measures Survey (CHMS), which provides a nationally representative snapshot of Canadian preschoolers' ( $n = 459$ ) physical activity levels. Colley and colleagues reported 84% of their 3-4 year-old participants met the recommended 180 minutes of daily activity over the 7-day span; however, only 14% of 5-year-old children accumulated at least 60 minutes of MVPA (the guideline changes at age 5). Using similar methods (accelerometers – Actigraph), Obeid et al. (2011), found that 30 preschoolers in Hamilton, Ontario accumulated on average, 220 minutes of total physical activity (TPA) per day, but most of this time was spent engaged in light physical activity (LPA). Different epoch sampling intervals were also used in this study, and highlighted that, compared with a 3-second epoch, sampling intervals of 15, 30, and 60 seconds resulted in more than 10 minutes of missed MVPA daily. The use of different epoch lengths, as well as different tools (i.e., Actical versus ActiGraph accelerometers) to assess the physical activity levels of preschoolers may help explain the discrepancies in the literature regarding preschool-aged children meeting the recommended 180 minutes of daily activity (Vanderloo, D'Alimonte, Proudfoot, Tucker, & Timmons, 2016), but also makes comparisons across studies challenging.

Within the childcare setting, the rates of physical activity have been less in line with daily recommendations. Three studies have objectively explored Canadian preschoolers' activity levels. The first study, which used Actical accelerometers ( $n = 65$ ), was conducted with preschoolers enrolled in family childcare. Temple and colleagues revealed that MVPA as well as TPA levels were alarmingly low in this setting (Temple et al., 2009), as preschoolers participated

in an average of 1.76 min/hr of MVPA and 20.83 min/hr of TPA, and accumulated a concerning average of 39.49 min/hr of sedentary time during childcare hours (~ 7 hours). More recently, Vanderloo et al. (2014) found that children attending centre-based childcare engaged in, on average, 1.54 min/hr of MVPA, and 17.42 min/hr of TPA, accumulating to 132.60 min of daily TPA. This is far below the Canadian Physical Activity Guidelines for the Early Years (CSEP, 2012). Comparing the physical activity levels of preschoolers ( $n = 297$ ) in three different early learning environments (center-based childcare, home-based childcare, and full-day kindergarten), Vanderloo et al. (2015) reported that preschoolers attending centre-based childcare were the least active in terms of MVPA compared to the other two settings during daytime hours (1.58 min/hr, 1.75 min/hr, and 3.33mins/hr respectively). Preschoolers' mean TPA levels (mins/hr) were 18.36 for centre-based childcare, 19.28 for home-based childcare, and 20.31 for full day kindergarten. While the activity levels of preschoolers within the three different early learning environments were similar, it is clear that those children attending centre-based childcare are the highest risk for inactivity. As indicated above, inconsistent results have been found regarding the accumulation of physical activity levels within preschool population; however, it should be noted that the majority of studies support levels of physical activity below the recommended physical activity guidelines for the early years.

### **Sedentary Behaviours of Preschoolers**

Although there is only a small body of literature in this evolving field, accumulating evidence has indicated that approximately 80% of preschoolers' waking hours are spent being sedentary (Reilly et al., 2004; Vale, Silva, Santos, Soares-Miranda, & Mota, 2010; Tucker, Vanderloo, Burke, Irwin, & Johnson, 2015). As well, using the results from CHMS (as described above), Colley and colleagues (2013), reported that only 18% of 3-4 year olds ( $n = 459$ ) in their

study met the screen time guidelines of less than one hour per day. This is concerning, as growing research in this field suggests that sedentary behaviours are linked to decreased fitness, pro-social behaviours, self-esteem, and academic achievement (Tremblay et al., 2012b). The high levels of sedentary behaviour have also been recognized in childcare centres. In fact, Temple et al. (2009), and Vanderloo and colleagues (2014) found that preschoolers engaged in an average of 39.49 and 40.64 min/hr of sedentary activity respectively. Tucker and colleagues (2015) assessed the sedentary behaviours of preschoolers in three early learning programs (full-day kindergarten, centre-, and home-based childcare facilities) and revealed that in all three environments, preschoolers spent the majority of their time engaged in sedentary behaviour (39.68mins/hr, 41.62mins/hr, and 40.72mins/hr, respectively). Just as physical activity habits established during the early years of life have the potential to track over time, sedentary behaviours formed during the preschool years may also carry forward into adulthood (Janz, Burns, & Levy, 2005), which is why it is essential to adopt appropriate sedentary behaviours from a young age.

### **The Childcare Environment**

Due to changes in demographics, family structure, gender roles, and economic prosperity over the past 35 years in Canada, more women are working outside of the home, which has resulted in an increased need for childcare for preschool-aged children (Story, Kaphingst, & French, 2006). Approximately 80% of Canadian preschoolers attend some form of childcare, for on average, 29 hours per week (Cleveland et al., 2008). Since preschoolers spend a large proportion of their day in the childcare setting, parents tend to rely on the childcare staff to ensure their children accumulate the recommended amount of daily activity (Tucker et al., 2006). Unfortunately, physical activity levels within centre-based childcare facilities are alarmingly low

(Pate et al., 2004; Vanderloo et al., 2014) and sedentary time is extremely high (Vanderloo et al., 2014). Brown et al. (2002), reported that approximately 89% of a preschoolers' day is spent being sedentary (e.g., sitting).

Centre-based childcare facilities are acknowledged as an important venue, which strongly influence preschooler's physical activity levels and sedentary time. Specifically, the policies and practices, as well as the physical design and equipment within a childcare center in which preschoolers attend are important factors influencing preschoolers' physical activity levels and sedentary time, and hence, their overall health (Trost, Ward, & Senso, 2010; Vanderloo et al., 2014). Finn, Johannsen, and Specker (2002), and Pate and colleagues (2004), found that the physical activity levels of preschoolers were strongly influenced by the specific preschool attended. In fact, Pate et al. (2004) suggested that close to 50% of the variance in preschoolers' physical activity could be accounted for by the individual childcare facility. Follow-up studies revealed that the quality of the play equipment (Boldemann et al., 2006), as well as the education of the childcare teachers were strongly associated with the physical activity levels of the preschoolers (Dowda, Pate, Trost, Almeida, & Sirard, 2004). Various other characteristics such as the time dedicated towards structured play, gross motor equipment available (e.g., balls, ropes, pavement markings, etc.), sufficient play space, and resources provided to childcare providers all contribute to the success of promoting physical activity within the childcare environment (Cardon, van Cauwenberghe, Labarque, Haerens, & De Bourdeaudhuij, 2008; Dowda et al., 2004; Hannon & Brown, 2008; Pate, McIver, Dowda, Brown, & Addy, 2008). The high attendance rates in childcare facilities, coupled with the low physical activity and high sedentary time attests to the importance of implementing health promotion activities in this environment.

### **Evidence for Intervention**

In 2013, Gordon, Tucker, Burke, and Carron conducted a meta-analysis which identified the effectiveness of physical activity interventions on preschoolers' overall physical activity and their MVPA. In total, 15 independent studies met the inclusion criteria, comprising a total of 2,618 preschoolers between the ages of 2.6 and 5.5 years, and were conducted in the United States, Scotland, Australia, Belgium, and Israel. The interventions had a small-to-moderate effect on their overall physical activity behaviours, and a moderate effect for MVPA levels (Gordon et al., 2013). This meta-analysis also highlighted the vital role that the location of the intervention had on increasing preschoolers' physical activity. Specifically, interventions located in the early-learning environment (e.g., childcare centres) had a moderate effect on preschooler' MVPA, whereas those interventions which were home-based had a small negative effect on preschooler's MVPA levels (Gordon et al., 2013). Gordon and colleagues (2013), also noted the heightened success of interventions that included environmental changes (i.e., the introduction of play equipment), compared to those which only focused on offering planned physical activity, and those that included physical activity plus education.

Most recently, Goldfield and colleagues (in press), conducted a parallel group cluster randomized control trial (RCT) in six childcare centres to assess the effectiveness of training childcare providers to increase the physical activities levels of children in their care. The staff received two 3-hour train-the-trainer workshops and a manual which contained information pertaining to increasing structured and unstructured physical activity through active play during childcare hours. Measured with Actical accelerometry, the overall physical activity levels of preschoolers in the intervention groups demonstrated a greater increase in minutes per day of activity during childcare hours only (148.8 to 168.2,  $p = .001$ ) compared to the three childcare

centres in the control group (162.9 to 159.8,  $p = .486$ ). As well, the intervention group showed a greater reduction in body fat percentage compared to the control group (Goldfield et al., in press).

Due to preschoolers' low levels of physical activity (Vanderloo et al., 2014; 2015), and the many negative health outcomes associated with being inactive (Timmons et al., 2007), physical activity interventions should be established for this population. Supported by the work of Gordon et al. (2013), and Goldfield et al. (in press), interventions for preschool-aged children have been effective, and these studies support childcare as an appropriate venue to facilitate increased levels of physical activity participation.

### **Purpose of Study**

Many preschool-aged children are enrolled in centre-based childcare, and spend upwards of 7.5 hours in this setting each day. Preschoolers' alarmingly low levels of physical activity within centre-based childcare facilities (Vanderloo et al., 2014; 2015) are extremely concerning given that physical activity has been shown to provide numerous physical as well as psychological health benefits (Timmons et al., 2007). Despite the recognition of the important influence of physical activity participation on HRQOL among older children (Bock et al., 2014) and preschoolers in other parts of the world (Wang et al., 2008), no such work has been undertaken among a Canadian preschool sample. As such, the primary purpose of this study was to determine the impact of an 8-week childcare physical activity intervention (the Supporting Physical Activity in the Childcare Environment [SPACE] study) on preschoolers' HRQOL. It was hypothesized that preschoolers assigned to the experimental condition (and therefore receiving the intervention) would engage in higher levels of physical activity and consequently display an increased HRQOL from pre- to post-intervention compared to preschoolers who were

assigned to the control group (and therefore did not receive the intervention). This paper will only report and comment on the analysis of the HRQOL data; a full report of the SPACE study and main findings of physical activity data will be published elsewhere.

## Chapter 2: Methods

### Study Design and Recruitment

A parallel clustered RCT was undertaken to evaluate the effectiveness of the SPACE intervention at improving preschoolers' HRQOL. Because it is not possible to offer a childcare-based intervention to some children at a facility and not others, instead of randomizing individual preschoolers, groups of preschoolers (i.e., childcare centres) were randomized to either the experimental or control condition. Facilities were randomly selected from an online document, which lists the City of London's licensed childcare centres ( $n = 69$ ). Before randomization, six centres were omitted from the list as they were French daycares, and did not meet our inclusion criteria. Using Microsoft Excel, a vector of random numbers was generated and used to randomly select childcare centres to participate in the study. Once a facility was selected, the project coordinator contacted (via phone) the centre and invited participation after explaining the nature of the study. If a centre agreed (60% agreement rate) to participate in the study, a third-party allocation protocol was followed to randomly assign the clusters into the two conditions. In total, 37 childcare centres were contacted by the project coordinator. Of the 37 centres contacted, 10 declined participation, three did not respond, and two were not eligible (i.e., childcare centre location/layout not suitable for intervention), leaving 22 centres to be included in the SPACE study. Research Randomizer ([www.randomizer.org](http://www.randomizer.org)) was used to allocate the centres into two equal groups of 11 using a blocked design. The website generated a number (either 0 or 1) and based on the number produced, the centre was assigned to either the control (i.e., 0) or the experimental (i.e., 1) group. Random allocation of participating centres was conducted prior to individual recruitment of participants (i.e., preschoolers). A single-blinded study design was utilized in which the research assistants collecting the data were unaware of the



group assignments. The Health Sciences Research Ethics Board at The University of Western Ontario approved all study procedures and related documents (Appendix A).

### *Sample size*

A sample size calculation was undertaken, based on the primary research question of the SPACE study, to examine the impact of the intervention on preschoolers' physical activity levels. A recent meta-analysis exploring the effectiveness of physical activity interventions in the preschool population reported a small-to-moderate effect for change in preschoolers' TPA level after participating in an intervention (Gordon et al., 2013). More specifically, assuming a small-to-moderate effect with the SPACE study, a power level of 0.8, and an alpha of .05, 83 participants per group were required without accounting for the study-design effect. Adjusting for the clustering effect of an average cluster size of 16 children is  $1+0.05(16-1) = 1.75$ . Therefore, the sample size of each group was inflated to  $83 \times 1.75 = 145$ . Previous interventions in this population have been shown to have loss to follow-up rates of 20% (Reilly et al., 2006), therefore, a minimum of 174 preschoolers per group were recruited to participate. The final targeted sample size was 348 preschoolers. With the average preschool-classroom size in London being 16 children, 22 childcare centers were included (i.e., 11 experimental and 11 control). Individual children were recruited from participating childcare facilities in London, Ontario after random allocation of childcare centres took place. While the above sample size calculation was not completed for the HRQOL research question, in the interest of being thorough and transparent, the SPACE sample size calculation is provided.

### ***Participant Consent***

A letter of information (Appendix B) and consent form (Appendix C) were provided to all potential participants prior to the commencement of the study. Interested parents/guardians were required to sign the consent form on behalf of their preschooler. Parents/guardians received a letter of thanks (Appendix D and E), along with a token of appreciation (\$10 gift certificate to a local grocery store) after each data collection period (i.e., baseline, post-intervention) to acknowledge their preschooler's participation.

### ***Inclusion criteria***

Randomly selected childcare centres were included if they: a) provided centre-based childcare in London, Ontario; b) had at least one preschool classroom in which childcare providers were willing to participate; and c) were an English speaking facility. The inclusion criteria for participants were as follows: a) child between the ages of 2.5 and 4 years at baseline; b) enrolled in a preschool classroom of a participating centre-based childcare facility; c) the parents of the participant could read and write in English; and d) the child received parental consent.

### **The SPACE Intervention**

The 8-week evidence-based SPACE intervention aimed to improve the physical activity levels of preschoolers attending centre-based childcare in London Ontario. Based on previous literature, researchers have identified that preschoolers are more active outdoors (Hinkley, Crawford, Salmon, Okley & Hesketh, 2008; Vanderloo et al., 2014) with higher levels of activity occurring the first 10 minutes of outdoor play (Alhassan et al., 2012), and interventions that targeted the addition of play equipment and staff training were the most effective (Ward, Vaughn, McWilliams, & Hales, 2012). As such, the SPACE study was designed to include these

key components. The intervention was registered and assigned an International Standard Randomized Controlled Trial Number (ISRCTN70604107).

***Experimental Condition:*** The centre-based childcare facilities randomly assigned to the experimental condition adopted the SPACE intervention which comprised three main components. These elements aimed to promote physical activity participation and included: environmental modifications, staff training, and curriculum changes.

*Environmental modifications* included the addition of new portable play equipment (e.g., balls, hula-hoops, obstacle course, hop scotch mat, etc.). Increasing the portable equipment compliment at childcare facilities has been shown to increase physical activity behaviours of preschoolers in previous studies (Cardon et al., 2008; Vanderloo et al., 2014). All equipment was available for the duration of the SPACE intervention, and the childcare centres kept the equipment after the study concluded. Childcare staff were asked to rotate the equipment each week to keep the children interested in using the pieces.

*Curriculum modifications* were administered to target both indoor and outdoor active play. Currently in Ontario, children are provided two 60-minute outdoor play periods (weather permitting) every day (Day Nurseries Act, 1990). However, research suggests that preschoolers are the most active during the first 10 minutes of outdoor play (Alhassan et al., 2012; McKenzie et al., 1997). As such, preschoolers in the experimental condition received four 30-minute outdoor play periods, instead of the prescribed two 60-minute sessions. Indoor curriculum modifications included bringing in a trained guest fitness instructor for one 30-minute session to encourage the preschoolers to be active while indoors and show the staff different activities they could adopt within the confines of their centre.

*Staff Training* was led by members of the research team, as well as a physical activity specialist. The information presented during the training session included: Canada's Physical Activity and Sedentary Behaviour Guidelines; the need for shorter bouts of activity (i.e., providing more opportunities for activity, but for shorter time periods); incorporating physical activity into indoor curriculum; and overcoming obstacles preventing children from being active in the preschooler setting (e.g., weather). Childcare directors and staff received one 4-hour information session provided as an evening workshop.

***Control Condition:*** The childcare facilities randomly assigned to the control condition did not make any changes to their day-to-day activities for the duration of the study. At the completion of the SPACE study (i.e., after the conclusion of the 12-month follow-up), the childcare facilities allocated to the control condition will be provided with the opportunity to receive the intervention training and resources if they chose.

### **Instruments and Tools**

*The Pediatric Quality of Life Inventory 4.0 (PedsQL 4.0) – Short Form.* This 15-item tool is a reliable and valid measure of HRQOL for the preschool population (aged 2-4 years), and measures young children's HRQOL in four domains: physical (5 items), social (4 items), emotional (3 items), and school functioning (3 items; Varni et al., 2009). Questions specially inquire about problems related to child health, activities, feelings, getting along with others, and school functioning. The tool was specifically designed to measure the core health dimensions outlined by the World Health Organization and can be used with healthy children as well as those with acute and chronic conditions. For young children, parents are asked to complete the inventory as proxies, and items are rated on a 5-point Likert scale to indicate how much the child has problems with various areas of functioning. The items are combined to generate 3 subscale

scores (i.e., Physical Health Summary Score, Psychosocial Health Summary Score [inclusive of social, emotional, and school functioning], and Total Quality of Life Score (generated by summing the Physical and Psychosocial Health Summary Scores). This tool has an extremely minimal response burden as questions are written at a third- to sixth grade reading level, and the entire questionnaire takes < 4 minutes to complete (Hullman, Ryan, Ramsey, Chaney, & Mullins, 2011). Varni et al. (2001), administered the questionnaire to 1,677 participants, and reported that the tool had strong internal consistency reliability for the Total HRQOL ( $\alpha = 0.90$ ), Physical Health Summary Score ( $\alpha = 0.88$ ), as well as the Psychosocial Health Summary Score ( $\alpha = 0.86$ ). In the present study, parents/guardians of preschoolers' in both the experimental and control condition were asked to complete the paper and pencil parent-report PedsQL 4.0 Short Form questionnaire (Appendix F) both pre- (i.e., baseline) and post-intervention (i.e., week 8).

Parents' responses on the Pediatric Quality of Life Inventory 4.0 were tallied using a scoring protocol (Appendix G) created by the tool's developers (Varni & Limbers, 2009). The data from the four dimensions were transformed from a 5-point Likert scale ranging from 0 (never) to 4 (almost always), to a scale from 0-100. The 15 items were reversed scored and linearly transformed to a 0-100 scale as follows: 0=100, 1=75, 2=50, 3=25, 4=0. A Physical Health Summary Score was calculated by summing the physical functioning items. Also, a Psychosocial Health Summary Score was calculated by dividing the sum of the items (social, emotional, and school functioning) by the number of questions answered in the three domains of emotional, social, and school functioning scales. An overall HRQOL score was determined by summing all of the items over the number of items answered in each dimension combined. To compute the individual scale scores (e.g., Physical Health Summary Score), 50% or more of the items in each scale needed to be completed in order to compute the respective scale score (i.e.,

physical, psychosocial, total). If 50% or more items were completed in a specific scale, then the mean of the completed items were used to compute the scale score. If a parent/guardian completed less than 50% of the items within a scale, then a scale score was not produced. Higher scores indicate a better HRQOL.

*Parent/Guardian Demographic Questionnaire.* This questionnaire (Appendix H) was completed by parents/guardians of preschoolers at baseline to gather information regarding potential correlates of preschoolers' physical activity (e.g., hours spent in childcare, time spent engaging in extracurricular activities, family income, parent education levels, as well as parental physical activity behaviours) and demographic information (e.g., their child's sex, age, ethnic origin).

All data collection took place between March and September 2015. Once consent was obtained, all participants were provided a unique identifier code which was used to match individual baseline responses on the parent demographic questionnaire and the Pediatric Quality of Life Inventory with post-intervention measurements. The tools were dropped off at the childcare centres for completion at baseline, approximately one week prior to the intervention initiation. Just prior to completion of the intervention, research assistants again dropped off questionnaires for all participating preschoolers. Research assistants kept track of all participants which had outstanding questionnaires and made frequent visits to the childcare centres in order to pick up remaining questionnaires which were returned after the data collection period.

### **Data Analysis**

All statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) program (version 23). To explore differences among participants at baseline, an independent-samples t-test was run to compare HRQOL subscale scores (i.e., physical,

psychosocial, and total) for the control and experimental group. Although there were no significant differences at baseline between groups, there may be subtle group differences that could affect post-intervention HRQOL scores. As such, three univariate analyses of covariance (ANCOVA) were completed (one for each subscale) in order to determine the impact of the 8-week childcare-based physical activity intervention on preschoolers' HRQOL. Specifically, this method allows for a comparison at post-intervention between the control and intervention group, while using the pre-intervention score as the covariate to eliminate systematic bias and reduce within group variance (Stevens, 1996). Covarying out the baseline score (e.g., baseline measurement) allows for the determination of the sole effect of the intervention. As part of the ANCOVAs, Levene's test was also run for each subscale in order to explore if the two groups had equal variances post-intervention.

### Chapter 3: Results

#### Participant Demographics

In total, 336 parents/guardians provided consent for their preschooler and were enrolled in the SPACE study; however, only 201 preschoolers ( $M_{age} = 40.27$  months;  $SD = 7.52$ ; 103 males) from the 22 childcare centres had complete survey data at both time points (i.e., baseline and week 8) and were retained for the HRQOL analyses. Of the participants included, 73.1% of children spent 30 or more hours per week enrolled in childcare, and 67.2% of parents/guardians perceived their preschooler as being 'very active' (while 30.8% reported their preschooler being 'somewhat active'). See Table 1 and Table 2 for complete participant and family demographic information.

#### Preschoolers' HRQOL – Physical Health Summary Score

Means and standard deviations for participants Physical Health Summary Score at baseline and post-intervention are shown in Table 3. There was a large degree of variance in preschoolers' Physical Health Summary Score at baseline in both groups ( $SD_{control} = 10.94$ ;  $SD_{intervention} = 14.68$ ), but the difference between groups at baseline was not significant  $t(201) = .773, p = .441$ . Across both groups, preschoolers were relatively healthy in terms of physical functioning, as the mean baseline Physical Health Summary Scores were above 90 out of a possible 100. The variance across groups post-intervention, as calculated by Levene's Test of Equality of Error Variance was not significant,  $F(1, 201) = 1.347, p = .247$ . After controlling for the participants pre-intervention Physical Health Summary Score, there was not a significant effect of group assignment on participants post-intervention Physical Health Summary Score,  $F(1, 201) = .618, p = .433$ .



**Preschoolers' HRQOL – Psychosocial Health Summary Score**

Means and standard deviations for participants Psychosocial Health Summary Score at baseline and post-intervention are shown in Table 3. While preschoolers in the control group had a higher psychosocial score at baseline compared to preschoolers in the experimental group, this difference was not significant  $t(201) = 1.36, p = .176$ . The variance across groups post-intervention, as calculated by Levene's Test of Equality of Error Variances was not significant,  $F(1, 201) = .675, p = .412$ . There was a significant effect of group assignment on preschoolers' post-intervention Psychosocial Health Summary score after controlling for participant's baseline score  $F(1, 201) = 3.850, p = .05$ , with participants in the control condition reporting a notably higher psychosocial health score, compared with their experimental counterparts.

**Preschoolers' HRQOL – Total HRQOL Score**

On average, participants in the control group had higher baseline total HRQOL score compared to the experimental group, but this difference was not significant  $t(201) = 1.29, p = .197$ . Overall, preschoolers' Total HRQOL decreased in the intervention group, but increased in the control group from baseline to post-intervention (see Table 3 for means and standard deviations). The variance across groups post-intervention, as calculated by Levene's Test of Equality of Error Variances, was non-significant  $F(1, 201) = 1.690, p = .195$ . There was no significant effect of group assignment on participant's Total HRQOL Score post-intervention after controlling for participants' baseline scores,  $F(1, 201) = 2.712, p = .101$ .

**Table 1***Preschooler Participants' Demographic Information (N = 201)*

	<i>N</i>	<i>%</i>
<b>Sex</b>		
Male	103	51.2
Female	98	48.8
<b>Child's racial or ethnic background</b>		
Caucasian	154	76.6
African Canadian	3	1.5
Native/Aboriginal	4	2.0
Arab	4	2.0
Latin-American	4	2.0
Asian	8	4.0
Other	20	10.0
<b>Time spent in childcare per week (hours)</b>		
Less than 10	6	3.0
10 – 19	13	6.5
20 – 29	30	14.9
30 +	147	73.1
<b>Activity level of child</b>		
Somewhat active	62	30.8
Very active	135	67.2
<b>Enrolment in extracurricular activities</b>		
Yes	126	62.7
No	72	35.8

*Note.* Some values shown in the table may not add up to 100% or *N* = 201 as some individuals chose not to answer certain questions.

**Table 2**

<i>Parent/Guardian Family Demographic Information</i>		
	<i>N</i>	<i>%</i>
Family arrangement		
Single-parent household	20	10.0
Double-parent household	169	84.1
Guardian-led	1	0.5
Other	3	1.5
Highest level of education completed		
Elementary school	2	1.0
Secondary school	10	5.0
College	57	28.4
University	73	36.3
Graduate school	52	25.9
Household income		
Less than \$20,000	10	5.0
\$20,000 - \$39,999	12	6.0
\$40,000 - \$59,999	13	6.5
\$60,000 - \$79,999	12	6.0
\$80,000 - \$99,999	15	7.5
\$100,000 - \$119,999	20	10.0
\$120,000 - 149,999	21	10.4
More than \$150,000	57	28.4
Parent/Guardian physical activity levels per week		
Less than 30 minutes	23	11.4
30 - 59 minutes	36	17.9
60 - 89 minutes	35	17.4
90 - 119 minutes	34	16.9
120 - 149 minutes	23	11.4
150 minutes or more	46	22.9

*Note.* Some values shown in the table may not add up to 100% or  $N = 201$  as some individuals chose not to answer certain questions.

**Table 3**

*Means and Standard Deviations of HRQOL Subscale and Total Scores at Baseline and Post-Intervention*

	Intervention		Control	
	<i>n</i> = 125		<i>n</i> = 77	
	Baseline	Post- Intervention	Baseline	Post- Intervention
	<i>M (SD)</i>		<i>M (SD)</i>	
Physical Functioning	90.32 (14.68)	89.84 (11.25)	91.82 (10.94)	91.62 (11.43)
Psychosocial Functioning	78.61 (12.35)	77.68 (11.73)	81.04 (11.15)	81.66 * (10.70)
Total HRQOL	84.57 (11.53)	83.83 (9.69)	86.60 (9.36)	86.71 (8.96)

*Note:* HRQOL = health-related quality of life; *M* = mean; *SD* = Standard Deviation.  $p < .05$ ; no significant difference existed between groups at baseline.

#### **Chapter 4: Discussion**

The purpose of this study was to explore the impact of an 8-week childcare-based physical activity intervention (the SPACE Study) on preschoolers' HRQOL. Specifically, this research sought to examine if preschoolers, exposed to the 8-week intervention, had improved HRQOL (Physical Health, Psychosocial Health, and Total) compared to those preschoolers assigned to the control group (and asked to continue with their regular daily activities). Given the strong link between physical activity and other health related benefits (e.g., physiological, psychological, cognitive, academic; Donnelly et al., 2009; Hill, Williams, Aucott, Thomspn, & Mon-Williams, 2011; Reed et al, 2010; Shephard, 1996) it stood to reason that intervening to support improved physical activity behaviours among young children would result in improved HRQOL scores.

Despite the success of the SPACE intervention at increasing preschoolers' MVPA levels during childcare hours (full results to be published elsewhere), this study found no evidence that the introduction of a physical activity intervention leads to significant improvements in HRQOL. Although the SPACE intervention was not specifically designed to improve preschoolers' HRQOL, as mentioned, physical activity offers many health benefits, and therefore, the results of this study were rather surprising. The mean HRQOL of the preschoolers who received the SPACE intervention actually decreased (slightly) from baseline to 8-weeks follow-up across all three subscales of the Pediatric Quality of Life Inventory. Those preschoolers who were in the control group and asked to maintain their current schedule and activities also had a decreased score for their physical functioning, but increased their psychosocial functioning and total HRQOL post-intervention. However, none of these results were statistically significant.

The relationship between physical activity and HRQOL has been predominantly explored in adult populations with chronic conditions and various health impairments (Bize, Johnson, & Plotnikoff, 2007; Penedo & Dahn, 2005). As such, comparisons across studies are rather difficult. Far less is known about HRQOL in preschoolers, only a few studies have used this tool to explore HRQOL among this cohort. Specifically, Sundberg, Sand, and Forsander (2015), compared only the total HRQOL score (measured via Peds QoL 4.0) of children under 5 years of age with and without type 1 diabetes, and found that healthy children scored a 93 on the questionnaire ( $SD = 4.4$ ) compared to 79 ( $SD = 13$ ) for those with diabetes. Out of a possible score of 100, participants in the present study had mean baseline scores of 91.83 for physical functioning, 81.04 for psychosocial functioning, and 86.60 as a total HRQOL score. This suggests that the baseline scores for participants in the current study are in line with previous research, and that parents perceive their preschoolers to have a high HRQOL. Moreover, Wang and colleagues (2008), using a Japanese version of the Dartmouth Primary Care Cooperative Project charts, with healthy children found that 94.3% of participants in their study had a HRQOL score which was reported to be average, good, or very good; again, indicating that healthy children report a high HRQOL.

In light of these high HRQOL scores, starting with an initial sample of (seemingly) healthy preschoolers makes it challenging to make and measure improvements in HRQOL. There is potential for dramatic ceiling effects when observing the change in HRQOL data, limiting the ability of the questionnaire to demonstrate any improvement after an intervention. If subjects are already scoring close to 100% at baseline, then the scale is unable to measure any improvement from pre- to post-intervention. Klassen and colleagues (2003) reported that 85.8% of healthy preschoolers (aged 3-4 years) in their study had a score of 100% for physical

functioning at baseline measurement, leaving no room for improvement. In contrast, cardiac rehabilitation programs have reported significant improvements in HRQOL following exercise, as patients are starting from a much lower point on the HRQOL scale (i.e., physical functioning = 70.7; mental functioning = 59.0; social functioning = 56.4; general health = 58.3), leaving more room for improvement (Berkhuysen et al., 1999; Willenheimer et al., 1998). Initial scores of HRQOL in the current study across all three subscales were extremely high, and therefore, it is possible that the post-intervention scores were influenced by a ceiling effect.

For those preschoolers assigned to both the experimental and control condition of the SPACE study, their Physical Health Summary Score decreased post-intervention. Our results contradict the majority of the literature, which suggests that increased activity levels are associated with improvements in physical functioning (Gu et al., 2016; Penedo & Dahn, 2005). Participation in regular physical activity helps one develop strong bones, strengthen muscles, improves cardiovascular health, as well as protects one from numerous adverse health conditions (Strong et al., 2005; Timmons et al., 2007). For these reasons, physical functioning typically improves with increased physical activity participation. While this was not the case in the present study, it is possible that this contradictory finding was an artefact of a ceiling effect. Given that the baseline Physical Health Summary Scores in for the control and experimental conditions were both above 90, little room is left for improvement. Alternatively, this notion could be a consequence of the measurement tool, in that, the Peds QoL is a proxy report of physical health QoL, and not an assessment of physiological markers or health status.

Given the large body of literature that highlights the effect of increased physical activity on psychosocial functioning (i.e., social and mental functioning; Brown & Blanton, 2002; Fleshner, 2000; Morgan, 1994) it was hypothesized that preschoolers in the intervention group

would improve their Psychosocial Health Summary Score post-intervention. A number of other studies ((Brown & Blanton, 2002; Crews, Lachbaum, & Landers, 2004) suggest improvements in psychosocial functioning as a consequence of improved physical activity. For example, Rank and colleagues (2014) investigated changes in HRQOL, body mass index, physical activity, and sedentary behaviour of 707 overweight and obese individuals 7-20 years of age participating in a 4- to 6-week weight-loss program. Following the 24-month follow-up, the most notable improvement in HRQOL was self-esteem, with physical activity levels positively associated with the increase in HRQOL. As well, Burke et al. (2015) reported following a 4-week lifestyle intervention (e.g., increasing physical activity, improving nutrition) for obese children ( $n = 40$ ,  $M_{age} = 10.6$  years), children's emotional quality of life was significantly higher at 12-months follow-up. In contrast, our findings, similar to the work by Sorenson et al. (1999), and Stanton and Arroll (1996) concluded that despite the intervention's success at increasing physical activity levels, there was no significant improvement in psychosocial functioning following the 8-week intervention. Stanton and Arroll (1996) randomized 219 healthy adults aged 41-50 years in four different intervention groups, and measured the effect of a 1-year exercise and diet intervention program on participant's mental health, quality of life, and self-esteem. Most notably, they concluded that although the exercise and diet intervention was successful at increasing participant's physical activity levels, there was no improvement in their emotional functioning, which is commonly reported as mood state or self-esteem. Similarly, a 6-month intervention conducted by Sorenson et al. (1999) with 177 sedentary, mildly hypertensive volunteers, reported that there was no difference in mood state between the participants who were randomized to an exercise group, compared to the control group. Individuals in the exercise group received three 40-minute exercise sessions a week for 6-months, and although they



reported increased levels of physical activity, there was no significant difference in their psychosocial functioning compared to the control group.

Depending on the population studied, mixed results have been reported for the influence of physical activity on overall/total HRQOL. HRQOL is a subjective construct and presumably affected by a multitude of factors. In the current study, there was no significant increase in the control groups total HRQOL, while the experimental groups total HRQOL decreased slightly. The results of this study may therefore, be perfectly accurate – the increase in MVPA due to the SPACE intervention had no effect on parent/guardian report of their preschoolers' HRQOL, but HRQOL scores were instead influenced by another factor. Alternatively, it is quite possible that parents/guardians simply don't have a good gauge on their child's HRQOL during childcare hours. There are many existing studies in adult populations which also report no improvements in overall HRQOL as a consequence of physical activity participation (Hellenius, Dahlof, Aberg, Krakau, & de Faire, 1995; King, Taylor, & Haskell, 1993; Pierce, Madden, Siegel, & Blumenthal, 1993; Sorensen, Anderssen, Hjermer, Holme, & Ursin, 1999; Stanton & Arroll, 1996). A double blind RCT conducted by Ashley, Lloyd, Lamb, and Bartlett (2001), included 260 sedentary participants ( $M_{age} = 50.5$  years) who were randomized to receive either exercise advice, or exercise advice plus the opportunity to attend a walking group with a structured program and instructor. Physical activity levels as well as HRQOL were measured at baseline, as well as at 6- and 12-months follow-up. Despite the improved physical activity levels of the participants assigned to the walking group, there was no evidence that the experimental groups' increased activity levels led to any significant improvements in HRQOL (Ashley et al., 2001). In contrast, Gu and colleagues (2016) examined the association between physical activity, physical fitness, and HRQOL in 201 healthy school-aged children in the United States and found a

significant positive association among physical activity and HRQOL. Specifically, when path analyses were conducted to evaluate the mediational relationships among physical activity, physical fitness, and HRQOL, steps/minutes emerged as a significant predictor of both physical fitness ( $\beta = .23, p < .01$ ) and increased HRQOL ( $\beta = .19, p < .01$ ). It is clear that additional research is necessary to explore the relationship between physical activity and overall HRQOL, specifically for the preschool population.

Establishing healthy lifestyle behaviours, such as healthy physical activity participation at a young age is extremely important, as behaviours learned during the early years of life tend to be carried forward into adulthood (Campbell & Hesketh, 2007; Guo et al., 1994). In 2008, Wang and colleagues collected survey data from 9,674 Japanese children 3 years of age; measuring lifestyle habits such as sleep duration, physical activity, and dietary patterns. The initial survey data was collected as part of the Toyama Birth Cohort Study, in which questionnaires were sent out to parents of targeted children through local public health centres. A follow-up study was then conducted with the same children during their first year of junior high (age = 12) and revealed that not only were the children's previous lifestyle patterns predictive of their current behaviours, but there was also a positive association between their established behaviours and quality of life (Wang et al., 2008). Quality of life was measured via a Japanese version of the Dartmouth Primary Care Cooperative Project charts, which included a self-administered survey of nine single-item subscales covering separate dimensions of HRQOL (Wang et al., 2008). Since a link between physical activity and HRQOL has been found in older populations, it is possible that this connection could also be made in children under 5 years of age. This research represents the first attempt to explore the relationship between a physical activity engagement and quality of life among young healthy children in Canada. This work is important given

researchers have shown that even children as young as 2 years of age can attain positive health effects from engaging in daily physical activity (Marcus et al., 2000).

### **Limitations and Future Directions**

Although this is the first Canadian study to explore the effect of a childcare-based physical activity intervention on HRQOL, several factors limit the findings and generalizability of this study. Firstly, it is possible that the same parent/guardian of each preschooler may not have filled out the questionnaire at both time points, and this could impact the HRQOL data collected for participants. For example, a child's father may have filled out the survey at pre-intervention, but the mother could have completed the questionnaire 8-weeks later. Inconsistent results have been found in the preschool population as to the correlation of parental reports in regards to children's HRQOL, specifically for non-observable measures (i.e., social and emotional functioning; Eisser & Mores, 2001). The ability of parents/guardians to assess their child's social, emotional, and school functioning was also extremely difficult in our study, as parents/guardians are not always accurate proxies for their children and may not spend a lot of time observing their preschooler during childcare hours. Over 70% of preschoolers in our study spent 30 plus hours in childcare a week, limiting parent's time with their child to observe their overall functioning. Due to the young age of the participants in our current study, parent/guardian proxies were used to elicit information for the participants. These measurements represent an adult's perspective of the child's experiences and are influenced by their relationship to the child (Langaraf & Abetz, 1998). Accuracy of parent proxies poses as a potential issue; because of preschoolers' cognitive immaturity, limited social experience, and continued dependency, they may interpret events differently than adults, and have different priorities than their proxy. Parent proxies have been found to be highly accurate when reporting

their child's observable functioning (i.e., physical HRQOL) but less precise when reporting non-observable functioning (i.e., emotional and social HRQOL); specifically, for healthy children (Eisser & Mores, 2001). HRQOL, is therefore, extremely difficult to measure in this population, as a critical component of the definition of HRQOL is the notion that an individual's *perception* of their HRQOL is unique. As well, parents/guardians were asked to rate their child's problems with "playing with other children", "other kids not wanting to play with him or her", "getting teased by other children", and "doing the same school activities as peers." As parents/guardians are not frequently in the childcare environment interacting with their child, it becomes very difficult for them to comment on their preschooler's functioning in relation to others in this setting. Upon further review of our study, and the Pediatric Quality of Life Inventory 4.0, childcare providers may have been a more logical choice to fill out the survey for each preschool participant, as they spend that majority of the time engaging with the preschoolers during childcare hours. This minor change may have influenced the HRQOL scores.

As well, several constructs (i.e., walking, feeling angry or afraid, doing the same school activities as peers) within the questionnaire were assessed by the use of a single question and may not have been an accurate representation of the construct being studied. Also, most of the data collection was completed in the spring and summer, and therefore, a number of preschoolers were missing at follow-up (~40%). A large proportion of preschoolers' were removed from childcare during the summer months, which impacted the sample of preschoolers' which we had completed questionnaire data for at both time points. Moreover, the sample used in this study was relatively homogenous as seen in Tables 1 and 2 (i.e., Caucasian, highly educated parents, higher income, double-parent household). It is therefore difficult to generalize these results to other preschooler populations.

Finally, it is difficult to determine which specific aspects of the SPACE intervention (i.e., curriculum changes, staff training, and addition of portable play equipment), if any, had an effect on preschoolers' HRQOL. The researchers did not observe the childcare centres for the complete 8-weeks of the intervention to monitor how the intervention was being implemented as directed, and therefore, differences in interpretation, and therefore, implementation, may be noteworthy. One aspect of the intervention required the preschoolers to receive four outdoor play times a day, each for 30-minutes, instead of two 60-minutes session, which is current practice. Staff in the experimental group may not have adapted well to the new schedule put forth by the research team due to the increased interruptions throughout the day, and decided to falter back to their pre-existing schedule occasionally during the 8-week intervention.

### **Conclusion**

Despite the limitations, this is the first Canadian study to assess the impact of an objectively measured physical activity intervention on preschoolers' HRQOL. Notwithstanding the success of the intervention at improving the physical activity levels of preschoolers in the experimental group, no positive impact was made on preschoolers' HRQOL. Although the results of this study were not what was hypothesized, more research is clearly needed to explore the relationship between physical activity participation and HRQOL in healthy preschool populations. Establishing healthy physical activity behaviours from a young age is critical, as lifestyle behaviours (and their associated benefits) tend to track forward into adulthood (Cleveland et al., 2008). The childcare environment represents an ideal (and convenient) environment to intervene and impact preschoolers' behaviours, as a large majority of Canadian children spend their days in centre-based childcare facilities. HRQOL is an important construct to measure in individuals of all ages, because it incorporates an individuals' unique perception of

their physical as well as mental health. Given the infancy, and inconsistency noted in HRQOL among young children, future research should be conducted in order to clarify the link between HRQOL and physical activity in the preschool population.

## References

- Alhassan, S., Nwaokelemeh, O., Mendoza, A., Shitole, S., Whitt-Glover, M., C., & Yancey, A., K. (2012). Design and baseline characteristics of the Short bouts of Exercise for Preschoolers (STEP) study. *BMC Public Health, 12*(1), 582. doi: 10.1186/1471-2458-12-582
- Ashley, A., Llyod, A., Lamb, S., & Bartlett, H. (2001). Is health-related quality of life a suitable outcome measure for evaluating health promotion programmes? *NT Res, 6*(3), 671-681. doi: 10.1177/136140960100600305
- Bates, H. (2006). Daily physical activity for children and youth: A review and synthesis of the literature. Ottawa, Ontario: Canadian Fitness and Lifestyle Research Institute.
- Berkhuysen, M. A., Nieuwland, W., Buunk, B. P., Sanderman, R., Viersma, J., Rispen, P. (1999). Effect of high- versus low-frequency exercise training in multidisciplinary cardiac rehabilitation on health-related quality of life. *J Cardiopulm Rehabil, 19*(1), 22-28.
- Bize, R., Johnson, J. A., & Plotnikoff, R. C. (2007). Physical activity level and health-related quality of life in general adult population: a systematic review. *Preventative Medicine, 45*, 401-415.
- Bock, D. E., Robinson, T., Seabrook, J. A., Rombeek, M., Norozi, K., Filler, G., Rauch, R., & Clarson, C. L. (2014). The health initiative program for kids (HIP Kids): Effects of a 1-year multidisciplinary lifestyle intervention on adiposity and quality of life in obese children and adolescents - A longitudinal pilot intervention study. *BMC Pediatrics, 14*(1), 296. doi: 10.1186/s12887-014-0296-1

- Boldemann, C., Blennow, M., Dal, H., Martensson, F., Raustorp, A., Yuen, K., & Wester, U. (2006). Impact of preschool environment upon children's physical activity and sun exposure. *Preventive Medicine, 42*(4), 301–308. doi: 10.1016/j.ypmed.2005.12.006
- Brown, D., & Blanton, C. (2002). Physical activity, sports participation, and suicidal behaviour among college students. *Medicine & Science in Sports & Exercise, 34*(7), 1087-1096.
- Burke, S. M., Shapiro, S., Petrella, R. J., Iriwn, J. D., Jackman, M., Pearson, E., S., ... Shoemaker, J., K. (2015). Using the RE\_AIM framework to evaluate a community-based summer camp for children with obesity: A prospective feasibility study. *BMC, 2*(21). doi: 10.1186/s40608-015-0050-8.
- Campbell, K. J., & Hesketh, K. D. (2007). Strategies which aim to positively impact on weight, physical activity, diet, and sedentary behaviors in children from zero to five years. A systematic review of the literature. *Obesity Reviews, 8*(4), 327-338.
- Canadian Society for Exercise Physiology. (2013). Canadian physical activity and Canadian sedentary behaviour guidelines. Ottawa: Canadian Society for Exercise Physiology. Retrieved from: [www.csep.ca/guidelines](http://www.csep.ca/guidelines)
- Cardon, G., Van Cauwenberghe, E., Labarque, V., Haerens, L., & De Bourdeaudhuij, I. (2008). The contribution of preschool playground factors in explaining children's physical activity during recess. *International Journal of Behavioral Nutrition and Physical Activity, 5*(11), 1-6. doi: 10.1186/1479-5868-5-11
- Chen, X., Sekine, M., Hamanishi, S., Wang, H., Gaina, A., Yamagami, T., & Kagamimori, S. (2005). Lifestyles and health-related quality of life in Japanese school children: A cross-sectional study. *Preventive Medicine, 40*(6), 668-678.



- Cleveland, G., Forer, B., Hyatt, D., Japel, C., & Krashinsky, M. (2008). New evidence about child care in Canada: Use patterns, affordability and quality. *Institute for Research on Public Policy Choices, 14*(2), 1-44.
- Cockrell Skinner, A., Perrin, E. M., & Steiner, M. J. (2010). Healthy for now? A cross-sectional study of the comorbidities in obese preschool children in the United States. *Clinical Pediatrics, 49*(7), 648-655. doi: 10.1177/0009922810362098
- Colley, R., Garriguet, D., Adamo, K., Carson, V., Janssen, I., Timmons, B., & Tremblay, M. (2013). Physical activity and sedentary behavior during the early years in Canada: A cross-sectional study. *International Journal of Behavioral Nutrition and Physical Activity, 10*(1), 54. doi: 10.1186/1479-5868-10-54
- Cotman, C., Berchtold, N., & Christie, L. Exercise builds brain health: Key roles of growth factor cascades and inflammation. *Trends in Neuroscience, 30*(9), 464-472.  
doi:10.1016/j.tins.2007.06.011
- Crews, D. J., Lochbaum, M. R., & Landers, D. M. (2004). Aerobic physical activity effects on psychological well-being in low-income Hispanic children. *Percept Mot Skills, 98*(1), 319-324.
- Deckelbasum, R. J., & Williams, C. L. (2001). Childhood obesity: The health issue. *Obesity Research, 9*, S239-S243.
- Donnelly, J. E., Greene, J. L., Gibson, C. A., Smith, B. K., Wasburn, R. A., Sullivan, D. K., . . . Williams, S. L. (2009). Physical Activity Across the Curriculum (PAAC): A randomized control trial to promote physical activity and diminish overweight and obesity in elementary school children. *Preventive Medicine, 49*(4), 336-341. doi: 10.1016/j.ypmed.2009.07.022

- Dowda, M., Pate, R. R., Trost, S. G., Almeida, M., & Sirard, J. R. (2004). Influence of preschool policies and practices on children's physical activity. *The Journal of Community Health, 29*(3), 183–196. doi:10.1023/B:JOHE.0000022025.77294.af
- Ebenegger, V., Marques-Vidal, P., Munsch, S., Quartier, V., Nydegger, A., Barral, J., . . . Puder, J. J. (2012). Relationship of hyperactivity/inattention with adiposity and lifestyle characteristics in preschool children. *Journal of Child Neurology, 27*(1), 852-858. doi: 10.1177/0883073811428009
- Finn, K., Johannsen, N., & Specker, B. (2002). Factors associated with physical activity in preschool children. *The Journal of Pediatrics, 140*, 81-85. doi:10.1067/mpd.2002.120693
- Fisher, A., Boyle, J. M., Paton, J. Y., Tomporowski, P., Watson C., McColl, J. H., & Reilly, J. J. (2011). Effects of a physical activity intervention on cognitive function in young children: randomized control pilot study. *BMC Pediatr, 11*, 99. doi: 10.1186/1471-2431-11-97
- Fisher, A., Reilly, J. J., Kelly, L. A. Montgomery, C., Williamson, A., Paton, J. Y., & Grant, S. (2005). Fundamental movement skills and habitual physical activity in young children. *Medicine & Science in Sports & Exercise, 37*(4), 684-688.
- Fleshner, M. (2000). Exercise and neuroendocrine regulation of antibody production: Protective effect of physical activity on stress-induced suppression of the specific antibody response. *International Journal of Sports Medicine, 21*, S14-S19.
- Goldfield, G. S., Harvey, A. L. J., Grattan, K. P., Temple, V., Naylor, P., Alberga, A. S. . . . Adamo, K. B. (in press). Effects of child care intervention on physical activity and body composition. *Am J Prev Med.*

- Gopinath, B., Hardy, L. L., Baur, L. A., Burlutsky, G., & Mitchell, P. (2012). Physical activity and sedentary behaviors and health-related quality of life in adolescents. *Pediatrics*, *130*(1), 167-174. doi: 10.1542/peds.2011-3637
- Gordon, E., Tucker, P., Burke, S. M., & Carron, A. V. (2013). Effectiveness of physical activity interventions for preschooler: A meta-analysis. *Research Quarterly for Exercise and Sport*, *84*(3), 287-294. doi: 10.1080/02701367.2013.813894
- Griffiths, L. J., Dowda, M., Dezaux, C., & Pate, R. (2010). Associations between sport and screen-entertainment with mental health problems in 5-year old children. *International Journal of Behavioural Nutrition and Physical Activity*, *7*(30). doi: 10.1186/1479-5868-7-30
- Gu, X., Chang, M., & Solmon, M. A. (2016). Physical activity, physical fitness, and health-related quality of life in school-aged children. *J Teach Phys Educ*, *35*(2), 117-126. doi: 10.1123/jtpe.2015-0110
- Gu, X., Solmon, M. A., & Zhang, T. (2014). Understanding middle school students' physical activity and health-related quality of life: an expectancy-value perspective. *Appl Res Qual Life*, *9*(4), 1041-1054.
- Guo, S. S., Roche, A. F., Chumlea, W. C., Gardner, J. D., & Siervogel, S. M. (1994). The predictive value of childhood body mass index values for overweight at age 35. *American Journal of Clinical Nutrition*, *59*(4), 810-819.
- Hannon, J. C., & Brown, B. B. (2008). Increasing preschoolers' physical activity intensities: An activity-friendly preschool playground intervention. *Preventive Medicine*, *46*(6), 532-536. doi: 10.1016/j.ypmed.2008.01.006

- Hellenius, M. L., Dahlof, C., Aberg, H., Krakau, I., & de Faire, U. (1995). Quality of life is not negatively affected by diet and exercise intervention in healthy men with cardiovascular risk factors. *Quality of Life Research, 4*(1), 12-20.
- Hill, L. J., Williams, J. H., Aucott, L. Thomson, J., & Mon-Williams, M. (2011). How does exercise benefit performance on cognition tests in primary-school pupils? *Dev Med Child Neurol, 53*(7), 630-635. doi: 10.1111/j.1469-8749.2011.03954.x
- Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool children and physical activity: A review of correlates. *Am J Prev Med, 34*, 435-441.
- Hinkley, T., Teychenne, M., Downing, K. L., Ball, K., Salmon, J., Hesketh, K. D. (2014). Early childhood physical activity, sedentary behaviors and psychosocial well-being: A systematic review. *Prev Med, 62*, 182-192. doi:10.1016/j.ypmed2014.02.007
- Hullan, S. E., Ryan, J. L., Ramsey, R. R., Chaney, J. M. & Mullins, L. L. Measures of general pediatric quality of life. *Arth Care & Res, 63*(S11), S420-S430. doi: 10.1002/acr.20637
- Janz, K. F., Burns, T. L., & Levy, S. M. (2005). Tracking of activity and sedentary behaviors in childhood: The Iowa bone development study. *American Journal of Preventive Medicine, 29*(3), 171-178. doi: 10.1016/j.amepre.2005.06.001
- Jones, S. M., Brown, J. L., & Aber, J. L. (2011). Two-year impacts of a universal school-based social-emotional and literacy intervention: An experiment in translational developmental research. *Child Development, 82*(2), 522-554. doi: 10.1111/j.1467-8624.2010.01560.x
- King, A. C., Taylor, C. B., & Haskell, W. L. (1993). Effects of differing intensities and formats of 12 months of exercise training on psychological outcomes in older adults. *Health Psychology, 12*(4), 292-300.

- Klassen, A., Landgrad, J. M., Lee, S. K., Barer, M., Raina, P., Chan, H. W. P... Brabyn, D. (2003). Health related quality of life in 3 and 4 year old children and their parents: preliminary findings about a new questionnaire. *Health and Qual Life Out*, 1(81). doi:10.1186/1477-7525-1-81.
- Kuhl, E. S., Rausch, J. R., Vami, J., W., & Stark, L. J. (2012). Impaired health-related quality of life in preschoolers with obesity. *Journal of Pediatric Psychology*, 37(10), 1148-1156. doi: 10.1093/jpepsy/jss090
- Lees, C., & Hopkins, J. (2013). Effect of aerobic exercise on cognition, academic achievement, and psychosocial function in children: A systematic review of randomized control trials. *Preventing Chronic Diseases*, 10, E174. doi: 10.5888/pcd10.130010
- Lindsey, E. W., & Colwell, M., J. (2003). Preschoolers' emotional competence: Links to pretend and physical play. *Child Study Journal*, 33(1), 39-52.
- Marcus, B. H., Dubbert, P. M., Forsythe, L. H., McKenzie, T. L., Stone, E. J., Dunn, A. L., & Blair, S. (2000). Physical activity behaviour change: Issues in adoption and maintenance. *Health Psychology*, 19(1 Suppl), 32-41.
- McCabe, P. C., & Altamura, M. (2011). Empirically valid strategies to improve social and emotional competence of preschool children. *Psychology in the Schools*, 48(5), 513-540. doi: 10.1002/pits.20570
- McKenzie, T., Sallis, J., Elder, J., Berry, C., Hoy, P., Nader, P., Zive, M., & Broyles, S. (1997). Physical activity levels and prompts in young children at recess: A two-year study of a bi-ethnic sample. *Research Quarterly for Exercise and Sport*, 68(3), 195-202.
- Meagher, S., M., Arnold, D. H., Doctoroff, G. L., Dobbs, J., & Fisher, P. H. (2009). Social-emotional problems in early childhood and the development of depressive symptoms in

school-age children. *Early Education and Development*, 20(1), 1-24. doi:  
10.1080/10409280801947114

National Longitudinal Survey for Child and Youth. (2013). Statistics Canada. Retrieved from:  
<http://www23.statcan.gc.ca/>

Nieman, P. (2002). Psychosocial aspects of physical activity. *Pediatric and Child Health (Oxford)*, 7(5), 309-312.

Obeid, J., Nguyen, T., Gabel, L., & Timmons, B. (2011). Physical activity in Ontario preschoolers: Prevalence and measurement issues. *Applied Physiology, Nutrition, and Metabolism*, 36(2), 291-297. doi: 10.1139/h11-002

Page, R. M., & Tucker, L. A. (1994). Psychosocial discomfort and exercise frequency: An epidemiological study of adolescents. *Adolescence*, 29(113), 183-191.

Pate, R. R., Brown, W. H., Pfeiffer, K. A., Howie, E. K., Saunders, R. P., Addy, C. L., & Dowda, M. (2015). An Intervention to increase physical activity in children: A randomized controlled trial with 4-year-olds in preschools. *Am J Prev Med*. doi:  
10.1016/j.amepre.2015.12.003

Pate, R. R., Pfeiffer, K. A., Trost, S., Ziegler, P., & Dowda, M. (2004). Physical activity among children attending preschools. *Pediatrics*, 114(5), 1258-1263. doi:10.1542/peds.2003-1088-L.

Pate, R. R., McIver, K. L., Dowda, M., Brown, W. H., & Addy, C. (2008). Directly observed physical activity levels in preschool children. *Journal of School Health*, 78(8), 438-444. doi: 10.1111/j.1746-1561.2008.00327.x

- Pate, R. R., O'Neill, J. R., & Mitchell, J. (2010). Measurement of physical activity in preschool children. *Medicine & Science in Sports & Exercise*, 42(3), 508-512.  
doi:10.1249/MSS.0b013e3181cea116
- Penedo, F. J., & Dahn, J. R. (2005). Exercise and well-being: A review of mental and physical health benefits associated with physical activity. *Current Opinion in Psychiatry*, 18(2), 189-193. doi: 10.1097/00001504-200503000-00013
- Pfeiffer, K. A., McIver, K. L., Dowda, M., Almeida, M. J., & Pate, R.R. (2006). Validation and calibration of the Actical accelerometer in preschool children. *Medicine & Science in Sports & Exercise*, 38(1), 152-157.
- Pierce, T. W., Madden, D. J., Siegel, W. C., & Blumenthal, J. A. (1993). Effects of aerobic exercise on cognitive and psychological functioning in patients with mild hypertension. *Health Psychology*, 12(4), 286-291. doi:10.1037/0278-6133.12.4.286
- Rank, M., Wilks, D. C., Foley, L., Yannan, J., Langhof, H., Siegrist, M., & Halle, M. (2014). Health-related quality of life and physical activity in children and adolescents 2 years after an inpatient weight-loss program. *J Peds*, 164(4), 732-737.  
doi:10.1016/j.peds.2014.05.045
- Reed, J. A., Einstein, G., Hahn, E., Hooker, S. P., Gross, V. P., & Kravtitz, J. (2010). Examining the impact of integrating physical activity on fluid intelligence and academic performance in an elementary school setting: A preliminary investigation. *Journal of Physical Activity and Health*, 7(3), 343-351.
- Reilly, J. J., Jackson, D. M., Montgomery, C., Kelly, L. A., Slater, C., Grant, S., & Payton, J. Y. (2004). Total energy expenditure and physical activity in young Scottish children: Mixed longitudinal study. *Lancet*, 363(9404), 211-212. doi: 10.1061/S0140-6736(03)15331-7

- Reilly, J. J., Kelly, L., Montgomery, C., Williamson, A., Fisher, A., McColl, J. H. ... Grant, S. (2006). Physical activity to prevent obesity in young children: cluster randomized controlled trial. *BMJ*, *333*, 1041. doi: 10.1136/bmj.38979.623773.55
- Rejeski, W. J., Brawley, L. R., & Shymaker, S. A. (1996). Physical activity and health-related quality of life. *Exercise and Sport Sciences Reviews*, *24*, 71-108.
- Sacheck, J. M., Nelson, T., Ficker, L., Kafka, T., Kuder, J., & Economos, C. D. (2011). Physical activity during soccer and its contribution to physical activity recommendations in normal weigh and overweight children. *Pediatric Exercise Science*, *23*(2), 281-292.
- Sanson, A., Letcher, P., Smart, D., Prior, M., Toumbourou, J. W., & Oberklaid, F. (2009). Associations between early childhood temperament clusters and later psychosocial adjustments. *Merill-Palmer Quarterly*, *55*(1), 26-54. doi: 10.1353/mpq.0.0015.
- Sedentary Behaviour Research Network. (2012). Letter to the editor: Standardized use of the terms “sedentary” and “sedentary behaviours.” *Applied Physiology, Nutrition, and Metabolism*, *37*(3), 540-542. doi: 10.1139/H2012-024
- Shephard, R. J. (1996). Habitual physical activity and academic performance. *Nutr Rev*, *54*(4 Pt 2), S32-36.
- Shields, M. (2005). Measured obesity: Overweight Canadian children and adolescents. Statistics Canada, Analytic Studies and Reports. ISSN: 1716-6713.
- Sorenson, N., Anderssen, S., Hjerman, I., Holme, I., & Ursin, H. (1999). The effect of exercise and diet on mental health and quality of life in middle aged individuals with elevated risk factors for cardiovascular disease. *Journal of Sports Sciences*, *17*(5), 369-377. doi:10.1080/026404199365885



- Stanton, J. M. & Arroll, B. (1996). The effect of moderate exercise on mood in mildly hypertensive volunteers: A randomized control trial. *Journal of Psychosomatic Research*, 40(6), 637-642. doi:10.1016/0022-3999(95)00643-5
- Stevens, J. (1996). Applied multivariate statistics for the social sciences (3<sup>rd</sup> ed., pp. 313-350). New Jersey: Lawrence Erlbaum Associates. Inc.
- Story, M., Kaphingst, K. M., & French S. (2006). The role of childcare settings in obesity prevention. *The Future of Children*, 16(1), 143-168.
- Strong, W. B., Malina, R. M., Blimkie, C. J., Daniels, S. R., Dishman, R. K., Gustin, B., . . . Trudeau, F. (2005). Evidence based physical activity for school-age youth. *The Journal of Pediatrics*, 146(6), 732-737.
- Stroth, S., Kubesch, S., Dieterie, K., Ruchsow, M., Heim, K., & Kiefer, M. (2009). Physical fitness, but not acute exercise modulates event-related potential indices for executive control in healthy adolescents. *Brain Research*, 1269, 114-124. doi: 10.1016/j.brainres.2009.02.073
- Sundberg, F., Sand, P., & Forsander, G. (2015). Short report: Educational and psychological health-related quality of life in preschooler children with type 1 diabetes. *Diabet. Med*, 32, 116-119. doi: 10.1111/dme.12557
- Taras, H. (2005). Physical activity and student performance at school. *Journal of School and Health*, 75(6), 214-218.
- Timmons, B. W., Naylor, P. J., & Pfeiffer, K. A. (2007). Physical activity for preschool children - How much and how? *Applied Physiology of Nutrition and Metabolism*, 32, S122-S134.

- Temple, M., & Robinson, J. C. (2014). A systematic review of interventions to promote physical activity in the preschool setting. *Journal for Specialists in Pediatric Nursing, 19*(4), 274-284. doi: 10.1111/jspn.12081
- Temple, V., Naylor, P. J., Rhodes, R., & Higgins, J. (2009). Physical activity of children in family child care. *Applied Physiology, Nutrition, and Metabolism, 34*(4), 794-798. doi: 10.1139/H09-061
- Toumbourou, J. W., Williams, I., Letcher, P., Sanson, A., & Smart, D. (2011). Developmental trajectories of internalizing behaviour in the prediction of adolescent depressive symptoms. *Australian Journal of Psychology, 63*(4), 214-223. doi: 10.1111/j1742-9536.2011.00023.x
- Tremblay, M. S., Katzmarzyk, P. T., & Willms, J. D. (2002). Temporal trends in overweight and obesity in Canada, 1981-1996. *Int J of Obes and Rel Meta Dis, 26*, 538-543.
- Tremblay, M. S., Leblanc, A., Carson, V., Choquette, L., Connor Gorber, S., & Dillman, C. (2012a). Canadian physical activity guidelines for the early years (aged 0-4 years). *Applied Physiology, Nutrition, and Metabolism, 37*(2), 345-369. doi: 10.1139/h2012-018
- Tremblay, M. S., LeBlanc, Carson, V., Choquette, L., Connor Gorber, S., Dillman, C., .... & Spence, J. C. (2012b). Canadian sedentary guidelines for the early years. *Applied Physiology, Nutrition, and Metabolism, 37*(2), 370-380. doi: 10.1139/h2012-019
- Trost, S., Ward, D., & Senso, M. (2010). Effects of child care policy and environment on physical activity. *Medicine & Science in Sports & Exercise, 42*(3), 520-525. doi: 10.1249/MSS.0b013e3181cea3ef
- Tucker, P. (2008). The physical activity levels of preschool-aged children: A systematic review. *Early Childhood Research Quarterly, 23*(4), 547-558. doi: 10.1016/j.ecresq.2008.08.005

- Tucker, P., & Iriwn, J. (2008). Physical activity behaviors during the preschool years. *Child Health and Education, 1*(3), 134-145.
- Tucker, P., Irwin, J. D., Sangster Bouck, L.M., He, M., & Pollett, G.L. (2006). Preventing paediatric obesity. Recommendations from a community-based qualitative investigation. *Obesity Reviews, 7*(3), 251-260.
- Tucker, P., Vanderloo, L. M., Burke, S. M., Irwin, J. D., & Johnson, A. M. (2015). Prevalence and influences of preschoolers' sedentary behaviours in early learning centers: A cross-sectional study. *BMC Pediatrics, 15*, 128. doi: 10.1186/s1286/s12887-015-0441-5
- Tucker, P., van Zandvoort, M. M., Burke, S. M., & Irwin, J. D. (2011). Physical activity at daycare: Childcare providers' perspectives for improvements. *Journal of Early Childhood Research, 9*(3), 207-219. doi:10.1177/1476718X10389144
- Vale, S., Silvia, P., Santos, R., Soares-Miranda, L., & Mota, J. (2010). Compliance with physical activity guidelines in preschool children. *Journal of Sports Science, 28*(6),603-608. doi: 10.1080/02640411003702694
- Vanderloo, L. M., Tucker, P., Johnson, A. M., Burke, S. M., & Irwin, J. D. (2015). Environmental influences on preschoolers' physical activity levels in early learning facilities. *Research Quarterly for Exercise and Sport, 86*(4), 360-370. doi: 10.1080/0270136.2015.1053105
- Vanderloo, L. M., D'Alimonte, N., Proudfoot, N., Tucker, P., & Timmons, B. W. (2016). Comparison of actical and actigraph accelerometers for measuring young children's physical activity levels and sedentary time. *Pediatric Exercise Science, 28*(1), 133-142. doi: 10.1123/pes.2014-0218

- Vanderloo, L. M., Tucker, P., Johnson, A. M., van Zandvoort, M. M., Burke, S. M., & Irwin, J. D. (2014). The influence of centre-based childcare on preschooler' physical activity levels: A cross-sectional study. *International Journal of Environmental Research and Public Health*, *11*(2), 1794-1802. doi: 10.3390/ijerph110201794
- Varni, J., & Limbers, C. (2009). The pediatric quality of life inventory: Measuring pediatric health-related quality of life from the perspective of children and their parents. *Pediatric Clinics of North America*, *56*(4), 843-863. doi: 10.1016/j.pcl.2009.05.016
- Wang, H., Sekine, M., Chen, X., Yamagami, T., & Kagamimiro, S. (2008). Lifestyle at 3 years of age and quality of life (QOL) in first year junior high school students in Japan: Results of the Toyama Birth Cohort Study. *Quality of Life Research*, *17*(2), 257-265.
- Ward, D. S., Vaughn, A., McWilliams, C., & Hales, D. (2010). Interventions for increasing physical activity at child care. *Med Sci Sport Exer*, *42*(3), 526-534.  
doi:10.1249/MSS.0b013e3181cea406
- White, L. J., & Castellano, V. (2008). Exercise and Brain Health – Part 1- Neuronal Growth Factors. *Sports Med*, *38*(2), 91-100. Retrieved from  
<http://www.ncbi.nlm.nih.gov/pubmed/18278981>
- Willenheimer, R., Erhardt, L., Cline, C., Rydberg, E, Israelsson, B. (1998). Exercise training in heart failure improves quality of life and exercise capacity. *Eur Heart J*, *19*(5), 774-781.
- World Health Organization. (2013). Childhood overweight and obesity. Retrieved from:  
<http://www.who.int/dietphysicalactivity/childhood/en/>
- World Health Organization Group Quality of Life. (1993). Mental health. Retrieved from:  
[http://www.who.int/mental\\_health/publications/whoqol/en/](http://www.who.int/mental_health/publications/whoqol/en/)

Wu, X. Y., Ohinmaa, A., & Veugelers, P. J. (2011) Diet quality, physical activity, body weight and health-related quality of life among grade 5 students in Canada. *Public Health and Nutrition*, 15(1), 75-81. doi: 10.1017/S1368980011002412

Yu, M. L., Ziviani, J., Baxter, J., & Haynes, M. (2012). Time use, parenting practice and conduct problems in four- to five-year-old Australian children. *Australian Occupational Therapy Journal*, 57(5), 284-292. doi: 10.1111/j.1440-1630.2009.00818x

Yu, M., I., Ziviani, J., Baxter, J., & Haynes, M. (2012). Time use differences in activity participation among children 4-5 years old with and without the risk of developing conduct problems. *Research in Developmental Disabilities*, 33(2), 490-498.

Appendix A: Ethics



Research Ethics

Western University Health Science Research Ethics Board  
HSREB Full Board Initial Approval Notice

Principal Investigator: Dr. Patricia Tucker  
Department & Institution: Health Sciences/Occupational Therapy, Western University

HSREB File Number: 105779  
Study Title: Supporting Physical Activity in the Childcare Environment: The SPACE Study  
Sponsor: Canadian Institutes of Health Research

HSREB Initial Approval Date: October 30, 2014  
HSREB Expiry Date: August 31, 2017

Documents Approved and/or Received for Information:

Document Name	Comments	Version Date
Other	Appendix W - CIHR notice of decision (section 2.1)	2014/09/04
Other	Appendix U - master tracking sheet for preschool participants	2014/09/03
Other	Appendix V - master tracking sheet for childcare staff participants	2014/09/03
Instruments	Appendix T - child temperament questionnaire	2014/09/03
Other	Appendix R - anthropometric tracking sheet	2014/09/03
Instruments	Appendix S - PedsQL questionnaire	2014/09/03
Other	Appendix Q - thank you letter for childcare staff	2014/09/03
Instruments	Appendix O - childcare staff self-efficacy questionnaire	2014/09/03
Other	Appendix P - thank you letter for parents	2014/09/03
Other	Appendix M - consent for childcare staff	2014/09/03
Instruments	Appendix N - childcare staff physical activity questionnaire	2014/09/03
Other	Appendix K - accelerometer log	2014/09/03
Other	Appendix I - CONSORT flow diagram	2014/09/03
Other	Appendix J - proposed training sessions and topics	2014/09/03
Other	Appendix H - interview guide for focus groups	2014/09/03
Other	Appendix G - consent for childcare staff (focus groups)	2014/09/03
Other	Appendix E - parent/guardian demographic questionnaire	2014/09/03
Other	Appendix A - Description of evaluation phases	2014/09/03
Revised Western University Protocol	Amendments to Western protocol - CLEAN (pdf)	2014/10/10
Revised Letter of Information & Consent	Appendix L - LOI and consent form for staff - CLEAN	2014/09/19
Revised Letter of Information & Consent	Appendix F - LOI and consent form for staff - Focus Groups - CLEAN (pdf)	2014/09/19
Revised Letter of Information & Consent	Appendix D - LOI and consent form for parents/guardians - CLEAN (pdf)	2014/09/19
Revised Letter of Information & Consent	Appendix C - LOI and consent form for childcare centres (NEW - CLEAN pdf)	2014/09/19
Recruitment Items	Appendix B - Email invitation and telephone script to participate - CLEAN (pdf)	2014/09/19
Letter of Information & Consent	Appendix C - LOI and consent form form childcare centres	2014/10/14

The Western University Health Science Research Ethics Board (HSREB) has reviewed and approved the above named study, as of the HSREB Initial Approval Date noted above.

HSREB approval for this study remains valid until the HSREB Expiry Date noted above, conditional to timely submission and acceptance of HSREB Continuing Ethics Review. If an Updated Approval Notice is required prior to the HSREB Expiry Date, the Principal Investigator is responsible for completing and submitting an HSREB Updated Approval Form in a timely fashion.

The Western University HSREB operates in compliance with the Tri-Council Policy Statement Ethical Conduct for Research Involving Humans (TCPS2), the International Conference on Harmonization of Technical Requirements for Registration of Pharmaceuticals for Human Use Guideline for Good Clinical Practice Practices (ICH E6 R1), the Ontario Personal Health Information Protection Act (PHIPA, 2004), Part 4 of the Natural Health Product Regulations, Health Canada Medical Device Regulations and Part C, Division 5, of the Food and Drug Regulations of Health Canada.

Members of the HSREB who are named as Investigators in research studies do not participate in discussions related to, nor vote on such studies when they are presented to the REB.

The HSREB is registered with the U.S. Department of Health & Human Services under the IRB registration number IRB 00000940.



Ethics Officer to Contact for Further Information

<input type="checkbox"/> Erika Basile	<input checked="" type="checkbox"/> Grace Kelly	<input type="checkbox"/> Mina Mekhail	<input type="checkbox"/> Vikki Tran
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This is an official document. Please retain the original in your files.

Appendix B: Letter of Information



**Supporting Physical Activity in the Childcare Environment: The SPACE Study**

**Letter of Information for Parents/Guardians**

**Investigators:**

Dr. Trish Tucker, PhD, Faculty of Health Sciences, University of Western Ontario  
Dr. Shauna Burke, PhD, Faculty of Health Sciences, University of Western Ontario  
Dr. Anca Gaston, PhD, Faculty of Health Sciences, University of Western Ontario  
Dr. Jennifer Irwin, PhD, Faculty of Health Sciences, University of Western Ontario  
Dr. Andrew Johnson, PhD, Faculty of Health Sciences, University of Western Ontario  
Dr. Brian Timmons, PhD, Child Health & Exercise Medicine Program, McMaster University

**Invitation to participate:**

Physical activity levels among preschoolers attending childcare have been reported as low. As such, this study aims to implement and evaluate an evidence-based physical activity intervention for preschoolers attending centre-based childcare. Your child is being invited to participate because he or she falls between the ages of 2.5 and 5 years and is enrolled in a childcare centre who has agreed to participate.

**Purpose of this letter:**

The purpose of this letter is to provide you with the information needed to make an informed decision regarding your child's participation in the present study.

**Background:**

Researchers have found that children starting at 2 years of age can benefit from participating in daily physical activity; however, current research supports that preschoolers (aged 2.5-5 years) engage in high levels of sedentary behaviours and low levels of physical activity while in childcare. Given the current childhood obesity epidemic (approximately 43 million children under the age of 5 worldwide), the need for effective approaches to improve physical activity engagement and participation among this vulnerable population is evident. Consequently, researchers at the University of Western Ontario and McMaster University are undertaking a study aimed at creating a health promotion-based physical activity intervention for preschoolers attending centre-based childcare. The findings from this work will have many implications for the preschool population with regards to physical activity behaviours and health.

**What will happen in this study:**

Your child's centre will be randomly assigned to either the *intervention* group or the *control* group. Should your child's centre be assigned to the *control* group, he or she will continue their typical daily curriculum and outdoor playtime for the duration of the intervention and follow-up periods. If your child's centre is assigned to the *intervention* group, environmental modifications (the addition of play equipment), staff training (about the benefits of physical activity), and curriculum changes (restructuring of outdoor playtime) will be made to his/her classrooms – all of which have been shown to encourage physical activity participation. Regardless of the group to which your child is assigned, if you agree to participate, he or she will wear an accelerometer (a small, motion sensor device) during childcare hours for 5 consecutive days at four different time points (pre-intervention, post-intervention, and at 6- and 12-month follow-up). A pager-like device in size (please see picture below), the accelerometer would be worn on an adjustable elastic belt around the child's waist (over top of clothing) to collect information about the amount and intensity of his/her movements. While wearing the accelerometer, your child would still be able to participate in all normal activities. Upon arrival at childcare, your child will be fitted with the accelerometer by staff, and will be removed at end-of-day prior to leaving for home. Prior to accelerometry data collection, two researchers will come to your child's childcare centre to take his/her height, weight, and waist circumference measurements (which are necessary to input into the Actical accelerometer to calculate energy output). Children will be individually measured by the researchers, along with a research assistant, and these measurements will be completed in a corner of the centre, to ensure your child's privacy. Children will also be asked to provide verbal assent to this process. In addition to this letter of information and consent form, you will find a brief demographic questionnaire, child temperament questionnaire, and quality of life questionnaire included. Please complete these forms and return to the research team in the included envelope by \_\_\_\_\_ [insert date here – will be given one week to return materials].

**Inclusion and exclusion criteria:**

In order for your child to participate in this study, he or she must: a) be between the ages of 2.5 and 4 years at the commencement of the intervention; b) be enrolled in the preschool classroom(s) of the participating childcare centre; c) be able to understand English; and d) have parents/guardians that can read and speak English. Your child will not be able to participate if he or she: a) is not between the ages of 2.5 and 4 years at the commencement of the intervention; b) is not enrolled in the preschool classroom(s) of the participating childcare centre; c) does not understand English; and d) does not have parents/guardians who read and write English.

**Alternatives and your right to withdraw from the study:**

Your participation (and your child's) in this study is voluntary. You may refuse to participate, refuse to answer any questions, or withdraw from the study at any time. You will also have the right to withdraw your (and your child's) data prior to the point of data



entry, at which time, the data will be removed. Your child also has the right to refuse participation on the day of data collection.

**Possible benefits and risks to you for participating in the study:**

Participating in this study may result in an increase in your child's physical activity levels. Physical activity is positively associated with healthy body weight promotion, a decreased risk for Type II diabetes, and improved academic and psychosocial scores. With physical activity participation, there is always a risk of injury (e.g., falling, tripping, etc.); however, these risks are no higher than any other typical day at childcare. You do not waive any of the legal rights you would otherwise have as a participant in a research study. There are no personal benefits to your child participating in this study. Tokens of appreciation will be distributed to the parents/guardians of the participants at the end of each data collection time point to acknowledge their contributions to the study.

**Confidentiality:**

We will keep your child's identity and physical activity level, as well as written records, confidential and secure. No names will appear on any publications generated during the course of this study. If we find information we are required by law to disclose, we cannot guarantee confidentiality.

All data obtained will be stored in secured computer files (password encrypted) and stored in locked filing cabinets at Western University. Only the research team will have access to these data. The data will be retained for five years after the results of the study have been published. After this period, all data will be destroyed (i.e., the computer data will be erased and all written/paper data will be shredded).

**Costs and compensation:**

There is no cost to you for participating in the study. To acknowledge your contribution to the study, you will receive a \$10 gift card to a local grocery store at the end of data collection.

**Publication of the results:**

When the results of the study are published, you/your child's name will not be used. If you would like to receive a copy of the overall results of the study, please tick the appropriate box on your child's consent form.

**This letter is for you to keep.**

Appendix C: Consent Form



**Supporting Physical Activity in the Childcare Environment:  
The SPACE Study**

I have read the Letter of Information, have had the nature of the study explained to me, and I agree to participate. All questions have been answered to my satisfaction.

\_\_\_\_\_  
Date                      Participant's Name                      Parent/Guardian Name                      Parent/Guardian Signature  
(please print)                      (please print)

\_\_\_\_\_  
Date                      Name of Researcher Obtaining                      Signature  
Informed Consent  
(please print)

Do you wish to obtain a copy of the study results?

- Yes
- No

If YES, how would you prefer to receive the results? (please provide necessary contact information)

- Email: \_\_\_\_\_
- Mail (post): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Would you like to be contacted to participate in future studies conducted by this research team?

- Yes (please provide contact information above)
- No

Appendix D: Letter of Thanks: Pre-intervention



**Supporting Physical Activity in the Childcare Environment:  
The SPACE Study**

Dear Parent/Guardian:

On behalf of our research team, I would like to thank you for consenting to your child's participation in this study. The information collected will assist with the promotion of healthy active behaviours among preschoolers in centre-based childcare. Please accept this token of appreciation as a small gesture of thanks.

Sincerely,

Dr. Trish Tucker  
Assistant Professor  
School of Occupational Therapy  
University of Western Ontario

Appendix E: Letter of Thanks: Post-intervention



**Supporting Physical Activity in the Childcare Environment:  
The SPACE Study**

Dear Parent/Guardian:

On behalf of our research team, I would like to thank you for your child's participation in the post-intervention portion of the SPACE study. The information collected will assist with the promotion of healthy active behaviours among preschoolers in centre-based childcare. Please accept this token of appreciation as a small gesture of thanks.

Sincerely,

Dr. Trish Tucker  
Assistant Professor  
School of Occupational Therapy  
University of Western Ontario

Appendix F: Pediatric Quality of Life Inventory 4.0

<sup>TM</sup>  
**PedsQL**  
Pediatric Quality of Life  
Inventory

Version 4.0 Short Form (SF15)

**PARENT REPORT for TODDLERS (ages 2-4)**

**DIRECTIONS**

On the following page is a list of things that might be a problem for **your child**. Please tell us **how much of a problem** each one has been for **your child** during the **past ONE month** by circling:

- 0** if it is **never** a problem
- 1** if it is **almost never** a problem
- 2** if it is **sometimes** a problem
- 3** if it is **often** a problem
- 4** if it is **almost always** a problem

There are no right or wrong answers.  
If you do not understand a question, please ask for help.

*In the past **ONE month**, how much of a **problem** has your child had with...*

<b>PHYSICAL FUNCTIONING (problems with...)</b>	Never	Almo st Neve r	Some- times	Ofte n	Almo st Alwa ys
1. Walking	0	1	2	3	4
2. Running	0	1	2	3	4
3. Participating in active play or exercise	0	1	2	3	4
4. Lifting something heavy	0	1	2	3	4
5. Helping to pick up his or her toys	0	1	2	3	4

<b>EMOTIONAL FUNCTIONING (problems with...)</b>	Never	Almo st Neve r	Some- times	Ofte n	Almo st Alway s
1. Feeling afraid or scared	0	1	2	3	4
2. Feeling sad or blue	0	1	2	3	4
3. Feeling angry	0	1	2	3	4
4. Worrying	0	1	2	3	4

<b>SOCIAL FUNCTIONING (problems with...)</b>	Never	Almo st Neve r	Some- times	Ofte n	Almo st Alway s
1. Playing with other children	0	1	2	3	4
2. Other kids not wanting to play with him or her	0	1	2	3	4
3. Getting teased by other children	0	1	2	3	4

<b>SCHOOL FUNCTIONING (problems with...)</b>	Never	Almo st Neve r	Some- times	Ofte n	Almo st Alway s
1. Doing the same school activities as peers	0	1	2	3	4
2. Missing school/daycare because of not feeling well	0	1	2	3	4
3. Missing school/daycare to go to the doctor.	0	1	2	3	4

Appendix G: Scoring Protocol for the Pediatric Quality of Life Inventory 4.0

Pediatric Quality of Life Inventory™ (PedsQL™)



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**PedsQL™ 4.0 SF15**  
**Short Form Generic Core Scales**

**PARENT Report for Toddlers (ages 2-4)**  
**CHILD and PARENT Reports for Young Children (ages 5-7),**  
**Children (ages 8-12), Teens (ages 13-18)**

The Parent Report for Toddlers (ages 2-4) and the Child & Parent Reports for Young Children (ages 5-7), Children (ages 8-12) and Teens (ages 13-18) of the PedsQL™ 4.0 SF15 Generic Core Scales are composed of 15 items comprising 4 dimensions.

**DESCRIPTION OF THE SF15 QUESTIONNAIRE:**

Dimensions	Number of Items	Cluster of Items	Reversed Scoring	Direction of Dimensions
Physical Functioning	5	1-5	1-5	Higher scores indicate better HRQOL.
Emotional Functioning	4	1-4	1-4	
Social Functioning	3	1-3	1-3	
School Functioning	3	1-3	1-3	

**SCORING OF DIMENSIONS:**

<b>Item Scaling</b>	5-point Likert scale from 0 (Never) to 4 (Almost always) 3-point scales: 0 (Not at all), 2 (Sometimes) and 4 (A lot) for the Young Child self-report
<b>Weighting of Items</b>	No
<b>Extension of the Scoring Scale</b>	Scores are transformed on a scale from 0 to 100.
<b>Scoring Procedure</b>	<p><b>Step 1: Transform Score</b></p> <p>Items are reversed scored and linearly transformed to a 0-100 scale as follows: 0=100, 1=75, 2=50, 3=25, 4=0.</p> <p><b>Step 2: Calculate Scores</b></p> <p><u>Score by Dimensions:</u></p> <ul style="list-style-type: none"> <li>• If more than 50% of the items in the scale are missing, the scale scores should not be computed,</li> <li>• Mean score = Sum of the items over the number of items answered.</li> </ul> <p><u>Psychosocial Health Summary Score</u> = Sum of the items over the number of items answered in the Emotional, Social, and School Functioning Scales.</p> <p><u>Physical Health Summary Score</u> = Physical Functioning Scale Score</p> <p><b>Total Score:</b> Sum of all the items over the number of items answered on all the Scales.</p>



Pediatric Quality of Life Inventory™ (PedsQL™)



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<b>Interpretation and Analysis of Missing Data</b>	If more than 50% of the items in the scale are missing, the Scale Scores should not be computed. If 50% or more items are completed: Impute the mean of the completed items in a scale.
--	--

Appendix H: Parent/Guardian Demographic Questionnaire



**Supporting Physical Activity in the Childcare Environment: The SPACE Study**

**Parent/Guardian Demographic Questionnaire**

**A. ABOUT YOUR PRESCHOOLER**

**What is the sex of your preschooler?**

- Male
- Female

**What is your preschooler's date of birth? (please be exact)**

\_\_\_\_\_

**What is your preschooler's racial background/ethnicity?**

- |  |  |
|--|--|
| <input type="checkbox"/> Caucasian         | <input type="checkbox"/> Asian                   |
| <input type="checkbox"/> African Canadian  | <input type="checkbox"/> Other (please specify): |
| <input type="checkbox"/> Native/Aboriginal | _____  |
| <input type="checkbox"/> Arab              | <input type="checkbox"/> Prefer not to answer    |
| <input type="checkbox"/> Latin-American    |  |

**Approximately how many hours per week does your preschooler spend in childcare?**

- Less than 10 hours
- 10-19 hours
- 20-29 hours
- 30 hours or more

**In your opinion, how active is your preschooler?**

- Not at all active
- Somewhat active
- Very active
- Do not know

**Is your preschooler enrolled in extra-curricular sports/activities?**

- Yes
- No

**If YES, what kinds of sports/activities is your preschooler enrolled in? (please check all that apply)**

- |  |  |
|--|--|
| <input type="checkbox"/> Soccer            | <input type="checkbox"/> Volleyball              |
| <input type="checkbox"/> Hockey            | <input type="checkbox"/> Dance                   |
| <input type="checkbox"/> Skating           | <input type="checkbox"/> Swimming                |
| <input type="checkbox"/> Baseball/Softball | <input type="checkbox"/> Karate                  |
| <input type="checkbox"/> Tennis/Badminton  | <input type="checkbox"/> Other (please specify): |
| <input type="checkbox"/> Basketball        | _____  |
| <input type="checkbox"/> Gymnastics        |  |

**If YES, how many hours per week does your preschooler spend in these extra-curricular sports/activities?**

- Between 2-5 hours
- Less than 2 hours
- More than 5 hours

## B. ABOUT YOUR HOUSEHOLD

**What is your family situation?**

- |  |   |
|--|---|
| <input type="checkbox"/> Single-parent | <input type="checkbox"/> Other: _____         |
| <input type="checkbox"/> Double-parent | <input type="checkbox"/> Prefer not to answer |
| <input type="checkbox"/> Guardian-led  |   |

**How many people live in your household (including yourself)?**

- 2     
  3     
  4     
  5     
  6     
  7 or more

**What is the approximate yearly income of your household?**

- Less than \$20,000
- \$20,000 - \$39,999
- \$40,000 - \$59,999
- \$60,000 - \$79,999
- \$80,000 - \$99,999
- \$100,000-\$119,999
- \$120,000-\$149,999
- More than \$150,000
- Prefer not to answer

**C. ABOUT YOU**

Please circle/check your highest level of education completed.

- Elementary school (Grade school)
- Secondary school (High school)
- College
- University
- Graduate School
- Prefer not to answer

On average, how many minutes per week do you spend engaged in moderate-vigorous physical activity (e.g., brisk walking, jogging, bike riding, cross-country skiing, etc.)?

- Less than 30 minutes
- 30-59 minutes
- 60-89 minutes
- 90-119 minutes
- 120-149 minutes
- 150 minutes or more

With regard to physical activity, do you feel that you are a strong role model for your preschooler?

- Yes, very much
- Somewhat, I could probably be a better role model
- Not at all
- Do not know

Thank you for completing this questionnaire.

# Stephanie Truelove

## Education:

2014 - present

Master's of Science in Health Promotion  
Western University, London, ON  
Supervisor: Dr. Trish Tucker  
Area of research: Physical activity in preschoolers and  
childhood obesity

2010-2014

Honors Bachelor of Science in Life Science  
McMaster University, Hamilton, ON

## Scholarships and Academic Honors

2016 - 2017

Ontario Graduate Scholarship  
\$15,000

2015

CIS Academic All-Canadian (track)

2014 - 2015

Dean's Honors List - Western University

2013 - 2014

Dean's Honors List - McMaster University

2013 - 2014

CIS Academic All-Canadian (basketball)

2013 - 2014

Dean's Honors List - McMaster University

2012 - 2013

CIS Academic All-Canadian (basketball)

2010

McMaster University Entrance Scholarship (average  
above 90%)  
\$3,000

## Research Experience

### **Child Health and Physical Activity Lab Research Assistant**

**September 2014 - present**

Dr. Trish Tucker, Western University, London, ON

Currently, I am helping with the implementation of a physical activity intervention in  
preschools across the city of London.

### **Chemical Engineering Laboratory Volunteer Research Assistant**

**May 2014 - September 2014**

Dr. Todd Hoare, McMaster University, Hamilton, ON

Conducted daily experiments on the viability of hydrogels made from different polymers.  
Inputted and graphed all data in the lab, which was carried out by numerous PhD students  
over the course of the summer.

**Histology and Neuroanatomy Laboratory Assistant**

**May 2013 - June 2013**

Dr. Sunita Nadella, McMaster University, Hamilton, ON

Learned advanced laboratory skills in order to help researchers carry out their work efficiently and effectively.

Teaching Experience

**Teaching Assistant**

**January 2016 - April 2016**

Dr. Clark Heard

Mental Health in Context (OT9562), Western University, London, ON

**Teaching Assistant**

**January 2015 - April 2015**

Dr. Lillian Magalhaes

Mental Health in Context (OT9562), Western University, London, ON

Training and Certifications

2016	WHMIS
2016	Standard First Aid and CPR Level C
2014	Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans
2013	WHMIS
2012 - 2013	Standard First Aid and CPR
2012	National Coaching Certification Program (NCCP)

Memberships

2016	Child and Youth Network of London, ON
2015 - present	North American Society for Pediatric Exercise Medicine – Student Member
2015 - present	Canadian Obesity Network- Students and New Professionals
2011 - present	Special Olympics Ontario
2010 - present	Children's Miracle Network

Publications – Under Review

Truelove, S., Vanderloo, L. M., & Tucker, P. *Defining Active Play Among Young Children: A Systematic Review*. Submitted to Journal of Physical Activity and Health. March 2016.

## Conference Presentations

Truelove, S., & Tucker, P. Change in Preschoolers' Health-Related Quality of Life Following the Implementation of a Childcare Physical Activity Intervention. North American Society of Pediatric Exercise Medicine. Knoxville, TN. August 10-13, 2016. **Abstract and Poster Presentation**

Vanderloo, L. M., D'Alimonte, N., Proudfoot, N., Tucker, P., & Timmons, B. W. Comparison of actical and actigraph accelerometers for measuring young children's physical activity levels and sedentary time. Faculty of Health Sciences Research Day. London, ON. March 2016. **Poster Presentation**

Truelove, S., & Tucker, P. Change in the Health Related Quality of Life of Preschoolers Following the Implementation of a Physical Activity Intervention. Health and Rehabilitation Sciences Graduate Research Conference. February 2016. **Abstract and Oral Presentation.**

Truelove, S., & Tucker, P. Preschoolers Quality of Life Following the Implementation of a Physical Activity Intervention. Child Health Symposium. May 2015. **Abstract and Oral Presentation.**

\*Truelove, S., & Tucker, P. *Change in the Health Related Quality of Life of Preschoolers Following the Implementation of a Physical Activity Intervention.* Health and Rehabilitation Sciences Graduate Research Conference. February 2015. **Abstract and Oral Presentation.**

*\*Won the award for the best oral presentation by a Master's student.*

## Work Experience

**Research Assistant, Child Health and Physical Activity Lab**

**April 2015 - present**

Dr. Trish Tucker, Western University, London, ON

**Intramural Basketball Convener**

**September 2015 - present**

London, ON

Responsible for organizing and scheduling 120 basketball teams and 30 officials each semester.

**Intramural Basketball Official**

**September 2015 - present**

Implement the rules of basketball and handle participant misconduct in order to create a safe and enjoyable playing environment.

**Retired Researchers Association**

**September 2014 - present**

London, ON

Instruct a fitness class for over 75 retired researchers from the London community 3 days a week.

**Volunteer Experience**

**Special Olympics Track Meets**

**May 2015 - present**

London, ON

Help organize track meets throughout the summer for individuals with special needs.

**Mac Mentor**

**May 2013 - present**

Hamilton, ON

Provide leadership and guidance to young females throughout the community. Meet with the girls once a month to provide mentorship.

**Special Olympics Track and Field Coach**

**May 2011 - present**

Barrie, ON

Train mentally disabled athletes in the various events of track and field.

**Mini Pan-Am Event**

**October 2014**

London, ON

Led elementary school kids through sports which make up the Pan-Am Games. Guest speaker and MC of the event, responsible for promoting activity in children, and getting them excited about the upcoming Pan-Am Games in Toronto.

**Camp Trillium Counselor**

**July 2014**

Barrie, ON

Volunteered as a counselor, supervising children with cancer, and allowing them to have a normal camp experience. Responsible for planning daily activities, fostering relationships between children and other counselors, and ensuring the safety of all children.

**Boys and Girls Club**

**January 2011 - August 2014**

Hamilton, ON

Taught children the fundamentals of sports, and the importance of living a healthy life.



**Mac Athletes Care**

**September 2010 - August 2013**

Hamilton, ON

Shared my passion for athletics with children of the Eva Rothwell Centre and the Boys and Girls Club of Hamilton.

**Me to We Program**

**July 2010 - August 2010**

Chimborazo, Ecuador

Travelled to Ecuador to help build a school for a rural community. Organized games for the children of Chimborazo and donated numerous school supplies.

**Related Course-Based Presentations**

**Child and Youth Health**

**December 2014**

Western University, London, ON

*Balanced School Day vs Traditional School Day Schedule*

**Child and Youth Health**

**November 2014**

Western University, London, ON

*Physical activity levels of children with Down Syndrome.*

**Hormones and Behaviour**

**December 2013**

McMaster University, Hamilton, ON

*Can physical activity be used as a therapy for depression?*

**Health and Disease**

**April 2012**

McMaster University, Hamilton, ON

*ADHD in children: Are they over diagnosing in schools?*

**Food and Nutrition**

**April 2012**

McMaster University, Hamilton, ON

*The importance of eating healthy at a young age.*