An Examination of Socioecological Factors that Influence Preschool-aged Children’s Cardiovascular Fitness and Gross Locomotor Skills within their Developmental Pathway

by

Jacob Szeszulski

A Dissertation Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy

Approved March 2019 by the Graduate Supervisory Committee:

Rebecca E. Lee, Chair
Matthew P. Buman
Steven P. Hooker
Sonia Vega-López
Gabriel Q. Shaibi

ARIZONA STATE UNIVERSITY
May 2019
ABSTRACT

Through three investigations, this dissertation examined properties of the family and early care and education center (ECEC) environments related to preschool-aged children's cardiovascular fitness (CVF) and gross locomotor skills (GLS). Investigation one used a systematic review and meta-analysis to synthesize the effectiveness of school-based interventions at improving CVF, in preschool-aged children. For investigations two and three product- and process-based measures of GLS were collected from children in ECECs (n=16), using the progressive aerobic cardiovascular endurance run (PACER; n=144) and the CHAMPS motor skill protocol (CMSP; n=191), respectively. Investigation two and three examined family factors and ECEC factors for associations with measures of GLS, respectively.

Investigation one revealed a moderate-to-large effect size for school-based interventions (n=10) increasing CVF (g=0.75; 95%CI [0.40-1.11]). Multi-level interventions (g=.79 [0.34-1.25]) were more effective than interventions focused on the individual (g=0.67 [0.12-1.22]). In investigations two and three children (78.3% Hispanic; mean ± SD age 53.2±4.5 months) completed a mean ± SD 3.7±2.3 PACER laps and 19.0±5.5 CSMP criteria. Individual and family factors associated with PACER laps included child sex (B=-0.96, p=0.03) and age (B=0.17, p<0.01), parents’ promotion of inactivity (B=0.66, p=0.08) and screen time (B=0.65, p=0.05), and parents’ concern for child’s safety during physical activity (B=-0.36, p=0.09). Child age (B=0.47, p<0.01) and parent employment (B=2.29, p=0.07) were associated with CMSP criteria. At the ECEC level, policy environment quality (B=-0.17; p=0.01) was significantly associated with number of PACER laps completed. Outdoor play environment quality (B=0.18; p=0.03), outdoor play equipment total (B=0.32; p<0.01) and screen time environment quality (B=0.60; p=0.02) were significantly associated with CMSP criteria. Researchers, ECEC
teachers and policy makers should promote positive environmental changes to preschool-aged children’s family and ECEC environments, as these environments have the potential to improve CVF and GLS more than programs focused on the child alone.
DEDICATION

I dedicate this dissertation to Yemi Lekuti, my loving Fiancé who has supported me throughout the completion of this doctoral program and the long hours spent writing this dissertation. Your unwavering support, kindness and belief in me consistently helps me to achieve more than I ever thought possible.

I would also like to dedicate this dissertation to my family and friends who have had to put up with the missed holidays, events and my long periods of absence. I would like to thank you for your continued visits and phone call that have helped to ground me throughout this project.
ACKNOWLEDGMENTS

I would like to acknowledge all of the mentors, both formal and informal, who have provided guidance and support throughout this program. I would like to thank Dr. Lee for her countless hours reading, rereading, and editing my writing. I would also like to thank her for allowing me to continue to work on the SAGE project over the course of three years. I would like to thank Dr. Hooker for allowing me the opportunity to work with REGARDS data and for allowing me the freedom to pursue my research passion. I would like to thank Dr. Vega-López for the learning opportunities that she has provided through AFL and for being a kind ear always willing to listen. I would like to thank Dr. Shaibi for allowing me to attend his mentorship meeting and constantly pushing me to think deeper and more critically. I would like to thank Dr. Buman for his statistical guidance and methodology expertise. Each of these experiences and interactions have provided me with countless, invaluable opportunities to learn and grow. I hope that each of you know how important your contribution is to the scientist that I am today.

I would also like to acknowledge all of the SAGE staff who have contributed to this project over the years. In particular, I would like to thank Elizabeth Lorenzo and Anel Arriola who were both with the SAGE project from the beginning and have provided numerous contributions to this dissertation through their feedback and guidance. I would also like to thank all of the scientific investigators on this project who have contributed to my learning through dozens of meeting over the past three years. I would also like to thank each and every one of the SAGE research staff, student interns, and graduate students without them, this project would not have been possible. I would also like to thank all of the community advisory board members, who have provided significant guidance over the years on how to translate science into real world applications.
Finally, I would like to acknowledge each of the funders who have contributed to this project over the years. This research was supported by the National Institutes of Health through the National Institutes on Minority Health and Health Disparities cooperative agreement 5U01MD010667-03 awarded to Dr. Rebecca E. Lee, the National Institute of Nursing Research grant 1F31NR017560-01 and Jonas Scholar Nurse Leader 2016-2018 Cohort awarded to Elizabeth Lorenzo, and the Arizona State University Graduate College Completion Fellowship awarded to Jacob Szczulski. Additionally, travel to conferences to present research from this dissertation was provided by the John and Elizabeth Ainsworth travel award, Arizona State Universities’ Graduate and Professional Student Association and the American Public Health Association’s Physical Activity Section.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>LIST OF TABLES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ix</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>LIST OF FIGURES</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x</td>
</tr>
</tbody>
</table>

# CHAPTER

1. INTRODUCTION ................................................................. 1
   CVF and PA: An Ecological Perspective ................................... 2
   Specific Aim 1 ....................................................................... 3
   Motor Skill Development: An Ecological Perspective ..................... 4
   Specific Aim 2 ....................................................................... 5
   Specific Aim 3 ....................................................................... 6

2. REVIEW OF LITERATURE ......................................................... 8
   Why use Ecological Models? ..................................................... 8
   Physical Activity in Preschool-aged Children ............................ 10
   Ecological Research Recommendations for PA ............................ 16
   Motor Skills in Preschool-aged Children ................................... 17
   Ecological Research Recommendations for Motor Skills ............... 24
   Perceived Motor Skill Competence  .......................................... 25
   Research Recommendations for Perceived Motor Competence .......... 26
   The Relationship between Motor Skills and PA .......................... 27
   Physical Activity, Motor Skills, and Health-related Fitness .......... 29
   Research Recommendations for Health-Related Fitness ............... 38
   Overall Summary .................................................................... 39
   Implications for Research, Policy and Practice .......................... 42

3. INVESTIGATION 1 .................................................................... 44
Implications for Practice ................................................................. 124
Implications for Policy ................................................................. 127
Strengths and Limitations ............................................................ 130
Future Research Directions ......................................................... 138

REFERENCES .................................................................................. 140

APPENDIX

A PRISMA REPORTING FOR SYSTEMATIC REVIEW AND META-ANALYSIS .. 157
B PARTICIPANT CONSENT FORM (ENGLISH) ...................................... 161
C PARTICIPANT CONSENT FORM (SPANISH) .................................... 169
D INSTITUTIONAL REVIEW BOARD APPLICATION ............................. 178
E SAGE PARENT SURVEY (ENGLISH) ............................................. 191
F SAGE PARENT SURVEY (SPANISH) ........................................... 204
G ENVIRONMENTAL ASSESSMENT ...................................................... 218
H CHILD GROSS LOCOMOTOR SKILLS DATA COLLECTION FORM ......... 226
I CHILD PACER DATA COLLECTION FORM ....................................... 229
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Table 3.1 School-based Cardiovascular Fitness Intervention Studies</td>
<td>64</td>
</tr>
<tr>
<td>2. Table 3.2 School-based Intervention Components</td>
<td>66</td>
</tr>
<tr>
<td>3. Table 3.3 Quality Rating Index Scores</td>
<td>66</td>
</tr>
<tr>
<td>4. Table 4.1 Comparison of Child Characteristics by Sex</td>
<td>86</td>
</tr>
<tr>
<td>5. Table 4.2 Bivariate Relationships</td>
<td>87</td>
</tr>
<tr>
<td>6. Table 4.3 Regression Model for Family Characteristics and PACER</td>
<td>88</td>
</tr>
<tr>
<td>7. Table 4.4 Regression Model for Family Characteristics and CMSP</td>
<td>89</td>
</tr>
<tr>
<td>8. Table 4.5 Correlations PACER Model</td>
<td>91</td>
</tr>
<tr>
<td>9. Table 4.6 Correlations CMSP</td>
<td>92</td>
</tr>
<tr>
<td>10. Table 4.7 PPAPP Substitution PACER</td>
<td>93</td>
</tr>
<tr>
<td>11. Table 4.7 PPAPP Substitution PACER (boys only)</td>
<td>94</td>
</tr>
<tr>
<td>12. Table 5.1 NAP SACC Assessment Scores</td>
<td>112</td>
</tr>
<tr>
<td>13. Table 5.2 Descriptive Characteristics of Participants by GLS Test</td>
<td>114</td>
</tr>
<tr>
<td>14. Table 5.3 Bivariate Relationships between ECEC Characteristics and GLS</td>
<td>115</td>
</tr>
<tr>
<td>15. Table 5.4 Regression Model for ECEC Characteristics and PACER</td>
<td>116</td>
</tr>
<tr>
<td>16. Table 5.5 Regression Model for ECEC Characteristics and PACER (policies)</td>
<td>117</td>
</tr>
<tr>
<td>17. Table 5.6 Regression Model for ECEC Characteristics and CMSP</td>
<td>118</td>
</tr>
<tr>
<td>18. Table 5.7 Correlations PACER Model (ECEC)</td>
<td>119</td>
</tr>
<tr>
<td>19. Table 5.8 Correlations CMSP Model (ECEC)</td>
<td>120</td>
</tr>
<tr>
<td>20. Table 5.9 Bivariate Relationships (ECEC variables)</td>
<td>121</td>
</tr>
</tbody>
</table>
### LIST OF FIGURES

<table>
<thead>
<tr>
<th>Figure</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Figure 1.1 Developmental Model in the Ecological Context of the EMPA</td>
<td>7</td>
</tr>
<tr>
<td>2. Figure 3.1 Study Selection Process</td>
<td>63</td>
</tr>
<tr>
<td>3. Figure 3.2 Forrest Plot of School-based Cardivascular Fitness Interventions</td>
<td>67</td>
</tr>
<tr>
<td>4. Figure 3.3 Study Funnel Plot of Intervention Effects</td>
<td>69</td>
</tr>
<tr>
<td>5. Figure 4.1 Demographic Differences in Gross Locomotor Score</td>
<td>90</td>
</tr>
</tbody>
</table>
CHAPTER 1
INTRODUCTION

Physical inactivity is a social and cultural consequence related to the rapidly developing technology in children’s homes, schools, and everyday lives. Inactivity begins to develop at a young age and tracks into adulthood to create negative health consequences later in life (Kelder et al., 1994; Tammelin et al., 2014). Although young children have higher levels of physical activity (PA) compared to adults, increasing PA to the recommended levels of 120 minutes per day (structured and unstructured play) is still a significant public health challenge (Clark et al., 2002; Pate et al., 2015; Troiano et al., 2008). A review examining over 10,000 preschool children found that only half (54%) reached 60 minutes of PA per day, and other studies have shown that preschool-aged children spend a majority of their school day in sedentary activities (Cerin et al., 2016; Pate et al., 2008; Tucker, 2008). Multiple expert bodies, including the Institute of Medicine (2011) and the PA Guidelines Advisory Committee (2018), have emphasized the importance of increasing PA as a positive, preventive health behavior to combat major chronic diseases. Unfortunately, interventions to improve PA in preschool-aged children have had little success, underscoring the difficulty in changing PA patterns (Mehtälä et al., 2014). Although interventions to improve PA in preschool-aged children have been mostly unsuccessful, it is important to begin influencing behavior at age. Thus, this dissertation will focus solely on preschool-aged children.

PA is a complex behavior that is influenced by a multitude of factors across varying levels of the socioecological perspective. One model, the ecological model of PA, discusses both the intra- and extra- individual factors, including factors within microsystems (immediate setting), mesosystems (linkages between people in two or more microsystems), exosystems (linkages to settings external to the individual), and
macrosystems (broader socioecological context) that influence PA (Spence & Lee 2003). Embedded within this socioecological context, Stodden et al. (2008) have proposed a model whereby young children’s PA has a reciprocal relationship with their motor skills, such that early participation in PA helps children to develop motor skills and reinforces continued participation in PA as children age. The model by Stodden et al. (2008) also suggests that development of both PA and motor skills affect children’s health-related fitness (CVF) and weight profiles. A fully synthesized depiction of these two models is displayed in Figure 1.1.

Multiple studies have addressed many of the etiological factors that influence preschool-aged children’s PA, including individual level factors (e.g., innate PA levels and enjoyment of PA), family factors (e.g., parenting practices and logistical support for PA), school-related factors (e.g., outdoor play time, available play space, and teacher encouragement of play), and policy factors (e.g., school PA policy) (Dowda et al., 2009; Henderson et al., 2015; Hesketh et al., 2017; O’Connor et al., 2013). Additionally, the same perspective has identified etiological factors that are related to children’s weight profiles (Davison & Birch, 2001). To date, less focus has been placed on how etiological factors affect other constructs of the developmental model (i.e., perceived motor competence, motor skills, and health-related fitness).

**CVF and PA: An Ecological Perspective**

CVF, a component of health-related fitness, is defined as the ability to perform large-muscle, whole-body exercise at moderate to high intensities for extended periods of time, and is related to multiple health outcomes in both adults and children (Myers et al., 2015; Ortega et al., 2008; Physical Activity Guidelines Advisory Committee). CVF has previously been shown to be related to PA, as well as other developmental factors, but the pathways by which children’s environments affect CVF through PA have yet to be
assessed (Janssen & LeBlanc, 2010; Malina, 2001). Based on the significant bodies of literature connecting children’s environments to their PA, and PA to CVF, we posit that environmental influences will play a significant role in the development of children’s CVF during PA interventions. For preschool aged children, the majority of these interventions occur in early care and education centers (ECECs).

Several ECEC-based interventions using a socioecological approach have been designed to influence CVF (Nemet et al., 2011; Purder et al., 2011). These interventions focus on multiple levels of influence by targeting the home and ECEC environment microsystems, but they have also strived to influence the mesosystems’ linkages (e.g., parent teacher interactions) between the two. Interventions aimed at improving CVF in children have been mostly successful, but few have attempted to identify specific environmental components within children’s ecology that may be responsible for improving CVF. Additionally, only one review has looked at the successfulness of CVF interventions, but this study was narrow in scope and did not include several large school-based interventions, suggesting a critical review is needed (Pozuelo-Carrascosa et al., 2017). Thus, the first aim and hypothesis of this dissertation are as follows:

Aim 1: To conduct a critical systematic review and meta-analysis of studies on school-based interventions that attempt to affect CVF in children, while examining socioecological factors within children’s environment that may influence CVF development.

Hypothesis 1: School-based interventions that incorporate more levels of the EMPA will result in more robust intervention effects on CVF than interventions that incorporate fewer levels of the EMPA.
Motor Skill Development: An Ecological Perspective

In 2002, Clark and Metcalfe released a seminal piece of work titled, “The Mountain of Motor Development”, which uses mountain climbing as a metaphor to describe how individuals develop motor skills over the course of their lives and the need for both product-based (quantitative outcomes) and process-based (quality of the movement) assessments of motor skills (Clark & Metcalfe, 2002). This work represented the first stages in the creation of the developmental model by Stodden et al. (2008), which was later reviewed by Robinson et al. (2015), and is used in the model above (Figure 1.1). Both papers on the developmental model and the paper on the mountain climbing metaphor are detailed pieces of literature that synthesize what is known about how motor skills and guides to future areas of research (Clark & Metcalfe, 2002; Robinson et al., 2015; Stodden et al., 2008). In all three articles, it is acknowledged that children’s motor skills will develop at different rates, based on “environmental constraints”, but descriptions of these constraints throughout the literature are scarce (Clark & Metcalfe, 2002; Robinson et al., 2015; Stodden et al., 2008).

To date, only a few studies have examined the individual and family level microsystem factors that are related to preschool-aged children’s fundamental motor skills. Overall, findings from these studies show that parental beliefs, parental behaviors, family demographic characteristics, PA resources, and participation in organized sports were related to improved processed-based measures of gross motor skills, but no studies have been conducted using product-based measures (Cools et al., 2011; Barnett et al., 2013). There are also no studies that have assessed individual and family level microsystems for Hispanic preschool-aged children, a group that has been shown to have worse motor skills and worse health outcomes than their non-Hispanic
peers (Goodway et al., 2010; Ogden et al., 2016). Thus, the second aim and hypothesis of this dissertation are as follows:

Aim 2: To examine factors at the individual and family level that may be related to children’s process-based and product-based gross motor outcomes in a group of predominantly Hispanic children.

Hypothesis 2(a): Individual and family factors will be significantly related to gross motor skills in predominantly Hispanic children; (b) but will not be significantly different based on ethnicity (Hispanic vs. non-Hispanic); (c) or method used (product-based vs. process-based) to measure gross motor skills.

In addition to the individual and family microsystems, the ECEC microsystem is a critical environment that may affect preschool-aged children’s gross motor skills. Over 12 million children are currently enrolled in ECECs across the United States, and children spend on average 24.8 hours per week there (Iruka et al., 2006; SHAPE America, 2015). Although many preschool-aged children are currently attending ECECs, evidence related to factors within the ECEC that affect children’s motor skills are scarce. To date, three studies have examined the relationship between the ECEC environment and motor skills, with findings indicating that classroom size/child ratio, teacher education, playground size, number of field trips per month, electronic media use, availability of indoor and outdoor play areas, play area size, geographic region, and type of preschool are associated with process-based motor outcomes (Chow et al., 2013; Goodway et al., 2010; True et al., 2017). Findings also indicate that Hispanic children living in the southwestern U.S. had significantly worse gross locomotor outcomes than their non-Hispanic counterparts, but reasons for differences between regions were not explored (Goodway et al., 2010). Additionally, no studies have examined the relationship between the ECEC environment and motor skills using both quantitative and qualitative
gross locomotor outcome measures (product-based), suggesting that a deeper investigation on the associations between gross locomotor outcomes and the ECEC environment is needed. Thus, the third aim and hypothesis of this dissertation are as follows:

Aim 3: To examine the association between ECEC characteristics with process-based and product-based gross locomotor outcome measures in predominantly Hispanic school children.

Hypothesis 3(a): ECEC factors will be significantly related to gross motor skills in predominantly Hispanic children; (b) but will not be significantly different based on ethnicity (Hispanic vs. non-Hispanic); (c) or method used (product-based vs. process-based) to measure gross motor skills.

The EMPA has been consistently and successfully applied to numerous aspects of the developmental model (Figure 1.1), but there are several components of this pathway that have received much less attention where ecological perspectives are concerned (Spence & Lee, 2003). The goal of this dissertation is to provide preliminary evidence for an ecological perspective at the microsystem level when assessing motor competence and CVF fitness outcomes in preschool-aged children. As suggested by Spence and Lee (2003), ecological models can help to explain variance outside of individual level behaviors, which then can be used to examine interactions between microsystems at the meso-, exo-, and macrosystem levels. Moreover, by determining factors that influence motor skills and CVF at such a young age, interventions can be created that will improve children’s PA and health profiles as children become adults (Malina, 2001; Robinson et al., 2015).
Figure 1.1 Developmental Model Embedded in the Ecological Context of the EMPA
CVF-Cardiovascular Fitness; EC-Early Childhood; MC-Middle Childhood; LC-Late Childhood
CHAPTER 2
REVIEW OF LITERATURE

In the introduction chapter a developmental model embedded within an ecological context was proposed as the guiding framework for this dissertation (Figure 1.1). This review will expand on the information in the introduction through discussions on the use of ecological models, the importance of PA in early childhood, the relationships between different components of the developmental model, and the relationship between each part of the developmental model with important ecological contexts. This review is meant to identify critical gaps within the literature and serve as a guide to future areas of research, specifically by focusing on relationships between the proposed developmental model and contextual factors that have been shown to influence important developmental concepts (i.e., motor competence, perceived motor competence, weight and health-related fitness) and behavioral outcomes (i.e., PA).

Why use Ecological Models?

Ecological models have existed for over 40 years, yet still play a critical role in the way we view human development (Bronfenbrenner, 1977). Ecological models offer an organized process through which to view multiple environments of influence that can affect human behaviors and health outcomes. Over the years, the traditional ecological model has been modified and adapted to describe many different behaviors and health outcomes to assess factors more closely related to specific areas of research interest (Davison & Birch, 2001; Langille & Rodgers, 2010; Robinson, 2008; Spence & Lee, 2003). In relation to the behavioral health pathway addressed in this dissertation, there are two models that are pertinent to address: a contextual model for children weight and the ecological model of PA (EMPA) (Davison & Birch, 2001; Spence & Lee, 2003).
Davison and Birch (2001) discussed factors associated with children’s weight. Within this model, three distinct levels of influence are identified, including the individual, interpersonal, and the community level (Davison & Birch, 2001). Within the individual level, children’s developmental factors, behaviors, and genetics are claimed to influence weight (Davison & Birch, 2001). At the interpersonal level, parenting styles (e.g., parent encouragement of PA, parent monitoring of child TV viewing) and family characteristics (e.g., nutritional knowledge, parent dietary intake) are addressed, and at the outmost level, community (e.g., food accessibility, crime rates), demographic (e.g., family socioeconomic status, ethnicity) and societal characteristics (e.g., school lunch programs) are included (Davison & Birch, 2001). Each of these levels are hypothesized to influence children’s weight profiles and each other level of the model within it. Although this model addresses many of the factors that influence weight, it does not account for interactions between factors inside and factors outside of an individual’s environment. This is where the ecological EMPA supplies additional guidance (Spence & Lee, 2003).

The EMPA presents both the intra- and extra- individual factors that may influence PA behaviors and includes constructs from microsystems (immediate setting), mesosystems (interaction between two or more microsystems), exosystems (system external to the individual), and macrosystems (socioecological context) and interactions between those constructs that may influence PA (Spence & Lee, 2003). Unlike the model proposed by Davison and Birch (2001), the EMPA accounts for factors outside of a child’s own environment (e.g., a parent work environment, a teacher’s home environment) that may be related to children’s PA participation (Spence & Lee, 2003). Factors outside of the child’s own environment may help to explain added variance between individuals.
Although there is not currently a socioecological framework for examining factors related to motor competence, perceived motor competence, or cardiovascular fitness (CVF), the developmental model suggests that all the constructs that are part of the developmental pathway are related to PA; thus, it stands to reason that similar ecological factors may be affecting each of the model’s components (Robinson et al., 2015; Stodden et al., 2008). Figure 1.1 displays how the EMPA can be used as a guiding ecological framework to encompass the developmental model, and how PA is related to other important developmental factors within the ecological context.

**Physical Activity in Preschool-aged Children**

PA is any bodily movement produced by skeletal muscles that results in energy expenditure and can occur in multiple domains including occupational, leisure time, transportation, and household (Bouchard et al., 1994; Craig et al., 2003; Physical Activity Guidelines, 2018). Although all these domains of PA exist, children’s participation in some domains are more common than in others and will be the focus of this review within the context of PA promotion.

PA promotion in early childhood has been identified by several expert panels as an important behavior to combat multiple future behavioral health conditions, including obesity, cancer, cardiovascular disease, and diabetes, among others (Strong et al., 2005; Trembley et al., 2012). Each of these expert panels has created an individual, evidenced-based PA recommendation for preschool-aged children that ranges from 60 minutes of moderate to vigorous PA (MVPA) per day, up to 180 minutes of PA at any intensity per day (Strong et al., 2005; Trembley et al., 2012). In the United States, current federal guidelines do not specify a recommended amount of PA, but instead state that preschool-aged children should be physically active throughout the day to enhance growth and development and that caregivers of preschool-aged children should encourage active
play that includes a variety of activity types, with the stipulation being that more PA is better (Physical Activity Guidelines, 2018).

Despite this wide variety of recommendations, most preschool-aged children are not achieving the recommended PA levels (Tucker, 2008). Additionally, critical environments that influence children’s PA (e.g., weekend PA and school day PA) do not contain enough activity to contribute to their PA total (Cardon & Bourdeaudhuij, 2008). A recent study found that on average preschool-aged children take part in ~15 minutes of PA per hour, that boy children participate in more PA than girl children and that only 41.6-50.2% of children are reaching 180 minutes of PA per day (Pate et al., 2015). With so few children reaching recommended PA levels, it becomes important to assess how caretakers promote or discourage PA.

**Physical Activity at Early Care and Education Centers**

One avenue that has been found critical in addressing preschool-aged children’s PA is the ECEC. Over 12 million children are currently enrolled in ECECs across the United States and children spend on average 24.8 hours per week at ECECs, creating a significant leverage point to influence PA among preschool children (Iruka et al., 2006; Shape America, 2015). Multiple studies have examined the prevalence and correlates of children’s participation in PA within ECECs and some studies have indicated that preschool-aged children spend over 85% of their school days in sedentary activities and less than 3% of their time in MVPA (Pate et al., 2004; Pate et al., 2008). Additionally, ECECs have also been described as the location where children spend the most time inactive throughout their day (Cerin et al., 2016).

Research on the demographic correlates of PA for children who attend ECECs has shown that preschool-aged boys are more active than girls, that older children are less sedentary than their younger peers, and that children with better motor coordination
were more physically active than less coordinated children (Oleson et al., 2013; Pate et al., 2004; Tonge et al., 2016). Demographic correlates (e.g., sex, age, race, ethnicity, BMI) are important sources of PA variability, but together they only explain a small part of the variance associated with children’s PA levels (~4.3%-10%). When the ECEC that children attended was assessed in addition to demographic characteristics, models explained substantially more variance in children’s PA (~22.0-43.3%) (Pate et al., 2004; Pate et al., 2008). This larger proportion of explained variance suggests that the ECEC environment plays a key role in children’s PA patterns but does little to describe the components of ECEC that are related to PA outcomes.

The number of studies examining components of the ECEC that are associated with preschool-aged children’s PA is moderate, but to date many of the findings have been mixed (Tonge et al., 2016). Two components of ECECs that have been found to be consistently correlated with greater participation in PA include physical environmental variables (e.g., amount of outdoor play time, size of outdoor place space) and opportunities to be active, but other variables such as teacher education, teacher training, and ECEC policies have had less consistent findings [Cerin et al., 2016; Tonge et al., 2016]. The environmental characteristics that have had inconsistent relationships with children’s PA have often been used to develop ECEC-based PA interventions, which may be related to the success or failure of these interventions.

Although a review of all PA interventions that occur in ECECs is outside of the scope of this dissertation, several reviews addressing pertinent issues are presented. One review that examined PA interventions in ECECs using a socioecological approach, found that time allocated for gross motor activities, teaching training, teacher involvement in PA and playground size were associated with increased PA at the intra- and interpersonal levels (Mehtälä et al., 2014). At the organizational level, more space and
added structured, but not unstructured, outdoor playtime increased PA levels, and the presence of specific playground features (i.e., open grass area, grass hill, and a looping cycle path) was also associated with more PA (Mehtälä et al., 2014). A second systematic review, that tried to identify common factors associated with the success or failure of PA interventions, found that highly structured PA programs that were implemented 5 or 6 days a week were more effective than interventions which occurred only 3 days per week (Ward et al., 2010). Additionally, studies that focused on environmental and policy components and included both teacher training and improved activity environment were associated with increased PA, although increased outdoor time alone was not (Ward et al., 2010).

Based on the findings from this body of literature we can see that preschool-aged children are far from meeting PA recommendations during their time spent at ECECs, but that ECECs play a significant role in children’s daily PA levels. It should be noted that both reviews mentioned that ECEC-based PA interventions are a relatively new area of research and that a limited number of studies had been conducted. Taken together, this evidence suggests that research on ECEC characteristics that influence PA still have substantial room for growth and that factors related to PA may interact with one another in the ECEC environment.

In summary, ECECs offer a potential avenue to positively influence preschool-aged children’s PA, but the factors that influence PA within the ECEC may be much broader than previously expected. At the individual level, children’s sex, age, and motor skill proficiency appear to warrant further exploration, but characteristics of ECECs that are related to PA are still under debate. Nevertheless, children’s behaviors at ECECs explain a sizeable proportion of PA variance (~22.0-43.3%) and characteristics of these
critical environments are likely important for future studies attempting to influence PA patterns.

**Physical Activity in the Home**

Due to the large proportion of time that children spend in ECECs, they have become the most commonly studied avenue to promote PA in children, but there is also a significant portion of time in the afternoon and on weekends where children have opportunities to be physically active outside of the ECEC (Verbestel et al., 2011). During times when children are not in the ECEC, parents play a critical role in influencing the amount of PA that children take part in (O’Connor et al., 2013). Moreover, parents’ promotion of PA behavior is often related to their environmental and cultural factors (O’Connor et al., 2014). Reviews that have examined parenting correlates of preschool-aged children’s PA have found that parents’ encouragement and support of PA are related to greater participation (Mitchell et al., 2012; Xu et al., 2015). Parents’ participation in PA can provide modeling opportunities for young children to learn about PA, which could also lead to greater participation (Mitchell et al., 2012). Additionally, Mitchell and colleagues (2012) found instrumental support (e.g., providing transportation, buying PA resources) to be associated with higher levels of PA in young children, but further studies are needed to assess this relationship.

When investigating parenting interventions to promote PA in young children, two reviews have found that positive parenting practices may be related to improved PA outcomes, but the lack of methodological rigor, use of multiple measures of parenting, and limited number of studies that measured change in both parenting and outcome variables limits firm conclusions (O’Connor et al., 2009; Skouteris et al., 2011). Additionally, both reviews described the body of literature on the relationship between parenting and children’s PA as in its infancy and many of the interventions included in
the reviews only tried to influence parents utilizing a family component of an ECEC-based intervention (O'Connor et al., 2009; Skouteris et al., 2011). Further studies that focus on parenting specific interventions are needed to determine the influences of parenting variables on preschool-aged children’s participation in PA.

**Physical Activity and the Neighborhood Environment**

Another area of research that is found to be in its early infancy is the relationship between the PA of preschool-aged children and the neighborhood environment (Christian et al., 2015). Studies that have examined the association between the neighborhood environment and PA of preschool-aged children have found that housing density was associated with more PA in boys and that more park space was associated with more PA in boys and girls (Roemmich et al., 2006). Time spent in parks and distance to the nearest park were also correlated with more PA in boys and girls, and more neighborhood amenities and fewer pathway obstructions have been found to be associated with greater outdoor play (Cerin et al., 2016; Lee et al., 2016; Pfeiffer et al., 2009). Other studies have found that neighborhood safety and walkability were not associated with PA in preschool-aged children, but a limited number of studies limits confidence in these findings [Burdette & Whitaker, 2005; Lee et al., 2016]. Overall, specific neighborhood characteristics may be associated with more PA in preschool-aged children, but the current body of evidence is small. More studies, including longitudinal studies that assess multiple characteristics of the neighborhood environment are needed before making a recommendation on the relationship between the neighborhood environment and PA in preschool-aged children.
Future Ecological Research Recommendations for PA in Preschool-aged Children

Preschool-aged children’s PA participation has been assessed within the context of individual, school, home and neighborhood microsystems, with the most evidence found within the individual and ECEC environments. Evidence has found that individual level components account for a small part of variance (~10%) between individuals PA levels, with more variance explained by the ECEC that children attend (~20-43%). Given the wide range of variability in explained variance and the limited number of studies within microsystems outside of children’s ECEC, the following recommendations for future research are made:

1. Outside of demographic correlates, researchers should continue to examine factors at the individual level that may explain preschool-aged children’s PA patterns. These factors may be biological, behavioral, developmental, or psychological in nature as individual factors likely explain more than 10% of the variance in PA outcomes.

2. The wide degree of variability in explained variance by a child’s ECEC (~20-43%) cannot be described by ECEC characteristics alone. Based on the conflicting evidence surrounding ECEC factors that influence preschool-aged children’s PA, it is recommended that interactions with children’s individual and home-based factors be used to help account for variance explained at the ECEC level.

3. Individual and ECEC level characteristics account for a total of ~43% of explained variance in preschool-aged children’s PA behaviors. Research at the family and neighborhood levels has begun to name added factors that influence the PA of preschool-aged children. More longitudinal study designs are needed to
determine the direction of these associations and their impact on changes in PA patterns.

**Motor Skills in Preschool-aged Children**

PA has been the most often studied factor within the context of health and health behavior pathways, but motor skills are considered the foundational building blocks related to human movement and a critical component of PA development in young children (Clark & Metcalfe, 2002; Robinson et al., 2016; Stodden et al., 2012). Children’s motor skills begin to develop at birth and transition through five distinct stages of motor development, including reflexive, preadapted, fundamental motor patterns, context specific movement, and skillful movement – the final of which tends to co-inside with the onset of puberty (Clark & Metcalfe, 2002). Most typically developing preschool-aged children are still in the fundamental movement patterns period and will stay in this period until about age seven, when they begin to apply their skills to context specific movements (e.g., sports, household chores) (Clark & Metcalfe, 2002). Developmental patterns may differ for children with developmental delays or movement disorders, but literature related to those areas will not be discussed here.

During the fundamental movement phase three domains of motor behavior emerge. These domains include locomotor skills (e.g., running, swimming and jumping), object projection skills (e.g., throwing, pushing, and kicking), and object interception skills (e.g., catching, deflecting, and stopping). These three skills, which form the basis for motor competence, are related to continued participation in PA as children age and need to be developed through practice and participation (Clark & Metcalfe, 2002; Goodway et al., 2003; Loprinzi et al., 2015; Robinson et al., 2015).

Although there are only three domains of fundamental movement skills, these domains need to be further classified into distinct types of movement to assess them.
Movements can be broken down into gross motor skills and fine motor skills. Gross motor skills, are movements like swimming or swinging a bat, require the coordination of multiple large muscle groups at once (Clark & Metcalfe, 2002). Fine motor skills are those that use small muscles groups for precise movements like writing, typing, or speaking (Clark & Metcalfe, 2002). Although both gross and fine motor movements are important to well-adapted daily function, gross motor movements are more closely related to other components of the developmental model (Figure 1.1) and thus, will be referenced when the terms “motor skills” or “motor competence” are used in this dissertation (Cools et al., 2009; Loprinzi et al., 2015; Robinson et al., 2015).

Both gross and fine motor skills can be measured using product-based or process-based measures (Figueroa & An, 2017). Product-based assessments evaluate the outcome of that movement, and process-based assessments evaluate how a movement is preformed (Logan et al., 2017). Both types of assessments are important, as the quantitative outcomes may not always be related to the quality of the movement produced, and these relationships change over time (Capio et al., 2013). Since measurements from product-based and process-based assessments may not always be perfectly correlated, it is recommended that both be used to gain an accurate understanding of motor skills competence (Logan et al., 2017). For a review of validated movement skill assessments in preschool-aged children, please see the review by Cools and colleagues (2009).

Although there is currently not an ecological model to guide motor competence, it has been suggested that children’s environments may affect the development of their motor skills (Clark & Metcalfe, 2002; Robinson et al., 2015; Stodden et al., 2008). These environments can include children’s homes, schools, neighborhoods, out of school learning activities, or any other environments were children spend a sizeable part of
their day (Hofferth & Sandberg, 2001). As previously stated, young children spend a significant part of their day at ECECs; thus, this environment has received the most attention.

**Motor Skills and Early Care and Education Centers**

Although guidelines for PA recommendations are more common than guidelines written for motor skills, many of the PA guidelines also emphasize the importance of motor skill development. For example, the US PA guidelines state that preschool-aged should be physically active throughout the day to enhance growth and development, suggesting that the development of motor skills is an important outcome for PA participation (Physical Activity Guidelines 2018). Additionally, 3 out of 5 Active Head Start Guidelines for PA in preschool-aged children are related to motor development and ECEC teachers often follow guidelines that assess children’s motor development in the classroom (e.g., teaching strategies GOLD) (Lambert et al., 2014; National Association for Sport and Physical Education, 2009).

Studies within the ECEC learning environment that have examined the cross-sectional associations between individual level characteristics and motor skill competence in preschool-aged children have found that children’s age, sex, BMI and the specific activities that children choose to participate in were related to various motor outcomes (Barnett et al., 2010; O’Neill et al., 2014; True et al., 2017; Yang et al., 2015). When demographic associations were examined by domain of motor competence, only age significantly influenced total motor, object control, and locomotor skill scores (Yang et al., 2015). Sex had a small influence on object control skills, and BMI was found to have even smaller influence on all three domains (Yang et al., 2015). Specific activities that were correlated with total locomotor score included skipping and jumping, and
dancing and throwing were associated with gross locomotor and object control domains, respectively (O’Neill et al., 2014).

At the ECEC level, some characteristics that were found to be associated with motor skill development included classroom size/child ratio, teacher education, playground size and electronic media usage (True et al., 2017). When gross locomotor skills were examined specifically, it was found that classroom size/child ratio, teacher education, and electronic media usage remained significant predictors of children’s motor skills, whereas number of field trips per month emerged as a new predictor (True et al., 2017). No associations were found between ECEC characteristics and object control scores (True et al., 2017). In other studies, that used only process-based measures of motor skills, the availability of indoor and outdoor play areas, play area size, geographic region and type of ECEC (public vs. private) were also shown to be associated with motor competence (Chow et al., 2013; Goodway et al., 2010).

Although similar to PA, these findings have variations that need to be explored. For example, teacher education appears to influence motor skill development, but not total PA participation, which suggests that more teacher education may be required to promote motor skill competence than PA (Tonge et al., 2016; True et al., 2017). Additionally, child to teacher ratio was a found to be a significant predictor of motor skills, but not PA, which may be due to the amount of specialized instruction time required to teach children motor skills.

Although initial findings on ECEC environmental factors influencing children’s motor skills appear to have some slight differences from PA, there have been no studies that have synthesized the evidence related to this relationship. Additionally, no studies have used both product-based and process-based measures of gross motor skills within the same study. Due to the limited number of studies and many threats to internal
validity within these studies, confidence in these findings is reduced. These limitations suggest that a deeper investigation on the associations between gross locomotor outcomes and the ECEC environment is warranted, emphasizing studies representing diverse populations that use longitudinal designs.

Despite the limited cross-sectional evidence on ECEC factors and preschool-aged children’s gross motor skills, two reviews of longitudinal studies have examined the effectiveness of interventions to improve motor skills in young children (Riethmuller et al., 2009; Veldman et al., 2016). Of the 24 studies included in both reviews, 17 of them show statistically significant findings for the improvements of motor competence (Riethmuller et al., 2009; Veldman et al., 2016). The review by Riethmuller and colleagues (2009) found that 65% of the studies were effective at improving motor skills and made three recommendations for future studies assessing motor competence. These recommendations included teachers and researchers should both be involved in the implementation of an intervention, that parent involvement in the intervention is critical for transfer on knowledge to the home environment, and that interventions are methodologically sound. (Riethmuller et al., 2009). Methodology quality was of concern because seven of ten articles were unpublished and only one study was rated by the reviewer as having high methodological quality (Riethmuller et al. 2009).

The review by Veldman and colleagues (2016) updated the earlier review by Riethmuller and colleagues (2009) and found that 86% of the studies included were effective at improving motor outcomes. Related to the previous recommendations by Riethmuller and colleagues (2009), six of the seven studies were implemented by center staff and supplemented with training by a research team, only two of the seven studies included parents, and four out of the seven studies were of high methodological quality (Veldman et al., 2016). Despite the increased quality of the studies in the review,
Veldman and colleagues (2016) mentioned the lack of detail about intervention programs as a limitation, which made comparison of intervention components at the ECEC level difficult.

Overall, findings suggest that ECEC-based interventions are an effective means to improve the motor skills of preschool-aged children and that including multiple ecological levels (e.g., home, community) outside of the ECEC is a positive way to increase intervention effects. Despite the sizeable number of effective ECEC-based interventions for improving motor outcomes, few studies have examined characteristics of the ECECs and components of ECEC-based interventions that are related to higher motor competence. Effective components of ECEC-base should be examined further to determine if they are similar to those utilized in PA interventions, or whether alternative intervention components are needed to influence motor outcomes.

**Motor Skills and the Home Environment**

Due to the small number of studies that have examined the relationship between the home environment and motor skills in preschool-aged children, limited evidence exists. Two studies examining the association have found that family characteristics related to higher motor competence include parental beliefs (importance of PA), parental behaviors (paternal PA, active transportation, and providing activity resources), and family demographic characteristics (parental education, parental socioeconomic-status, and number of children in the household) (Cools et al., 2011; Venetsanou et al., 2010). In addition, a second group of studies examining the association between family environmental supports and motor skills found that home PA resources, enrolling child in swimming activities, and more outdoor space were related to improved motor competence (Barnett et al. 2013; Hua et al. 2015). Overall, current evidence suggests that the family environment is an important correlate of preschool-aged children’s motor
skills, but the number of studies assessing each type of support is minimal. To determine significant factors associated with motor competence at the family level, more studies across various populations need to be conducted.

In addition to the small number of cross-sectional studies assessing family factors, only ~20% of school-based motor skill interventions have included a parent component. Successful motor skill intervention studies including parents have supplied tools, resource packets, and encouraged parents to reduce sedentary time in several ways (Birnbaum et al., 2017; Hamilton et al., 1999; Reilly et al., 2006; Riethmuller et al., 2009). Despite the success of these interventions, more research is needed to determine parent intervention components that are successful and how each of these components are related to intervention outcomes. Current recommendations suggest that parents should be included in motor skill interventions, as they are key to improved motor outcomes in preschool-aged children (Riethmuller et al., 2009). Based on the current evidence, this recommendation may be too strong. Instead, studies should focus on examining parental methods of supporting children’s motor skill development, so future interventions can utilize parental components following evidenced-based recommendations.

**Motor Skills and the Other Environments**

In addition to the home and the ECEC environments, there have been a small number of studies that have assessed characteristics of other potentially influential environments on preschool-aged children gross motor skills. Victoria and colleagues (1990) measured motor movements in preschool-aged children from Brazil and England and found that children from cultures that promote spontaneous movement, such as Brazil, have children with better movement skills than children from cultures that promote self-contained, quiet, work-oriented behaviors, like England. These findings are
similar to a previously cited study which found children from the Midwest US scored better on qualitative tests (process-based) of gross motor skills than children from the Southwest US (Goodway et al., 2010). The association between culture and motor skills development is an interesting finding, but caution is warranted. Tests of motor skill development are often content specific to the regions where they were developed; thus, differences may be due to regional testing protocols as opposed to true findings (Robinson et al., 2017).

**Future Ecological Research Recommendations for Motor Skills in Preschool-aged Children**

Overall, building fundamental motor skills in preschool-aged children is a critical part of early development that cannot be ignored. Although much has been done to examine individual level factors that influence motor development, recent lines of research suggest that children’s activity environment may play a vital role in the rate at which skills develop. Based on these assumptions, the following recommendation are made on ways to build the body of literature surrounding motor development, so critical environments affecting these skills can be explored further:

1. Research should continue to examine factors within family, school, and neighborhood microsystems, across multiple racial and ethnic populations, which influence the development of preschool-aged children’s motor skills using both product-based and process-based measures.

2. Researcher should review the current literature on the relationship between environmental determinants and preschool-aged children’s gross motor skills, which will provide evidence-based research recommendations on ways to incorporate environmental components into interventions and provide guidance on additional environments that need further study.
3. Researchers should work across labs and countries to determine quality testing methodology that can be consistently applied to measure product-based and process-based gross motor skills, which will allow comparison of work across populations, studies and levels of ecological models.

**Perceived Motor Skill Competence**

PA and motor skill competence are the short-term outcomes of the most interest to researchers, but perceived motor competence is a precursor that may facilitate changes in both PA and motor skill outcomes in early childhood (Robinson et al., 2015; Stodden et al., 2008). Perceived motor competence is defined as an individual’s perception of their movement capabilities, which once developed is believed to have a reciprocal relationship with motor competence and PA (Harter & Leahy, 2001). The developmental model states, young children with higher motor competence will engage in more PA and develop better motor skills, which then reinforces their belief that they have better motor competence than their peers (Robinson et al., 2015; Stodden et al., 2008).

A meta-analysis by Babic et al. (2014), found a low correlation ($r=.08$) between PA and motor competence in preschool-aged children that increased in middle and late childhood ($r=.30$), which suggests that perceived motor competence may predict PA as children age. Although this meta-analysis begins to support a reciprocal relationship between PA and perceived motor competence, only one study of preschool-aged children was included (Planinšec et al., 2005). Additionally, the one study that examined the relationship between PA and motor competence in preschool-aged children utilized parent proxy report as a measure of PA, which is considered a low validity measure of PA (Pate et al. 2010; Planinšec et al., 2005). Based on the findings of one study, there is not
enough evidence to support the relationship between perceived motor competence and PA in young children.

When examining the relationship between motor competence and perceived motor competence in preschool-aged children, several studies have found perceived motor competence to be related to actual motor competence, but a similar number of studies have seen contradictory findings (Famelia et al., 2018; Lopes et al., 2016; Robinson, 2011; Spessato et al., 2012; Toftegaard-Stoeckel et al., 2010). A study by Toftegaard-Stoeckel et al. (2010) found that factors related to perceived motor competence included BMI, teacher perceptions of children’s motor competence, and children’s actual motor competence. Despite these findings, a majority of the literature suggests that measures of perceived motor competence do not align with current measurements of motor skills and that parent proxy reports of motor competence are only weakly related to motor outcomes in preschool-aged children (O’Neill et al., 2014; Robinson et al., 2015; Zysset et al., 2018). New valid measures of perceived motor competence that alight with measure of motor competence are needed to determine if relationships between variables exists.

**Future Ecological Research Recommendations for Perceived Motor Competence in Preschool-aged Children**

In one study an association was found between perceived motor competence and actual motor competence, but the majority of literature suggests that measures of perceived motor competence do not align with current measurements of motor competence (Famelia et al., 2018; Lopes et al., 2016; Robinson, 2011; Spessato et al., 2012; Toftegaard-Stoeckel et al., 2010). Taking this limited body of evidence into account, more research delineating the specific relationship that perceived motor competence has with PA and actual motor competence is needed.
The Relationship between Motor Skills and PA

At the center of the developmental model, PA and motor skill development are shown to have a reciprocal relationship (Robinson et al., 2015; Stodden et al., 2008). As part of this reciprocal relationship, early childhood PA predicts motor skills development, which then reinforces participation in more PA as children age (Figure 1.1) (Robinson et al., 2015; Stodden et al., 2008). The relationship between PA and motor skills is extremely important in young children, as Seefeldt and colleagues (1980) suggest that there is a “hypothetical motor proficiency barrier”, which once overcome will reinforce children’s engagement in PA throughout the life course.

Two reviews of cross-sectional studies that examined the relationship between PA and motor skills found a significant positive association between variables in a majority of studies (8/11 and 4/4) (Figueroa & An, 2017; Logan et al., 2012). Although a relationship was found to exist, studies within the review found that the strength and the direction of the association may differ based on the intensity of PA, the time of week PA occurs, the gender of the child, and the domain of motor skills assessed (Cliff et al., 2009; Fisher et al., 2005; Foweather et al., 2015). For example, Cliff and colleagues (2009) found that object-control skills had strong positive associations with PA in boys, but locomotor skill competence had strong negative associations with PA in girls. In another example, MVPA was shown to be associated with both locomotor and object control scores, but total PA was only associated with object control scores (Foweather et al., 2015). In a third study, Robinson and colleagues (2012) examined school day PA and motor competence and found that children’s locomotor skills accounted for ~21% of variance in their school day PA, while a child’s sex, body mass index (BMI), and object control skills made no difference in motor outcomes. Despite the multiple variations in the strength of the association between PA and motor competence, it is highly likely that
a real association exists within preschool-aged children. The next step in determining the relationship between PA and motor competence is to examine the direction of this relationship over time.

**Longitudinal Relationship between PA and Motor Competence**

Despite a cross-sectional relationship between PA and motor competence, a small number of studies have examined the relationship longitudinally (Barnett et al., 2009; Larsen et al., 2015; Lima et al., 2017; Lopes et al., 2012). Lopes and colleagues (2012) examined the longitudinal relationship between motor competence and self-report PA and found that children who had higher levels of motor competence at age six, also had higher levels of PA at age nine, compared to their peers with lower motor competence. Barnett et al. (2009) examined the association between self-report PA with motor competence domains and found that object control skills, but not locomotor skills in childhood were associated with more PA in adolescence.

Research that studied the relationship using objective measures of PA found that improvements in motor competence and improvements in PA were related at three and seven years after initial measurements (Larsen et al., 2015; Lima et al., 2017). In addition, Larsen and colleagues (2015) also found that health-related fitness was an important predictor of improved MVPA, although it was more important in boys than in girls. The study by Lima and colleagues (2017) opted for a structural equation modeling approach and determined that vigorous PA was associated with better motor competence longitudinally, but that MVPA was only associated with motor competence when mediated by CVF. In the opposite direction, motor competence was associated with increased vigorous PA and MVPA, but again the association with MVPA was moderated by CVF (Lima et al., 2017). Overall, a 1 standard deviation increase in either PA or motor
competence was associated with a .11-.18 standard deviation increase in the other variable at 7 years follow up (Lima et al., 2017).

Although findings from most studies show a consistent positive relationship between PA and motor competence, these variables tend to have a low to moderate correlation with one another. Additionally, each variable (motor competence or PA) only explains ~10% of the variance in the other variable, after controlling for potential confounders (Malina et al., 2016). Overall, there is a substantial body of evidence that supports a relationship between PA and motor competence, but the role of CVF is only just beginning to be understood.

These finding have important implications for future health. PA has been shown to be consistently related to multiple health outcomes, whereas the relationship between motor competence and health is just beginning to be understood. The relationship between PA or motor competence and chronic health conditions (e.g., cancer, diabetes, or cardiovascular disease) cannot be seen in preschool-aged children, but the presence of a relationship with health-related fitness has often been explored (Donnelly et al., 2016; Lubans et al., 2010; Strong et al., 2005).

**Physical Activity, Motor Skills, and Health-related Fitness**

PA and motor skill development have been shown to be connected to one another, but also to be related to multiple health-related fitness outcomes (Barnett et al., 2016; Cattuzzo et al., 2016). The developmental model suggests that in early childhood, both PA and a motor competence aid in the development of health-related fitness (Figure 1.1) (Robinson et al., 2015; Stodden et al., 2008). As children age into middle and late childhood, health-related fitness then mediates the relationship between motor competence and PA, which would allow children to engage in PA for longer periods of time (Robinson et al., 2015; Stodden et al., 2008). Health-related fitness outcomes can
be broken down into five domains including body composition, CVF, flexibility, muscular strength and muscular endurance, which are already measured in many school-aged children (Ortega et al., 2015; Plowman et al., 2006). Body composition is the most commonly studied health-related fitness outcome measure, followed by CVF, muscular strength and endurance, and flexibility. The next sections will describe the evidence for relationships of each health-related outcome with PA and motor skills in preschool-aged children.

**Physical Activity, Motor Competence and Weight in Preschool-aged Children**

In 2010, 43 million (6.7%) preschool children were considered overweight or obese worldwide, a relative increase of 60% from 1990 (De Onis et al., 2010). In 2014, Ogden and colleagues reported that obesity rates began leveling off in children age 2-5-years old, but Skinner and his colleagues (2018) suggest that these rates continue to increase. Prevalence data from 2015-2016, among children age 2 to 5-years-old in the United States, suggest that one in four (26%) children are overweight and that one in every eight children (13.7%) is obese, both up 4% from 2011-2012 data (Skinner et al., 2016). Due to the high prevalence of overweight and obese preschool-aged children, the role weight plays in development is often an area of research interest. Within the developmental model, weight is separated from other areas of health-related fitness and believed to play a feedback role in the developmental process (Stodden et al., 2008). Stodden and colleagues (2008) hypothesized that increased weight creates a negative engagement spiral, which promotes decreased PA as children age; alternatively, children with normal weight have a positive engagement spiral, which predicts greater future participation in PA.
Due to the substantial number of studies that have examined the relationship between PA and weight in preschool-aged children, several reviews have been presented herein. Timmons and colleagues (2012) examined randomized controlled trials of PA interventions and found that PA interventions had no effect on the BMI of preschool-aged children, but longitudinal studies included in the review found that more PA at a young age was associated with improved weight profiles later in life (Timmons et al., 2012). A newer review by Carson et al. (2017), found limited evidence for a relationship between PA and weight in very young children, with the majority of studies (37/57) showing null, mixed, or unfavorable results for the relationship. Overall, these findings indicate that PA may not affect weight within preschool-aged children, but that PA participation may help to promote a positive weight trajectory as children age.

Cross-sectional studies have also examined the relationship between motor competence and weight within preschool-aged children. Studies that examined the relationship using process-based measures found a low-to-moderate strength relationship between motor competence and weight, while studies that have examined the relationship using product-based measures only found differences between clinically meaningful groups (i.e., normal weight vs. overweight and obese children) (Krombholz et al., 2013; Logan et al., 2011; Morano et al., 2011; Nervik et al., 2001; Saraiva et al., 2013; Vameghi et al., 2013). One study examined the relationship between motor competence and weight longitudinally but did not find a significant association at follow up (Hands, 2008). This finding provides some support for a motor proficiency barrier, as clinically meaning differences in weight may provide a barrier to the development of motor skills in children.

A more recent study that examined BMI, PA and motor competence within the same analysis, provided more conflicting findings (Guo et al., 2018). Guo and colleagues
(2018) found no association between PA and BMI and no association between BMI and motor competence, although BMI score did moderate the relationship between motor competence and PA. Children with higher BMI scores and high motor competence participated in more PA. Findings from this study highlight the complexity of the relationship among variables in the developmental pathway and signify the need for further studies to assess interactions within this pathway.

Overall, the evidence for a relationship between PA and weight, or motor competence and weight, is minimal, which may be due to the complicated connections between biology and the environment (Barnowski et al., 2019). Children with one (91%) or two (238%) obese parents are more likely to be obese adults, compared to children with no obese parents, but reasons for this are not well understood (Manios et al., 2007). The relationship between a child’s weight status and parents’ weight status is likely genetic, in part, but shared environment may also play a role through mediational health behaviors (e.g., PA, nutrition, sleep) (Albuquerque et al., 2017). In summary, current evidence does not support an association between PA or motor competence and weight, but interactions of these variables with biological and environmental factors should continue to be explored as potential pathways for improving weight profiles.

**Physical Activity, Motor Competence and Cardiovascular Fitness in Preschool-aged Children**

CVF is defined as the ability to perform large-muscle, whole-body exercise at moderate to high intensities for extended periods of time and has been shown to be related to both PA and motor competence in preschool-aged children (Bürgi et al., 2011; Leppänen et al., 2016; Physical Activity Guidelines, 2018; Taylor et al., 1955; Valhov et al., 2014). In addition to PA and motor competence, CVF has also been shown to be related to preschool-aged children’s weight profiles, blood lipid profiles and cognitive
function, along with being related to reduced health risk in early adolescence and adulthood (DuBose et al., 2007; DuRant et al., 1993; Goñi et al., 2017; Henriksson et al., 2016; Martinez-Tellez et al., 2016; Niederer et al., 2011; Ortega et al., 2018). Due to CVF’s relationship with so many significant health outcomes across the lifespan, research has examined it as a critical component of health-related fitness within preschool-aged children.

A major review that examined PA and CVF in young children found that there was a significant positive relationship between variables (Carson et al., 2017). Despite this consistent association, the quality of evidence in the review was rated as very low (Carson et al., 2017). All three of the studies in the review did not control for potential confounders, which suggests potential bias within the studies (Carson et al., 2017). Other studies outside of those included in the review have also seen positive relationships between PA and CVF in preschool-aged children and suggested that more vigorous PA may be needed to see CVF improvements (Bürgi et al., 2011; Leppänen et al., 2016). A similar number of conflicting findings refute that hypothesis and suggest that only light or moderate PA is needed (Fang et al., 2017; Tanaka et al., 2012). Although evidence for the intensity of PA needed to improve CVF demonstrates conflicting findings, there appears to be a real relationship between PA and CVF. Future studies are needed to determine the PA prescription that should be used to produce CVF improvements in preschool-aged children.

The most recent review that examined the relationship between motor competence and CVF in children and adolescents found that 16/16 studies had a significant positive association between variables (Cattuzzo et al., 2016). Studies that examined the association in preschool-aged children more specifically, used only product-based measures of motor skills and found that there was a low to moderate
correlation between motor competence and CVF (Reeves et al., 1999; Stodden et al., 2013). More studies, using process-based measures are needed to determine associations between motor competence and CVF in preschool-aged children.

Two longitudinal studies have examined the relationship between motor competence and CVF in preschool-aged children. In one longitudinal study, young children with better motor skills also had greater CVF in middle childhood (Hands 2008). The second longitudinal study used both locomotor and object control scores to measure motor competence and found that both types of motor skills were related to improved CVF in high school, but that object control scores were a slightly better predictor of improved CVF outcomes than locomotor skills (Valhov et al., 2014). Although these studies provide support for the association between CVF and motor competence in preschool-aged children, none of the studies that assessed the relationship controlled for PA. Due to the known relationship between PA and motor competence, lack of control for PA suggests that there might be collinearity issues in the relationship between motor competence and CVF that future studies should address. Additionally, the two studies that have collected data on motor competence, PA, and CVF together, have only examined the role of CVF as a mediator and not as an outcome in preschool-aged children (Bürgi et al., 2011; Lima et al., 2017). Although evidence from this literature review suggests that motor competence and PA are related, the role that PA plays in this relationship needs further assessment before promoting motor competence as a means to improve CVF outcomes.

Several studies have also examined environmental factors correlated with CVF in preschool-aged children. Studies that examined the relationship between parents’ characteristics and CVF found that parental age, socio-economic status, and self-efficacy for PA were not related to CVF in preschool-aged children, but that parents enrolling
children and allowing them to participate in sports were related to improved CVF outcomes (Drenowitz et al., 2013; Ebenegger et al., 2012; Latorre-Roman et al., 2016; Parekh et al., 2017). Findings from these studies are not surprising. Based on the model by Stodden and colleagues (2008), CVF is a health outcome that needs to work through PA or motor competence to produce an effect; thus, parents’ characteristics should not be directly associated with CVF, but may influence CVF indirectly or as a moderator.

Despite limited evidence for the environment producing an effect on CVF, many successful school-based PA interventions have used multiple ecological levels when intervening to improve CVF outcomes (Eliakim et al., 2007; Purder et al., 2011; Tan et al., 2016). Interventions attempting to influence CVF have included intervention components within the home, school, and neighborhood microsystems, but factors within each of those environments that led to successful CVF changes were not examined (Eliakim et al., 2007; Purder et al., 2011; Tan et al., 2016). Although successful intervention components were not identified, these interventions provide support for a pathway between the environment and CVF, though PA. Future studies should examine interventions within this pathway to determine the extent to which the environment can influence CVF.

Overall, studies that have examined the longitudinal association between PA and CVF have found that intra-individual correlations between CVF in adolescence and CVF in adulthood ranged between .30 and .74, which suggests that the development of CVF in early age is an important predictor of adult CVF (Janz et al., 1999; Malina, 2001). Based on available evidence, it appears that there is an association between both PA and motor competence with CVF, but that the pathway through which CVF is developed is not fully understood. Additionally, the role that critical developmental environments play on influencing this pathway remain mostly unexplored. Additionally, findings related to the
development of CVF in preschool-aged children should be tempered by the lack of studies reporting on validated measure of CVF, although many measurements are highly reliable (Bénéfice et al., 1999; Niederer et al., 2012; Oja & Jürimäe, 1997; Ortega et al., 2015; Reeves et al., 1999; Rikli et al., 1992). In summary, the environment may be related to CVF development, but likely through pathways that involved PA, motor competence, or both. Future studies attempting examine the pathways between the environment and CVF should include PA or motor competence in their analyses.

**Physical Activity, Motor Competence and Muscular Strength/Endurance in Preschool-aged Children**

Muscular strength and muscular endurance are two measures of musculoskeletal fitness that are often analyzed together; thus, they will be presented together here (Cattuzzo et al., 2016; Institute of Medicine, 2012). To date, musculoskeletal fitness has not been shown to be related to health benefits in preschool-aged children, mostly due to the small amount of research that has examined the relationship (Cattuzzo et al., 2016). Although there are a limited number of studies that have examined musculoskeletal fitness in preschool-aged children, it has been found to be connected to health benefits for older children, suggesting that the relationship may be important in preschool-aged children as well (Millard-Stafford et al., 2015).

The one study that examined the relationships of moderate PA, vigorous PA, and MVPA with measures of musculoskeletal fitness in preschool-aged children found that MVPA and vigorous PA were associated with greater upper body strength (handgrip test) and lower body strength (long jump), but that moderate PA alone was not (Leppänen et al., 2016). Two studies that have examined the relationship between motor competence and musculoskeletal fitness in preschool-age children, also found a positive association (Hands, 2008; Stodden et al., 2014). In the study by Stodden and colleagues (2014),
children were tested on push-ups, curl-ups, grip strength, and PACER tests, and a health-related fitness variable was calculated by combining normalized scores for all four tests. This health-related fitness score was significantly correlated with kicking and jumping motor outcomes, but was not associated with throwing (Stodden et al., 2014). In the second study, preschool-aged children were pair matched into low motor competence and high motor competence groups and completed test of musculoskeletal fitness over the course of 5 years (Hands, 2008). Children in the low motor competence group performed significantly worse on a standing long jump test, than their high motor competence peers at all testing timepoints (Hands 2008).

Overall, three studies show an association of motor competence and PA with musculoskeletal fitness in preschool-aged children, but limitations (i.e., combined health-related fitness measures, limited number of tests, and small sample size) temper confidence in these findings. Stodden and colleagues (2014) cited that preschool-aged children have difficulty completing pushups and sit-ups, which is an added barrier to testing validity, and only recently have field-based tests of musculoskeletal fitness received formal testing protocols for use in preschool-aged populations (Ortega et al., 2015). Future studies should continue to examine the relationship of PA and motor competence with musculoskeletal fitness in preschool-aged children using valid testing protocols.

**Physical Activity, Motor Competence and Flexibility in Preschool-aged Children**

Similar to musculoskeletal fitness, the relationship of PA and motor competence with flexibility has received little attention in preschool-aged children. There have been no studies that have connected flexibility and improved health profiles in preschool-aged children and the evidence related to flexibility in older children and adults also suggests
that they are minimal health benefits conferred (Ortega et al., 2015; Physical Activity Guidelines, 2018). No recent studies that examined the relationship of flexibility with PA or motor competence in preschool-aged children could be found.

**Future Ecological Research Recommendations for Health-Related Fitness in Preschool-aged Children**

Due to the small number of studies connecting PA and motor competence to musculoskeletal fitness or flexibility and the large number of studies that show null or mixed findings with weight, CVF appears to be the health-related fitness outcome that is most influenced by PA and motor competence in preschool-aged children. There also appears to be a small number of studies that have influenced CVF through ECEC-based PA interventions. Considering these findings and the proposed importance of health-related fitness in the developmental pathway, the following recommendations are made:

1. Future studies should use mediational models to examine environmental factors that influence CVF in preschool-aged children through PA, while controlling for other important biological factors.

2. Due to the large number of school-based intervention studies that have aimed to influence CVF, researchers should summarize this evidence to determine whether school-based interventions are an effective means of increasing CVF, while examining components of interventions that have the potential to influence CVF outcomes.

3. In addition to CVF, there appears to be preliminary evidence to support the relationships between PA and musculoskeletal fitness, as well as motor competence and musculoskeletal fitness, suggesting that future studies should determine the strength and importance of this relationship before determining environmental factors that may modify it.
**Overall Summary**

This chapter has reviewed the literature examining the applicability of the developmental model in preschool-aged children while exploring important environments and factors within those environments that may affect components of the model. Through this review ten recommendations for continued areas of research have been made including three related to PA, three related to motor competence, one for perceived motor competence, and three for health-related fitness. This dissertation addresses two of these recommendations.

**Recommendation 1 Addressed**

Due to the large number of school-based intervention studies that have aimed to influence CVF, researchers should summarize this evidence to determine whether school-based interventions are an effective means of increasing CVF, while examining components of interventions that have the potential to influence CVF outcomes.

Based on findings from this literature review, current evidence supports CVF’s relationship with PA and motor competence, while PA has been shown to be influenced by multiple important environmental contexts. There is currently relatively little evidence to support an association between the environment and CVF, but multiple interventions have targeted several environmental constructs when attempting to influence CVF outcomes. Most studies that have tried to improve CVF in preschool-aged children have done so through an ECEC, while adding intervention components from other influential microsystems. These interventions have been mostly successful but have consistently failed to identity intervention components that account for their success. Thus, this dissertation will attempt to synthesize this literature to determine environmental influences that may affect CVF, through PA interventions that occur in ECECs. Synthesis of this literature is critically important because improved CVF has
been shown to confer several positive health benefits for preschool-aged children, including improved weight, blood lipid profiles and cognitive function. By undertaking this review now, environmental interventions components that are successful at positively modifying the PA and CVF pathway will be identified, which can then be applied to future interventions that attempt to promote a positive CVF trajectory in young children. Thus, the first aim of this dissertation is as follows:

Aim 1: To conduct a critical systematic review and meta-analysis of studies on school-based interventions that attempt to affect CVF in children, while examining socioecological factors within children’s environment that may influence CVF development.

Hypothesis 1: School-based interventions that incorporate more levels of the EMPA will result in more robust intervention effects on CVF than interventions that incorporate fewer levels of the EMPA.

**Recommendation 2 Addressed**

Researchers should continue to examine factors within family, school, and neighborhood microsystems, across multiple racial and ethnic populations, which influence the development of preschool-aged children’s motor skills using both product-based and process-based measures.

Based on the findings from this literature review, motor competence was found to have a low to moderate correlation with PA in preschool-aged children and is related to overcoming the “proficiency barrier” that likely predicts increased engagement in PA as children age. In addition, the literature also suggests that motor competence may be related to improved CVF, and musculoskeletal fitness, which are important heath correlates in young children. Despite findings that motor competence is meaningful for development in young children, literature on environmental factors that affect motor
competence is currently lacking in the literature connecting PA and the environment. Several major studies have also found that aspects of the home and ECEC environment are significantly related to motor competence and that these factors may be different than the environmental factors that affect PA. The current literature connecting the home and ECEC environments to motor competence also has several large gaps including, limited inclusion of racial and ethnic minorities and use of only one type of measure of motor competence (product-based and process-based) that need to be addressed.

This dissertation addresses this recommendation and these gaps in the literature by adding product-based and process-based measures of gross motor skills to the baseline data collection of an ongoing, garden-based intervention, occurring in ECECs in the southwestern US (Lee et al., 2019). By adding both types of measurements to this investigation we will gain a comprehensive understanding of gross motor skills – the domain most likely to be related to PA and CVF- in predominantly Hispanic preschool children, which is an understudied population in relationship to motor skills. Additionally, this dissertation will utilize home and family environmental data to address the following aims related to this recommendation.

Aim 2: To examine factors at the individual and family level that may be related to children’s process-based and product-based gross motor outcomes in a group of predominantly Hispanic children.

Hypothesis 2(a): Individual and family factors will be significantly related to gross motor skills in predominantly Hispanic children; (b) but will not be significantly different based on ethnicity (Hispanic vs. non-Hispanic); (c) or method used (product-based vs. process-based) to measure gross motor skills.
Aim 3: To examine the association between ECEC characteristics with process-based and product-based gross locomotor outcome measures in predominantly Hispanic school children.

Hypothesis 3(a): ECEC factors will be significantly related to gross motor skills in predominantly Hispanic children; (b) but will not be significantly different based on ethnicity (Hispanic vs. non-Hispanic); (c) or method used (product-based vs. process-based) to measure gross motor skills.

**Implications for Research, Policy and Practice**

This dissertation has the potential to affect not only future research on school- and home-based assessment of motor skills, but also current policy and practices promoting healthy development of preschool-aged children. By assessing environmental factors (policy, PA resources, and playground size) at ECECs where preschoolers develop motor skills, we can determine current policies that are effective or ineffective for their development. In addition, by examining a variety of PA resources that are currently available, this work can provide guidance to educators on the most economical allocation of resources to develop motor skills, in a time where budgets in education are shrinking.

Determination of resources that affect motor skills in children’s current environmental context has immediate benefits, as changes in environmental resources can easily be implemented by the teacher or director, while policy changes or behavioral interventions may take longer to implement and are more time and resource intensive.

By investigating the home environment (PA parenting practices, PA resources, family size, acculturation, and socioeconomic status) that affects the skill development in young children, this work will determine characteristics that are related to underdeveloped motor skills in children as they enter preschool. By identifying these factors this work will be able to provide guidance to teachers on which children may need
more careful motor skill assessments and ultimately individualized experience plans for
development of skills. In addition to providing guidance for teachers, this work will be
able to guide parents to resources to help encourage children’s GLS development before
they reach the classroom. Interventions to improve motor skills may occur through the
ECEC or may involve academic and community partnerships to help intervene, which
will result in overall healthier communities for current and future generations of
children.
Effectiveness of School-Based Interventions for Improving Cardiovascular Fitness in Early Childhood: A Systematic Review and Meta-Analysis

Jacob Szeszulski¹, Elizabeth Lorenzo², Gabriel Q. Shaibi², Matthew P. Buman¹, Sonia Vega-López¹⁻³, Steven P. Hooker⁴ and Rebecca E. Lee²

¹ Arizona State University, College of Health Solutions, 550 North 3rd St, Phoenix, AZ, USA 85004; ² Center for Health Promotion and Disease Prevention, College of Nursing and Health Innovation, Arizona State University, Phoenix, Arizona; ³ Southwestern Interdisciplinary Research Center ⁴ San Diego State University, College of Health and Human Services, 5500 Campanile Drive, San Diego, CA, USA 92182

Corresponding Author:
Jacob Szeszulski
550 N 3rd St.
Phoenix, AZ, USA, 85004
jszeszul@asu.edu
Abstract

This systematic review and meta-analysis examined the literature on school-based physical activity interventions to identify factors that may improve cardiovascular fitness in preschool-aged children. Data sources included PubMed, Web of Science, Cochrane Library Trials, CINHAL, Science Direct, PsychINFO and SPORTDiscus. Peer-reviewed publications of studies that met the following criteria: (1) mean age of participants between two and a half and five and a half years old; (2) randomized controlled trials or quasi-experimental interventions with a control group; (3) interventions occurring before, during, or immediately after school; (4) use of an objective measure or field-based estimate of cardiovascular fitness; (5) enrolled apparently healthy children were eligible for inclusion. Titles (n=1,197) were initially reviewed for inclusion into the study and seventy-four abstracts and full texts were further assessed for eligibility. Ten articles met all eligibility criteria and were included in the final review. A random effects meta-analysis suggested a moderate-to-large effect size for school-based interventions to increase cardiovascular fitness (Hedge’s $g=.75$; 95%CI [.40-.11]). Multi-level interventions ($g=.79$ [.34-.125]) were more effective than those interventions focused on the individual ($g=.67$ [.12-.22]). Preliminary evidence suggests that school-based interventions to increase cardiovascular fitness are highly effective at improving preschool children’s exercise test scores and that including three or more levels of the socioecological model within the intervention increases their efficacy. Although school-based interventions appear promising, the small number of studies included in this review limits confidence in these findings. This study is registered at PROSPERO CRD42018099115.
Introduction

Cardiovascular fitness (CVF) is defined as the ability to perform large-muscle, whole-body exercise at moderate to high intensities for extended periods of time and is related to multiple health outcomes in both adults and children (Myers et al., 2015; Ortega et al., 2008; Ortega et al., 2015; Physical Activity Guidelines Advisory Committee, 2018). CVF begins to develop at a young age and tracks into adulthood to predict future CVF, physical activity (PA) and healthy weight profiles (Malina, 2001). Although CVF early in life is primarily determined by biological factors, there are behavioral (e.g., physical activity) and developmental (e.g., motor competence) factors that also contribute to differences in CVF in young children and thus offer a means for improvement (Malina, 2014; Robinson et al., 2015; Stodden et al., 2008).

According to The Institute of Medicine (IOM), Early Care and Education Centers (ECECs) are primary targets for behavioral interventions because of the large number of young children they enroll (McGuire, 2011). Children spend an average of 24.8 hours per week at ECECs, which makes school-based intervention an important place to leverage to influence CVF in early childhood (Iruka et al., 2006; SHAPE America, 2015). Children at ECECs spend approximately 80% of their day in sedentary activities and only 2-3% in moderate to vigorous PA and low levels of PA have been shown to be related to underdeveloped CVF in early childhood (Bürgi et al., 2011; Leppänen et al., 2016; Pate et al., 2008; Reilly et al., 2010). Despite the association between PA and CVF, interventions focused on improving PA rarely examine concurrent change in CVF outcomes in young children, and several studies describe the correlation between CVF and PA as low in this population, suggesting that tangential factors related to PA may also influence improvements in CVF (Reilly et al. 2010; Carson et al., 2017; Ward et al., 2010).
CVF is also hypothesized to be related to higher levels of motor competence (MC) in young children through both physiological (i.e., improved neuromuscular function) and behavioral (i.e., motivation and activity participation choices) processes (Robinson et al., 2015). Although the mechanisms themselves have yet to be tested, several systematic reviews already support the association between CVF and MC in children and adolescents (Cattuzzo et al., 2016; Figueroa et al. 2017, Logan et al., 2014). Additionally, multiple environmental factors have been shown to be related to MC in preschool age children, including factors found in the home and ECECs (Cools et al, 2011; O’Neill et al. 2014). The relationship between these findings suggest that a child’s environment may contribute to the increases in CVF though both increases in PA and improvements in MC.

To date, only one review has examined the literature related to the improvements in CVF in young children (3 to 12-years-old) and was limited in scope by selecting only PA-related randomized controlled trials (Pozuelo-Carrascosa et al., 2018). Moreover, several sizable intervention studies to improve CVF in preschoolers were excluded. The current review adds to the literature by focusing specifically on studies that included very young children (2.5 to 5.5-years-old), examining additional study designs, and focusing on intervention components that are hypothesized to affect CVF outcomes.

Ecological models, like the ecological model of physical activity (EMPA), often serve as a framework for examining pathways across multiple levels (microsystems, exosystems, mesosystems, and macrosystems) of influence to affect PA behaviors, and can also provide guidance for exploring indirect pathways related to CVF (Spence & Lee, 2002). In addition, several school-based studies have used ecological frameworks when intervening to influence CVF, which suggests that they would aid as a roadmap for assessing indirect factors that may also contribute to its improvement (Eliakim et al. 2015).
Therefore, the purposes of this study were to 1) systematically review the literature on ECEC- or school-based interventions designed to increase CVF and 2) determine ecological factors related to increases in CVF in preschool-aged children.

Methods

Protocol and Registration

This systematic review and meta-analysis was registered with the International Prospective Register of Systematic Reviews (PROSPERO; Registration no. CRD42018099115; available from: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=99115). It was conducted and reported following the Preferred Reporting Items of Systematic Reviews and Meta-Analyses (Moher et al., 2009).

Data Sources and Search Strategy

Literature searches were conducted in June of 2018 using seven electronic databases, including PubMed, Web of Science, Cochrane Library Trials, CINHAL, Science Direct, PsychINFO and SPORTDiscus. For all databases, advance-searching options were used, and identical search strings were entered into each database. All possible search terms were entered into each search string, using the Boolean operators “AND” and “OR” to connect terms. The search string used to identify articles was (preschool OR day care OR pre-k OR early care and education) AND (school-based intervention OR before school intervention OR after school intervention) AND (fitness OR physical fitness OR cardiorespiratory fitness OR cardiovascular fitness OR aerobic fitness OR aerobic capacity OR aerobic power OR physical work capacity OR maximal oxygen consumption). No search limits were set for study year or country where the study took place. Only articles in English were reviewed. Initial searches were completed.
by one author (JS), who compiled a list of all article titles and removed the duplicates. Two independent authors (JS, EL) reviewed the title list, with duplicates removed, for inclusion into the study. Results were compared, and discrepancies were discussed until a consensus was reached. Once titles that definitively did not match the PICO (Population: preschool-aged children, Intervention: school-based, Comparison: control group included, Outcome: CVF) were removed. In the event that the two reviewers could not reach consensus, a third reviewer (REL) was asked to resolve the conflict. Reviewers repeated the review process a second time reviewing abstracts and full texts based on all eligibility criteria to determine the final studies to be included in this review. When searches identified multiple articles that described different aspects of the same study (e.g., follow up, different outcome measures, subgroup analysis), data from all articles were included into the review if articles contributed additional information related to CVF. The systematic review was supplemented by identifying articles through reference lists and additional searches that took place as part of dissertation literature review.

**Eligibility Criteria**

For inclusion in this review, studies had to be published in peer-reviewed journals, written in English, and meet the following inclusion criteria, (1) study reported mean age of participants between two and a half and five and a half years old, (2) interventions were either randomized controlled trials or quasi-experimental interventions with a control group; (3) interventions must have occurred immediately before, during, or immediately after school; (4) CVF must have been assessed either directly or through a field-based estimate (e.g., timed runs or distance runs); (5) participating children must have been apparently healthy with no known cognitive or motor skills deficit at recruitment.
Data Extraction

Research articles were critically reviewed several times. Main study characteristics were extracted and recorded in an excel spreadsheet to help with summarization, interpretation, rating, and comparison of study results. Study information related to effectiveness or possible intervention components was extracted from the article and included the following: (1) intervention length; (2) intervention setting (before, during, or after school); (3) age and number of participants included in the study; (4) country in which the study took place; (5) intervention characteristics; (6) methods of CVF measurement; (7) description of study findings; (7) inclusion of follow-up data (if applicable); (8) study design; and (9) characteristics needed for a rating of study quality.

Study Quality Assessment

Study quality was rated using a Quality Index Score (QIS) developed for use in both randomized and non-randomized control trials (Downs & Black, 1998). QIS has a score that ranges from 0-28 (higher scores equal stronger quality) and when previously validated had high levels of internal consistency, test re-test reliability (r =.88), inter-rater reliability (r =.75), and criterion validity (r =.90). The QIS reports on several aspect of bias including: quality of reporting, external validity, measurement/intervention bias, subject selection bias, and whether the study was appropriately powered. Two independent observers (JS, EL) completed the QIS and discrepancies were discussed until a consensus was reached. In the event consensus could not be reached a third reviewer (REL) helped to resolve the conflict.

Data Synthesis

A narrative synthesis was created for all studies. Results were synthesized by study design, region where the study took place, study quality, method of measurement
for CVF, and intervention components from each level of the socioecological model. Additionally, the number of studies within each synthesized category were tabulated and examined in an attempt to identify patterns within each tabulated group. Lastly, overall completeness, quality of the evidence, and potential biases in the review process were discussed.

**Meta-Analysis**

Pre-post intervention means and their standard deviations/standard errors were extracted from each article and transformed into mean differences and pooled standard deviations. When multiple measures of CVF were present within one article the outcome measure that was most closely related to the definition of CVF was selected (Physical Activity Guidelines Advisory Committee, 2018). Studies that analyzed data subsamples separately (normal weight vs. obese), or made multiple measures within one test (heart rate at multiple workloads), were combined to create one effect size and weighted according to the number of participants in each group. When additional information was needed to determine effect size, authors were contacted up to three times in attempt to retrieve the data. In the event the author could not be reached, effect sizes were estimated from graphs as opposed to table values. Each individual study only contributed one effect size to the meta-analysis, despite the number of articles included in the review.

Hedge’s $g$, a measure of effect size that corrects for the impact of small sample sizes and standard errors, was calculated for each sample that provided data (Borenstein et al., 2009). In the event two articles reported the same sample, the primary outcome paper was used to compute effect size. In addition, because interventions occurred in the school setting, a design effect was applied that took into account the average number of subjects per classroom, and an estimated clustering effect was used to correct the
Hedge’s $g$ standard error for studies that did not originally control for clustering in their analyses. Purder et al. (2011) found an interclass correlation (ICC) of 0.07 for measures of CVF in 40 preschool classrooms, while Kriemler et al. (2010) and Meyer et al. (2014) found ICC’s between 0.02 and 0.04 in elementary children. An ICC of 0.07 was used when adjusting for clustering as it provided the most conservative estimate for the population included in the current review.

A forest plot was created in the Cochrane database review manager using adjusted effect sizes and their 95% confidence intervals (RevMan 2014). A summary effect was provided based on a random effects meta-analysis. Heterogeneity was estimated using Cohran’s $Q$ and a random effects meta-analysis was used, as it incorporates both within study and between study variance and provides a better estimate in cases where studies have high heterogeneity or low sample sizes. Sub-analyses were conducted to compute effect sizes for each of the following groups in an attempt to examine patterns or explain heterogeneity: study design (randomized controlled trials vs. quasi-experimental), length of intervention (one academic year vs. less than one academic year), world region where the study took place (North America vs. Middle East vs. China vs. Asia), method of CVF measurement (heart rate vs. shuttle runs vs. distance runs), and number of levels of the socioecological model included in the intervention (3+ vs. <3). Finally, a funnel plot was created and visually inspected to examine potential publication bias based on methodological quality. Statistical tests were underpowered to detect publication bias, thus were not used (Begg et al., 1994; Egger et al., 1997).

**Results**

The search process returned 1,197 individual titles that were reviewed for inclusion in the study. Seventy-four abstracts and full texts were read based on their title
matching the PICO and ten articles met all eligibility criteria and were considered acceptable for final review (Figure 3.1). Of the ten articles, eight contributed individual effect size data one article was a follow-up study, and another was a secondary data analysis (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Nemet et al., 2013; Niederer et al., 2013; Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). Of the eight studies that contributed individual data, three were almost identical interventions by the same research team, but the intervention was tested in three separate populations (Eliakim et al., 2007; Nemet et al., 2011(a); Nemet et al., 2011(b)).

Data extracted from the articles can be found in Table 3.1. Sample sizes ranged from 24 to 795 children. All of the studies occurred during the school day, and interventions lasted between eight weeks and one full academic year. Seven of the eight studies had an experimental study design, whereas one used a quasi-experimental study design (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). Three studies took place in the Middle East, two occurred in Asia, two were conducted in Europe, and one occurred in North America (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). Four studies used shuttle runs as their primary method of measurement for CVF, three used a timed run, and one used heart rate response at multiple progressive workloads (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). In addition, one study used heart rate measurements before and after a specified workload as a secondary measure of CVF (Tan
et al., 2017). The use of each level of the socioecological model as intervention components for each study can be found in Table 3.2.

Results from the random effects meta-analysis suggest a moderate-to-large effect size for the school-based interventions on CVF (Figure 3.2). Due to high heterogeneity between study effects (Cohran’s $Q = 44.92; p < .001$), subgroup analyses were conducted to explore differences. Randomized controlled trials had a larger effect size ($g = .81$ 95%CI [.41-1.21]; $n = 8$), than quasi-experimental study designs ($g = .43$ [-.06-.92]; $n = 1$) (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). Study interventions that occurred for one full academic year ($g = .60$ [.18-1.02]; $n = 4$) were less effective than those occurring for only a partial year ($g = 1.00$ [.27-1.72]; $n = 4$) (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). The study that occurred in North America ($g = 1.40$ [.52-2.28]; $n = 1$) had the largest effect size, followed by those that occurred in the Middle East ($g = 1.13$ [.61-1.66]; $n = 3$), Asia ($g = .41$ [.02-.79]; $n = 2$), and Europe ($g = .21$ [.06-.36]; $n = 2$) (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). When examining methods of measurement, the study that used heart rate response to a set workload ($g = 1.40$ [.52-2.28]; $n = 1$) showed the strongest intervention effect, followed by those that measured CVF with shuttle run tests ($g = .93$ [.37-1.50]; $n = 4$), and timed runs ($g = .44$ [.01-.87]; $n = 3$) (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). Finally, studies which included 3 or more components of the socioecological model in their intervention ($g = .79$ [.34-1.25]; $n = 5$) were more effective than studies that intervened only at the individual
level (g=.67 [1.12-1.22]; n=3) (Alpert et al., 1990; Eliakim et al., 2007; Latorre-Román et al., 2018; Nemet et al., 2011(a); Nemet et al., 2011(b); Purder et al., 2011; Tan et al., 2017; Zhou et al., 2014). None of the sub-analyses completely explained the heterogeneity in the results (p’s>.05).

Assessment of study quality

Quality assessments of each study can be found in Table 3.3. Overall, the study quality was moderate, with an average of 17.9±4.3 (63.9%) of twenty-eight items on the checklist being met. Studies demonstrated the lowest quality rating on power analysis and external validity criteria. Only one of eight studies reported a power analysis and, on average, just over one (1.3, 43.3%) of three of the external validity items were reported. Other areas of bias had substantially better scores. On the reporting subscale, the average study reported 7.6 (69.1%) of eleven items, and 5.0 (71.4%) of the seven internal validity and 3.9 (65.0%) of the six selection bias items. The one quasi-experimental study included had comparable levels of bias with other studies, and, thus, should not have impacted the results of this review.

Results from the funnel plot are depicted in Figure 3.3. Interventions with large sample sizes (low standard errors) were dispersed evenly around the average effect size with several studies indicating small to no effect. Smaller studies (high standard errors) were skewed to the right, above the 95% confidence interval on the distribution, suggesting that there may be some evidence of publication bias related to these studies. Due to the small number of studies, statistical tests were not used.

Discussion

Overall, this study found that interventions focused on improving the CVF profiles of young children impart a moderate-to-large effect on CVF, and interventions which include multiple components of the socioecological model are more effective than
those aimed at the individual level. Interpersonal and organizational factors included in these studies focused on training and incorporation of teachers into intervention delivery, whereas parents were included through newsletters, discussions, orientation sessions, webinars, and family homework. Additionally, PA equipment was installed into classrooms and play areas of ECECs. The one intervention that included both community and policy level intervention components focused on center-level play policies, improved curricula and curricular monitoring, improvement of neighborhood play equipment, and neighborhood events for families (Zhou et al., 2014). Strategies implemented by these studies are consistent with the literature on improving PA and supported by the EMPA, which posits that interventions that occur across multiple levels have linkages that allow effects to transfer from one level to another (Spence & Lee, 2002).

Hypothesized transfer linkages are a potential explanation for the larger effect size of interventions that included three or more levels found in this systematic review. In addition, the finding that multi-component interventions are more effective for improving CVF aligns with the current recommendations for including multiple levels of the socioecological model in school-based interventions to improve PA, although effect sizes for school-based interventions on PA are smaller than those found for CVF in this meta-analysis (Beets et al., 2009; Van Sluijs et al., 2007; Wechsler et al., 2000). Two previous reviews that examined the relationship between school-based PA interventions and CVF in children, including older children, discovered that PA interventions only created small effects on CVF profiles (Beets et al., 2009; Pozuelo-Carrascosa et al., 2018). Smaller effect sizes could potentially be due to a dilution effect related to grouping all children, aged 3-12 years-old, into one analysis, as environments and developmental patterns in younger children differ from older children (Malina, 2001; Ortega et al., 2007).
Several of the sub-analyses from this meta-analysis revealed interesting results. First, sub-analyses showed that full academic year interventions had smaller effect sizes than interventions that occurred for a partial year. While this finding appears counterintuitive, intervention frequency (3x-6x per week), duration, and type (structured vs. unstructured) varied substantially across studies and may be responsible for these results. Previous research has shown that higher intensity, longer duration per session, and higher frequency of sessions per week have all been related to improved CVF levels (Wenger et al., 1986). Many of the studies in the current review address frequency per week and duration per session, but differences in exercise intensity and type (aerobics, sport, free play, structure) preclude from defining a program prescription to compare across studies. Future studies that address CVF should include and report measures of frequency, intensity, duration, and mode to facilitate comparisons.

Second, sub-analyses revealed that effects varied substantially based on the measure used to discern CVF (g=.44-1.40), and that the strongest intervention effects were found with the use of heart rate monitoring (Alpert et al., 1990). Although heart rate is important to measure in relationship to CVF, submaximal exercise heart rate has been found to be variable in preschool-aged children (Nguyen et al., 2011). In addition, issues related to pacing or motivation may prevent children from reaching maximal exercise intensity. There is no gold-standard field-based measure for CVF and previous reviews suggest that a shuttle run test with a pacesetter may be the best option; however, this test may be influenced by factors other than the cardiovascular system (weight, motivation, motor competence, perceived motor competence, listening skills) (Ortega et al., 2015; Ruiz et al., 2011). Future studies that validate field-based measures of CVF in preschool-aged children and/or develop new measures are needed to advance the field.
**Strengths**

A strength of this meta-analysis lies in the choice of a narrowly defined age range. By selecting only studies with preschool-aged children, environmental intervention components specific to this age group can be analyzed. Preschool children often face a unique set of environmental circumstances compared to elementary-aged children including shorter school weeks, higher levels of teacher engagement in activity lessons, and higher initial levels of PA (Chow et al., 2015; Ishii et al., 2015). Additionally, preschool teachers often have more flexibility in how to implement PA interventions within the classroom (Howie et al., 2016). By examining only preschool-aged children, findings from this study have increased applicability to young children’s schools and thus are more likely to be successfully implemented, resulting in higher levels of CVF. Furthermore, CVF has been found to have higher inter-age correlations than PA in childhood, suggesting that children who improve their CVF early on in life may sustain improved CVF into later childhood (Malina, 2001). Future research should determine if CVF intervention effects in childhood can be maintained as children age.

A second strength of this meta-analysis was the high methodological quality (mean QRI score=17.9) of this group of studies compared to other studies that have examined health-related interventions (Downs & Black 1998; Prince et al., 2008; Warburton et al., 2010). Initial testing during the design process found average QRI score of 14 for a randomized health care intervention, while an average score for a quasi-experimental study was 11 (Downs & Black 1998). Subsequent use of the QRI in two PA interventions revealed that 11 and 12 of (~75-80%) the items were reported, although several scales were modified to remove less relevant items (Prince et al., 2008; Warburton et al., 2010). In this group of studies, all but two of the randomized controlled trials and quasi-experimental studies scored at least 14 or higher on the QRI.
checklist, which suggest a high level of scientific rigor for the studies included in this review (Nemet et al., 2011 (a); Nemet et al., 2011(b)).

Limitations

Despite the strong methodological quality overall, only one study reported a power analysis and controlled for clustering related to having multiple classrooms in their analysis (Purder et al., 2011). Three studies determined that there was a significant intervention effect, which was later erased when an estimated design effect was applied (Tan et al., 2017; Latorre-Román et al., 2018; Zhou et al., 2014). On average, fewer than half of the items were reported in relationship to external validity, which limits the generalizability of these findings to larger and more diverse populations. Despite the limitations related to power and external validity, scores for reporting, internal validity, and selection bias were high suggesting that this body of research applied rigorous study designs with high internal consistency. Consequently, the finding from these studies are likely real effects and not due to poor methodology or flawed research practices.

When interpreting the evidence presented in this review several factors should be considered. First, this meta-analysis found a high level of heterogeneity in the studies, suggesting that studies were more different from one another than similar. Based on the small number of studies and the variety of characteristics of the studies included in this meta-analysis, an increased amount of heterogeneity is to be expected. Characteristics that may have contributed to the heterogeneity are inclusion of both quasi-experimental and experimental study designs, use of multiple measures of CVF, interventions with varying numbers of intervention components, multiple countries with differences in early childhood education, and lack of reporting on external validity. Further, this analysis was unable to compare sociodemographic differences between study populations. Although some explanations for heterogeneity were explored through
stratified analysis, interaction between several factors could have still occurred which allowed increased levels of heterogeneity to remain. More studies aimed at increasing CVF are needed to determine the extent to which each of these factors play a role in the improvement of CVF in early childhood.

A second element that should be considered when interpreting the results of this meta-analysis is the choice of measure used to determine CVF. The majority (7/8 studies) of studies in this review used field-based measures of CVF, including shuttle and distance runs, while only one study examined the effects of CVF interventions on a physiological outcome. CVF the ability to perform large-muscle, whole-body exercise at moderate to high intensities for extended periods of time and is best measured by physiological responses to exercise (Armstrong et al., 2011; Physical Activity Guidelines Advisory Committee, 2018). Only one study in this meta-analysis measured heart rate, a physiological component related to CVF, while other studies use performance on field-based tests, which estimate CVF through prediction equations. Field-based tests and related prediction equations can be a useful tool in the community-based or school setting. However, current field-based tests for CVF have not been validated for use in young children (< 6 years old), and thus may be related to constructs (PA, MC, motivation) other than CVF (Ortega et al., 2015). This sentiment is further supported by Ruiz et al. (2011) who reported that run/walk tests are not an accurate measure of CVF in young children as there is a major challenge in developing pacing. Nevertheless, CVF is an important construct to understand in young children, as it has been shown to be consistently related to improved health profiles in adolescents and adults (Meyers et al., 2015; Ruiz et al., 2016).
Conclusion

This meta-analysis suggests a strong effect of school-based interventions on CVF in preschool-aged children and use of an ecological framework to develop interventions appears to impart a stronger effect than individual level interventions alone. Relative contributions of intervention components at each level of the model has yet to be determined, but parents and educators can currently utilize components on multiple levels of the ecological model to improve the CVF profiles of their children. CVF at an early age has the potential to improve the health trajectory of young children now and into the future and children’s environments may serve as a roadmap to determining the most effective means to do just that.

Declarations

Ethical approval: The research was approved by the institutional review board at Arizona State University.

Availability of data and materials: The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Funding: This research was supported by the National Institutes of Health through the National Institutes on Minority Health and Health Disparities cooperative agreement 5U01MD010667-03 awarded to Dr. Rebecca E. Lee, the National Institute of Nursing Research grant 1F31NR017560-01 awarded to Elizabeth Lorenzo, and Jonas Scholar Nurse Leader 2016-2018 Cohort.

Author Contributions: JS completed the search process, conceptualized the analysis, analyzed and interpreted the results, drafted the manuscript and is accountable for all aspects of the content in this manuscript. EL replicated the search process, was a major contributor to the revision of manuscript and approved the final version of this manuscript. GQS, MPB, SVL, SH, and REL provided guidance on the conceptualization
of this analysis, were major contributors to the revision of manuscript and approved the final version of this manuscript. RL also obtained funding for this project and provided guidance on the conceptualization of this analysis.

Acknowledgements: Not applicable
Figure 3.1 Study Selection Process
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention Setting: Length</th>
<th>Population</th>
<th>Country</th>
<th>PA Intervention Components</th>
<th>Fitness Measurement</th>
<th>Findings</th>
<th>Follow-up Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albert et al. 1990</td>
<td>During school; 8 weeks</td>
<td>n=24 children 3- to 5-years-old (mean age 44 months)</td>
<td>USA</td>
<td>30 minutes daily designed to increase HR to 90-90% HR max. Children exercised with music and imagery. HR was monitored every 10-minutes. Stickers were given for achieving HR goals. 2 parent orientation sessions. Teachers implemented sessions 4x per week and youth coaches implemented sessions 2x per week for 45 min/session (80% running games; 20% sports activities).</td>
<td>Cycle ergometer test at three workloads (12.5, 25, and 37.5 watts). Change in exercise HR. 600-meter run</td>
<td>HRs were significantly lower at post-test compared to pretest for all workloads in the X group compared to the O group. Workload 1: O (~9 bpm) vs. X (~7 bpm). Workload 2: O (~7 bpm) vs. X (~15 bpm). Workload 3: O (~5.5 bpm) vs. X (~20 bpm). O group significantly increased endurance run time by 6 seconds, while X group decreased by 14 seconds. Overweight and obese O increased by 7 seconds, while X decreased by 7 seconds.</td>
<td>N/A</td>
</tr>
<tr>
<td>Eliakim et al. 2007</td>
<td>During school; 14 weeks</td>
<td>n=101 upper-middle SES 3-6-year-old</td>
<td>Israel</td>
<td>2 parent orientation sessions. Teachers implemented sessions 5x per week and youth coaches implemented sessions 1x per week for 45 min/session (90% running games; 20% sports activities).</td>
<td>10-meter shuttle run test</td>
<td>O group decreased total number of laps by 10.3 ± 1.6 (males 7; females 1.6), while X group increased by 11.6 ± 4.1 laps (males +11; females +13); overweight and obese O decreased by 12 and 2 laps respectively, while overweight and obese X participants increased by 7 and 18 laps respectively. *</td>
<td>N/A</td>
</tr>
<tr>
<td>Nemet et al. 2011 (a)</td>
<td>During school; one school year</td>
<td>n=342 low SES 4-7-year-old</td>
<td>Israel</td>
<td>2 parent orientation sessions. Teachers implemented sessions 5x per week and youth coaches implemented sessions 1x per week for 45 min/session (80% running games; 20% sports activities).</td>
<td>10-meter shuttle run test</td>
<td>O group decreased total number of laps by 3 (males 0; females 3), while X group increased by 18 laps (males +20; females +17); overweight and obese O decreased by 2 and 3 laps respectively, while overweight and obese X participants increased by 17 and 18 laps respectively. *</td>
<td>Nemet et al. (2014) 0.03 (53%). Both O and X had more laps 1 year later. The X remained significantly higher than the O. N/A</td>
</tr>
<tr>
<td>Nemet et al. 2011 (b)</td>
<td>During school; one school year</td>
<td>n=195 low SES 3-8-year-old</td>
<td>Israel</td>
<td>2 parent orientation sessions. Teachers implemented sessions 5x per week and youth coaches implemented sessions 1x per week for 45 min/session (80% running games; 20% sports activities).</td>
<td>10-meter shuttle run test</td>
<td>O group increased total number of laps by 3 (males 6; females 3), while X group decreased by 18 laps (males -20; females -17); overweight and obese O decreased by 2 and 3 laps respectively, while overweight and obese X participants increased by 17 and 18 laps respectively. * Normal weight X group improved shuttle run (+1.8 stages) compared to O (+1.5 stages). Overweight X children did not significantly improve shuttle run (+1.7 stages) compared to O (+1.3 stage). Low fit X group did not improve shuttle run (+1.8 stages) compared to O (+1.6 stages). Normal fit X group improved shuttle run (+1.7 stages) compared to O (+1.4 stages). Neither weight nor fitness level were not found to modify intervention effects for the shuttle run.</td>
<td>N/A</td>
</tr>
</tbody>
</table>

(Continued)
<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Intervention Setting: Length</th>
<th>Population</th>
<th>Country</th>
<th>PA Intervention Components</th>
<th>Fitness Measurement</th>
<th>Findings</th>
<th>Follow-up Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purde et al. 2011</td>
<td>During school; 1 academic year</td>
<td>n=512 migrant 5-6 years-old preschool children</td>
<td>Switzerland</td>
<td>Four 45-minute PA sessions/wk Implementers gave 1 PA session/wk. Reduced to 2x/month after 4 months. Other sessions ran by teachers after two workshops. Every 2nd wk children took home PA card. Parents joined 3 discussions. Play equipment installed/provided to classrooms.</td>
<td>20-meter shuttle run test</td>
<td>X group significantly increased shuttle run (1.7 stages) compared to O group shuttle run (1.4 stages).</td>
<td>NA</td>
</tr>
<tr>
<td>Latore-Roman et al. 2016</td>
<td>During school; 10 weeks</td>
<td>n=111 children aged 4-6 years-old</td>
<td>Spain</td>
<td>Three 30 minute training sessions/wk. Sessions included aerobic games that increased from a total of 15-18 minutes in duration over the 10 weeks.</td>
<td>10 x 20 meter shuttle run</td>
<td>Time decreased by 8.5 seconds in the X group and decreased by 3.6 seconds in the O group. Group by time interactions were not statistically significant.</td>
<td>NA</td>
</tr>
<tr>
<td>Tan et al. 2017</td>
<td>During school; 10 weeks</td>
<td>n=104 children 5-year-old</td>
<td>China</td>
<td>Five one hour supervised sessions/wk. 10 minute warm-up and cool down. 40 minutes of moderate PA (walking, running, jumping, rope skipping, squats, stretching) in 4 minute intervals followed by 1 minute rest. Exercise occurred at 50% of HR max (monitored by HR monitor).</td>
<td>20-meter shuttle run test; HR Index- HR response to a workload (30 repeats at 30 sec). Formula: resting HR + end exercise HR – recovery HR at one minute - (200) ÷ 10</td>
<td>Obese X group increased their 20-meter shuttle 1.05 laps compared to a .33 lap increase in obese O. Lean X group increased by 1.06 laps compared to a .32 increase in lean O. Results not significant. Obese X group decreased HR index by - .98, while obese O HR index decreased - .24. Lean X group decreased HR index - .17, while lean O decreased by -.12. Results were significant (p&lt;.001) for both groups.</td>
<td>NA</td>
</tr>
<tr>
<td>Zhou et al. 2014</td>
<td>12 months</td>
<td>n=357 children ages 3-5 years-old</td>
<td>China</td>
<td>New outdoor play policy (60-80 minutes with 10-minute exercise session). Teacher received bi-weekly training (20 hours total). Outdoor play curriculum developed and monitored daily. New outdoor play equipment. Monthly education webinars and newsletters for families. Internet resource website. Family events and new play equipment for families. Renovation of neighborhood playgrounds, including new equipment. Neighborhood events.</td>
<td>20-meter agility run</td>
<td>Significantly decreased their 20 meter agility run time (-1.22 seconds) compared to control (-.59 seconds).</td>
<td>NA</td>
</tr>
</tbody>
</table>

Epm=beats per minute; HR=heart rate; O-control; PA=physical activity; SES=socioeconomic status; X=experimental
*Estimates are from a graph where a standard deviation is not reported. Exact values are not reported in the manuscript.
†Same Study as Purde et al. 2011. Analysis of intervention effects by weight (overweight vs. normal weight) and fitness (low fitness vs. normal fitness).
<table>
<thead>
<tr>
<th>Study</th>
<th>Individual</th>
<th>Interpersonal</th>
<th>Organizational</th>
<th>Community</th>
<th>Policy</th>
<th>Total number of Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpert et al. 1990 [40]</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Eliakim et al. 2007 [27]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Latorre-Roman et al. 2016 [37]</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Nemet et al. 2011(a) [38]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Nemet et al. 2011(b) [39]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Purder et al. 2011 [26]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Tan et al. 2017 [25]</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Zhou et al. 2014 [36]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

1= Level of the model included in the intervention; 0=level of the model not included in the intervention
Figure 3.2 Forrest plot of the effect sizes for school-based interventions on cardiovascular fitness outcomes (random effects meta-analysis).
### Table 3.3 Quality Rating Index Scores

<table>
<thead>
<tr>
<th>Study</th>
<th>Study Type</th>
<th>Total QRI Score*</th>
<th>Reporting Score</th>
<th>External Validity</th>
<th>Internal Validity</th>
<th>Selection Bias</th>
<th>Power Analysis†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpert et al. 1990 [40]</td>
<td>E</td>
<td>19 (28 possible)</td>
<td>6 (11 possible)</td>
<td>3 (3 possible)</td>
<td>6 (7 possible)</td>
<td>4 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Eliakim et al. 2007 [27]</td>
<td>E</td>
<td>17 (28 possible)</td>
<td>8 (11 possible)</td>
<td>1 (3 possible)</td>
<td>3 (7 possible)</td>
<td>5 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Latorre-Roman et al. 2016 [37]</td>
<td>E</td>
<td>18 (28 possible)</td>
<td>8 (11 possible)</td>
<td>1 (3 possible)</td>
<td>5 (7 possible)</td>
<td>4 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Nemet et al. 2011(a) [38]</td>
<td>E</td>
<td>13 (28 possible)</td>
<td>5 (11 possible)</td>
<td>1 (3 possible)</td>
<td>4 (7 possible)</td>
<td>3 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Nemet et al. 2011(b) [39]</td>
<td>E</td>
<td>13 (28 possible)</td>
<td>5 (11 possible)</td>
<td>1 (3 possible)</td>
<td>4 (7 possible)</td>
<td>3 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Purder et al. 2011 [26]</td>
<td>E</td>
<td>26 (28 possible)</td>
<td>11 (11 possible)</td>
<td>1 (3 possible)</td>
<td>7 (7 possible)</td>
<td>6 (6 possible)</td>
<td>1 (1 possible)</td>
</tr>
<tr>
<td>Tan et al. 2017 [25]</td>
<td>E</td>
<td>21 (28 possible)</td>
<td>10 (11 possible)</td>
<td>1 (3 possible)</td>
<td>5 (7 possible)</td>
<td>5 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td>Zhou et al. 2014 [36]</td>
<td>QE</td>
<td>16 (28 possible)</td>
<td>8 (11 possible)</td>
<td>1 (3 possible)</td>
<td>6 (7 possible)</td>
<td>1 (6 possible)</td>
<td>0 (1 possible)</td>
</tr>
<tr>
<td><strong>Mean (SD)</strong></td>
<td></td>
<td><strong>17.9±4.3</strong></td>
<td><strong>7.6±2.2</strong></td>
<td><strong>1.3±.7</strong></td>
<td><strong>5.0±1.3</strong></td>
<td><strong>3.9±1.6</strong></td>
<td><strong>1±.4</strong></td>
</tr>
</tbody>
</table>

QE=Quasi-experimental; E=Experimental; SD= Standard Deviation
*Total QRI score is a composite of the 5 subscales
†Power Analysis was reported in the manuscript (1=yes; 0=no)
**Figure 3.3** Funnel plot of intervention effect sizes (x-axis) and their corresponding standard errors (y-axis). Solid triangle represents predicted distribution and 95% confidence interval of effect sizes based on a null hypothesis. Dashed triangle represents the actual distribution and related 95% confidence intervals.
CHAPTER 4
MANUSCRIPT 2

Associations Between Individual Level and Family Factors with Preschool Children’s Gross Locomotor Skills in Predominantly Hispanic Families

Jacob Szeszulski\textsuperscript{1}, Elizabeth Lorenzo\textsuperscript{2}, Teresia O’Connor\textsuperscript{3}, Jennie L. Hill\textsuperscript{4}, Gabriel Q. Shaibi\textsuperscript{2}, Matthew P. Buman\textsuperscript{1}, Sonia Vega-Lópe\textsuperscript{z1,5}, Steven P. Hooker\textsuperscript{6} and Rebecca E. Lee\textsuperscript{2}

\textsuperscript{1} College of Health Solutions, Arizona State University, 550 North 3rd St, Phoenix, AZ, USA 85004; \textsuperscript{2} Center for Health Promotion and Disease Prevention, College of Nursing and Health Innovation, Arizona State University, Phoenix, Arizona; \textsuperscript{3} Baylor College of Medicine, Houston, TX, USA; \textsuperscript{4} University of Nebraska Medical Center, Omaha, NE; \textsuperscript{5} Southwestern Interdisciplinary Research Center, Arizona State University, Phoenix, AZ; \textsuperscript{6} San Diego State University, College of Health and Human Services, San Diego, CA, USA

Corresponding Author:
Jacob Szeszulski
425 N 5\textsuperscript{th} St.
Phoenix, AZ, USA, 85004
jszeszul@asu.edu
Abstract

Objective: To examine individual and family factors associated with the quantity and quality of gross locomotor skills (GLS) in predominantly Hispanic children. Design: Cross-sectional. Methods: Parents’ and children’s demographic characteristics, parenting practices, parents’ physical activity (PA) level, and number of home-based PA resources, were collected via surveys. Survey measures were examined for associations with children’s product-based (PACER) and process-based (CHAMPS GLS protocol) GLS via forward selection stepwise linear regression models in the full sample and by sex. Results: Children’s (n=144; 78.3% Hispanic; mean ± SD age 53.2±4.5 months) scores (mean ± SD) for the product- (n=144) and processed-based assessments (n=91) were 3.7±2.3 laps and 19.0±5.5 criteria, respectively, and had a moderate correlation (r=0.46; p<.01) with each other. Children’s sex (B=-0.96; p=0.03), age (B=0.17; p<0.01), parents’ promotion of inactivity (B=0.66; p=0.08), parents’ promotion of screen time (B=0.65; p=0.05), and parents’ concern for safety (B=-0.36; p=0.09) were significantly associated with higher product-based GLS. Children’s age (B=0.47; p<0.01) and their parent being employed (B=2.29; p=0.07) were significantly associated with higher process-based GLS. Individual level factors accounted for ~20% of the variance in GLS and addition of family level factors increased this to 30-45%. Conclusions: Individual level demographic characteristics accounted for a substantial portion of GLS development in preschool-aged children, but home environmental context was almost equally as important. Parents should be made aware of the role their behaviors play in children’s GLS development and provided resources to help create positive developmental family environments. Trial Registration: ClinicalTrials.gov Identifier: NCT03261492 (date of registration 8/25/17)
Introduction

Motor competence begins to develop at birth and progresses based on the changing constraints that children face during their lives (Clark & Metcalfe, 2002). Consequently, policy-making organizations have recommended that preschool-aged children should be physically active throughout the day to enhance growth and development trajectories, which will result in early acquisition and refinement of fundamental motor skills (McGuire, 2011; US Department of Health and Human Services, 2018). Gross locomotor skills (GLS), one of three domains (locomotor, object projection, and object deflection skills) of fundamental motor skills are associated with increased physical activity (PA) in preschool-aged children and related to continued participation in PA as children age into middle and late childhood (Lopriznzi et al., 2015; Robinson et al., 2015). Thus, development of GLS offers an avenue to promote positive health outcomes associated with PA throughout the lifespan.

Young children’s PA levels have been shown to be strongly related to individual level factors (e.g., sex, weight, age) and factors within the home, including PA resources, parenting practices, and parents’ PA levels (Dowda et al., 2011; O’Connor et al., 2014; Pate et al., 2004; Pate et al., 2015). The ecological model of PA (EMPA) suggests that interventions spanning across multiple levels of influence (individual, family, school, etc.) are more likely to improve PA than those that occur only at the individual level (Spence & Lee, 2003). Similarly, current models for improving motor competence often theorize the importance of the individual and family environments when intervening on motor outcomes; however, evidence is sparse (Robinson et al., 2015).

Two studies have examined influence of the family environment on gross motor outcomes in preschool-aged children. One study, found that parental beliefs (importance of PA), parental behaviors (paternal PA, active transportation, and providing activity
resources), and family demographic characteristics (parental education) were related to improved processed-based measures of gross motor skills, but did not differentiate between domains of gross motor skills (Cools et al., 2011). The second study reported that number of home PA resources and participation in swimming were related to improved processed-based measures of GLS but did not use a product-based measures (Barnett et al., 2013).

Product-based assessments evaluate the outcome of a movement and process-based assessments evaluate how a movement is preformed (Logan et al., 2017). The quantitative outcomes (i.e., how many running laps can be completed) may not always be related to the quality of the movement (e.g., a child’s running form), and relationships between types of assessments have been shown to change over time (Logan et al., 2017). Both types of measure are needed to comprehensively assess motor competence, but no investigations between motor competence and the family environment have used both. There have also been no studies assessing the relationship between the family environment and GLS in Hispanic preschool-aged children, who have been shown to have worse GLS then their non-Hispanic peers (Goodway et al., 2010). The purpose of this study was to examine factors at the individual and family level that may be associated with product- and process-based measures of GLS in a group of predominantly Hispanic children (78.3%). Additionally, this study explored these associations by children’s sex.

Methods

Participants

This study added baseline motor competence measures to an ongoing early care and education center (ECEC)-based, PA intervention. Parents and their children were recruited from 16 ECECs across central Arizona and included both school and center-
based ECECs. A description of ECEC and participant recruitment methods has been published (Lee et al., 2019). Briefly, ECECs were eligible to participate if the center was licensed, participated in the Child and Adult Care Food Program or National School Lunch Program, and were located in a census tract with >30% Hispanic/Latino population. To reduce clustering effects within ECECs, the director of each center chose only one classroom to participate based on teachers’ enthusiasm to receive a garden. Parents and children were eligible to participate if the child was between the age of 3 and 5-years-old and both parent and child were willing to complete assessments. Parents provided signed, written informed consent for themselves and their child in English or Spanish prior to participation, and children verbally assented to participate in motor skill protocols. All protocols and procedures were approved by the Institutional Review Board at Arizona State University.

**Demographic Measurements**

Parents’ and children’s age, sex, ethnicity, and birth country were collected using questions from the Behavioral Risk Factor Surveillance System (Nelson et al., 2001). Parent’s age was self-reported in years and child’s age (months) was calculated as the difference between date of birth and the date that classroom assessments of GLS occurred. Ethnicity was collapsed into Hispanic and non-Hispanic categories. Parental marital status, education, job status, and income were collected using questions from the Maternal and Infant Health Assessment (Braveman et al., 2001). Job status was collapsed into employed and not employed categories. Parental acculturation was assessed in both Hispanic and non-Hispanic parents using the general acculturation index, which is highly reliable ($\alpha=0.82$) and has been shown to be a valid measure of education attained in Latin America and the United States (Balcazar et al., 1995). All survey questions were provided in English or Spanish and available to be filled out
online or in paper format. Surveys were provided to parents, completed on their own time and returned within two weeks to research staff or their child’s ECEC teacher.

**Height and Weight**

Children’s height was measured using a Seca stadiometer (model 213, Seca Corporation, Hamburg, Germany) to the nearest quarter inch. Two measurements were taken without shoes and averaged. If the measurements were more than a quarter inch apart, then a third measurement was taken, and the two most similar measurements were averaged. Weight was measured using a Tanita body composition analyzer (model TBF-310, Tanita Corporation, Tokyo, Japan). Two measurements were taken, and a third was obtained if the difference between weights was more than one half pound. Average height and weight were used to calculate body mass index (BMI) percentile using the standard formula and CDC growth charts (Kuczmarski et al., 2000).

**PA Parenting Practices, Parents PA and PA Activity Resources**

PA parenting practices were measured by the Preschooler PA Parenting Practices (PPAPP) instrument, which assesses practices that encourage or discourage children to be active and has been shown to have moderate to excellent test-retest reliability (O’Connor et al., 2014). The survey consists of 32 items that describe parents’ behaviors and make up two major scales (encouragement of PA and discouragement of PA). Several sub-scales also exist for discouragement of PA (screen time, promotion of inactivity, psychological control, and concern for safety). Each item is scored as 1 (never) to 5 (always), and averages were computed for items according to scoring protocols. Parent’s PA was self-reported on the survey using the validated Stanford Leisure-Time Categorical Item (Kiernan et al., 2013).

Home PA resources were measured using a 14-item checklist related to PA resources (e.g., bikes, jump ropes, and play rooms) available in the home (Rosenberg et
The scale has previously been shown to have strong test-retest reliability (ICC=.80) when parents reported on items available for children. Each resource on the list was scored as either present or absent, and a sum of all present resources was calculated (range 0-14).

**Gross Locomotor Skills**

GLS were measured using both process- and product-based measures. The 20-meter shuttle run (PACER) was used as the product-based measure of GLS. The 20-meter shuttle run was chosen as a product-based measure because it has been shown to be reliable, but is not currently validated as a measure of CVF in preschool-aged children (Ortega et al., 2015). Shuttle run testing occurred during a baseline on-site visit to each ECEC during a recess period. After observing a demonstration to familiarize them with the test, children completed the test in groups of 2-3 on the playground at each site. During the test, children ran back and forth 20-meters with an initial running speed of 8.5 km/hour and a progressive .5 km/hour increase in running speed every minute (Lerger et al., 1988). A research team member led the children through the test to help establish pace and provide instructions. Children were considered to be finished with the test when they did not complete two laps in the required time or were too tired to continue. Results are expressed as the last lap that the child successfully completed.

For the process-based measure, a subgroup of children completed the gross locomotor portion of the CHAMPS motor skill protocol (CMSP) (Williams et al., 2008). Due to the amount of time required to administer the CSMP (∼5-10 minutes per child), consented children were randomly selected by the teacher to participate and as many children as possible were tested in the available recess time that day. The CMSP has been shown to be reliable (R=0.88-0.97) and have strong concurrent validity with other tests of gross motor skills (R=0.95-0.98). Two trials of six GLS (run, broad jump, slide, gallop,
leap, and hop) were completed by each child following two expert demonstrations of each skill. One demonstration was provided facing the child and one was provided in the direction that the child was asked to complete the skill. A trained assessor checked-off each process-based characteristic that the child completed correctly for each skill. No feedback or additional demonstrations were provided. The two trials for each skill were averaged and a total process-based locomotor score was summed from the average of each individual skill. Possible final scores ranged from 0-35, with higher scores indicating better quality movements.

**Statistical Analysis**

A design effect (DEFF) was calculated to determine if multi-level models were needed to control for clustering. Due to low levels of between school variance for both PACER laps (ICC=0.04; DEFF= 1.44) and CMSP score (ICC<0.01; DEFF=1.11), and a relatively small sample size of schools (n=16), multilevel models were not used for this analysis (Hox& Maas, 2002; Wears, 2001).

Descriptive characteristics were determined with means, standard deviations and percentages. Independent t-tests and chi-square tests were used to assess demographic differences by the test completed (locomotor vs. PACER only) and by sex (girls vs. boys). Bivariate tests were conducted between each independent variable and outcome measures. Independent variables were entered into forward selection stepwise regression models in up to three blocks. Block one included individual demographic variables (child age, sex, BMI percentile, ethnicity, and birth country). Block two included family demographic variables and parents’ PA level (parents’ age, marital status, employment, education, income, acculturation, and parents’ PA level). Block three included parenting practices and PA resources (shown in results tables). Models were evaluated after each block and non-significant variables were removed at each stage.
An initial model was fitted for all participants, followed by stratified models for girls and boys. Due to the exploratory nature of this study, \( p < .10 \) was considered significant in the final model. Following block one, significant associations between child demographic variables and outcomes were plotted by age tertile and/or sex for visualization. Following block three, bivariate associations were conducted to check for multi-collinearity between final variables included in the model. Parenting practices that were significant in the final models were individually replaced in regression models by their subscale items in an effort to help with translation. All analyses were completed using SPSS version 24.

**Results**

Overall, 144 children from 16 ECEC participated in GLS measures. The PACER test was completed by 142 children and 91 completed the CMSP. Two children completed the CMPS but declined participation in the PACER test. One ECEC with a higher proportion of girls (87.5%) opted not to complete the CMPS, thus more boys \( (n=54) \) completed this assessment than girls \( (n=37; \chi^2=7.40; p=.01) \). There were no other significant differences in demographic variables between those who completed the CMPS \( (n=91) \) and those who did not \( (n=53; p>.05) \). The average score on the PACER test was 3.7±2.3 laps and average score on the CMSP was 19.0±5.5 criterion. PACER and CMSP scores were moderately correlated \( (r=.46; p<.01) \). Boys scored significantly higher on the PACER test than girls \( (4.4±2.5 \text{ laps vs. } 3.0±1.9 \text{ laps}; p<.01) \), but there were no other significant differences by sex \( (p>0.05) \) (Table 4.1).

Bivariate analysis in the full sample revealed that child’s age \( (r=0.38; p<0.01) \) and sex \( (r_{pb}=-0.30; p<0.01) \), parents’ promotion of screen time \( (r=0.30; p<0.01) \), parents’ promotion of inactivity \( (r=0.19; p=0.05) \), and parents’ concern for safety \( (r=-0.23; p=0.02) \) were significantly related to the number of PACER laps completed. In the
stratified analysis, significant associations with child’s age \( (r=0.27; p=0.03) \), parents’ promotion of screen time \( (r=0.26; p=0.06) \), and parents’ concern for safety \( (r=-0.23; p=0.02) \) remained for boys. For girls, only significant associations with child’s age \( (r=0.50; p<0.01) \) and parents’ promotion of screen time \( (r=0.31; p=0.02) \) remained and a new significant association with parents’ encouragement of PA was identified \( (r=-0.22; p=0.01) \). Children’s total number of PACER laps by sex and age tertile can be seen in Figure 4.1 (a).

For children’s CMSP score, bivariate associations revealed that children’s age \( (r=0.38; p<0.01) \), and parents’ promotion of screen time \( (r=0.24; p=0.04) \) and parents’ promotion of inactivity \( (r=-0.20; p=0.09) \) were significantly associated with total number of criteria met. In the stratified analysis, only child’s age \( (r=0.33; p=0.02) \) remained significantly associated with CMSP score for boys. Child’s age \( (r=0.42; p=0.01) \) and parents’ promotion of screen time \( (r=0.34; p=0.07) \) remained significant for girls. Children’s CSMP score by age can be seen in Figure 4.1 (b). A table of bivariate associations between outcome and independent variables can be found in the Table 4.2.

Regression models in the full sample demonstrated that both child’s sex and age were significantly related to PACER laps, in addition to parents’ promotion of inactivity, parents’ promotion of screen time, and parents’ concern for their child’s safety. Individual level factors explained 20.1% of variance in PACER scores, while addition of higher-level variables explained 33.5% of total variability in the full sample. For boys and girls, 21.6% and 20.9% of PACER variance was explained by individual level factors, while addition of higher-level variables explained a total of 31.9% and 31.9% of variance, respectively. Table 4.3 displays all final PACER models. Although residuals from the PACER regression models approached normality, the presence of a small floor effect was detected. In sensitivity analysis, removal of the four most extreme PACER values to
restore normality (n=4; 100% boys) significantly reduced the effect of sex in the full sample, but confirmed all other associations in the full sample, for boys and for girls.

Regression models in the full sample demonstrated that age and parental employment were significantly related to CMSP. Individual level factors explained 20.3% of CMSP variance, while including higher-level variables increased that to 28.7% in the full sample. For boys and girls, 20.8% and 23.2% of CMSP was explained at the individual level, while higher-level variables increased this to 26.7% and 44.3%, respectively. Table 4.4 displays all final CSMP models.

There were no multi-collinearity issues between variables included in any of the final models $p's>.05$ (Table 4.5 and 4.6). Individual parenting practice items from each subscale, that explained grater portions of variance in the final models, can be found in tables 4.7 and 4.8.

**Discussion**

Results revealed that individual level demographic factors, account for ~20% of the variance in preschool-aged children's GLS, using both product- and process-based outcome measures. Addition of parent demographic variables, parenting practices, and PA resources explained an additional ~10-25% of variance. These results support the assertion that individual and family factors within children’s environmental are associated with preschool-aged children's GLS beyond what is accounted for by their individual demographic characteristics. Previous studies found that family level correlates of process-based gross motor skills include parents’ PA levels, parents’ education and the availability of home PA resources, none of which were associated with GLS in this analysis (Barnett et al., 2013; Cools et al., 2011). Although parents’ education was not associated with GLS in this analysis, parental employment was, suggesting that characteristics of a family’s socioeconomic position may be related to children’s GLS.
Both PA resources and parents’ PA levels were not associated with GLS in this analysis, but PA resources approached significance with product-based measures and several parenting practices were significantly associated with GLS. These findings provide continued support for the important role that parents play in children’s early development; although, more research is needed to determine the specific actions that parents can take to help develop children’s GLS.

Studies that have used the PACER and CMSP tests in preschool-aged children have reported an average of 14-21 laps complete and 19.0 criteria met, respectively (Niederer et al., 2012; Williams et al., 2008). Results from the present study mirror those for the CMSP (19.0±5.5 criteria) but are well below those found for the PACER test (3.7±2.3 laps). Reasons for differences in the PACER test may be due to the age of preschool-aged children who participated in this study (53.2±4.5 months), who were almost a year younger than in the study by Niederer and colleagues. Additionally, Goodway and colleagues (2010) found that Hispanic children had lower motor competence than their non-Hispanic peers, and this study revealed that Hispanic boys and boys born in Mexico had worse GLS (~3 PACER laps and ~3 CMSP criteria) than their non-Hispanic and US born peers. Taken together, the young age and high proportion of Hispanic school-aged children in this sample may have accounted for the lower number of PACER laps completed. Hispanic preschool-aged children have been shown to participate in less MVPA and have higher BMIs than their non-Hispanic peers, which according to the developmental model, may be related to lower GLS (Skinner et al., 2018; Trost et al., 2013). Future studies should examine the relationship between these factors in Hispanic preschool-aged children.

Regarding parenting practices, parents’ promotion of screen time (e.g., keeping the child occupied by letting them watch TV) and parents’ promotion of inactivity (e.g.,
carrying the child when they could walk) were associated with higher GLS. Parental concern for their child’s safety (e.g., not letting the child play outside because of worries about strangers traffic or crime) was associated with lower GLS scores. The association between promotion of screen time and inactivity with GLS are in opposite direction of what is reported in the literature for the association between parenting practices and PA (Xu et al., 2015). The positive association found between screen time and GLS may be due to parents responding to children’s GLS (i.e., parents’ promoting more screen time for child who has better GLS because they view them as already very active), although this cannot be determined through this study’s cross-sectional design. Additionally, the positive association between promotion of inactivity (allowing their child to walk less) and GLS may be due to parents concern about not being able to control their child in public or in less safe situations (i.e., walking along the road). Furthermore, the association between PA and parenting practices have been shown to be influenced by both child demographic variables and parents’ perceived environmental context; both of which could similarly be complicating the relationship with children’s GLS in this analysis (O’Connor et al., 2014).

**Strengths**

This study assessed the relationship of individual and family level factors with GLS by child’s sex. Assessing factors by sex is important, as parents provide support for or discourage PA differently in boys than girls (Jago et al., 2011). This study’s findings extend current literature by demonstrating that parental behaviors also have differential associations with boys’ and girls’ GLS, suggesting that parents either parent differently or respond to GLS development differently for boys and girls. This study also assessed individual and family level factors related to GLS in a predominantly Hispanic population (78.3%). The Hispanic population is one of the fastest growing populations in
the United States, and cultural characteristics have been shown to be related to parenting practices around PA (Abascal et al., 2015; O’Connor et al., 2014). Results from this study show that Hispanic children have lower GLS than their non-Hispanic peers, and that parenting practices play a role in these differences within a predominantly Hispanic population. Finally, this study included both process- and product-based measures when examining the relationship between GLS and individual and family level variables. Each type of measures produced different associations between GLS and individual and family level factors, supporting the need for inclusion of both types of measures within future studies.

**Limitations**

This study was cross-sectional; therefore, a causal relationship between parenting practices and GLS cannot be determined. Future longitudinal studies are needed to determine the direction of the association between parenting practices and children’s GLS. Children’s PA levels were not assessed in this analysis. PA and GLS are co-linear, and there is a possibility that the relationships between environmental factors and GLS could have been erased or accentuated if PA had been controlled for in this analysis. Although possible, when Barnett et al. included PA as a variable in their analysis, it was not significantly correlated to process-based GLS measures, suggesting that the relationships in this study would still exist, even with PA controlled for in the analysis (Barnett et al., 2013). Since initial protocol design, adaptations have been recommended for the PACER test, which include running with two research staff (one in front and one behind) and a reduction in the initial running speed from 8.5 km/h to 6.5 km/hour for very young children (Mora-Gonzalez et al., 2017). Result from the PACER test in this study demonstrated a small floor effect for very young children, which supports the slower initial running speed recommended by Mora-Gonzalez and colleagues (2017).
Conclusion

Individual level demographic characteristics, parents’ demographic characteristics and children’s home environments may be important factors to consider for intervention researchers, teachers, and policy makers, who all play a significant role in the development of children’s GLS. ECEC teachers should be taught to recognize the individual ethnic and sex specific relationships that exist for GLS and provide activities and resources that are culturally and contextually appropriate. Parents should be made aware of how their behaviors are related to children’s GLS and guided to stimulate behaviors that promote positive developmental trajectories. Finally, policy makers should consider environmental differences that are related to GLS and strive to provide safe neighborhoods and equal opportunities for all children to participate in activities that promote positive development.

Practical Implications

Boys and older children have better gross locomotor skills than girls and younger children. ECEC teachers should write development plans that consider the home environment for children whose skills are lagging behind the age and sex specific norms.

Process-based and product-based measurements of motor skills are not perfectly related and measurement of both may be required to accurately characterize motor skill development.

Parent’s concern for their child’s safety was correlated to worse product-based motor outcome measures, suggesting that families who live in unsafe neighborhoods may have children with worse locomotor outcomes.

Declarations

Ethical approval: The research was approved by the Institutional Review Board at Arizona State University.
Availability of data and materials: The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Funding: This research was supported by the National Institutes of Health through the National Institutes on Minority Health and Health Disparities cooperative agreement 5U01MD010667-03 awarded to Dr. Rebecca E. Lee, the National Institute of Nursing Research grant 1F31NR017560-01 and Jonas Scholar Nurse Leader 2016-2018 Cohort awarded to Elizabeth Lorenzo, and the Arizona State University Graduate College Completion Fellowship awarded to Jacob Szeszulski.

Author Contributions: JS conceptualized the analysis, analyzed and interpreted the results, drafted the manuscript and is accountable for all aspects of the content in this manuscript. EL was a major contributor to the revision of manuscript and approved the final version of this manuscript. TO, JH, GQS, MPB, SVL, SPH, and REL provided guidance on the conceptualization of this analysis, were major contributors to the revision of manuscript and approved the final version of this manuscript. REL also obtained funding for this project.

Acknowledgements: Authors would like to acknowledge Timothy Debaise for his help with data collection, Anel Arriola as project manager, and all of the other students, community advisory board members, and early care and educations center teachers and directors who have contributed to the success of the Sustainability via Active Garden Education project.
Table 4.1 Comparison of parent and child characteristics participating by child sex

<table>
<thead>
<tr>
<th></th>
<th>Total Sample (n=144)</th>
<th>Boys (n=73)</th>
<th>Girls (n=71)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parent Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, years*</td>
<td>31.7±7.7</td>
<td>32.4±8.0</td>
<td>31.0±7.5</td>
<td>0.29</td>
</tr>
<tr>
<td>Female (%)</td>
<td>93.1</td>
<td>89.6</td>
<td>96.8</td>
<td>0.10</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>76.0</td>
<td>71.6</td>
<td>80.6</td>
<td>0.23</td>
</tr>
<tr>
<td>Marital Status (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.11</td>
</tr>
<tr>
<td>Married</td>
<td>42.7</td>
<td>45.3</td>
<td>40.4</td>
<td></td>
</tr>
<tr>
<td>Living like married, but not</td>
<td>20.0</td>
<td>11.3</td>
<td>28.1</td>
<td></td>
</tr>
<tr>
<td>Separated divorced or widowed</td>
<td>15.5</td>
<td>15.1</td>
<td>15.8</td>
<td></td>
</tr>
<tr>
<td>Single (never married)</td>
<td>21.8</td>
<td>28.3</td>
<td>15.8</td>
<td></td>
</tr>
<tr>
<td>Education (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.90</td>
</tr>
<tr>
<td>8th grade or less</td>
<td>13.6</td>
<td>13.2</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Some high school</td>
<td>12.7</td>
<td>15.1</td>
<td>10.5</td>
<td></td>
</tr>
<tr>
<td>High school Degree or GED</td>
<td>33.6</td>
<td>35.8</td>
<td>31.6</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>27.3</td>
<td>24.5</td>
<td>29.8</td>
<td></td>
</tr>
<tr>
<td>Completed college or trade school</td>
<td>12.7</td>
<td>11.3</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Job Status (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.18</td>
</tr>
<tr>
<td>Employed</td>
<td>50.0</td>
<td>43.1</td>
<td>56.1</td>
<td></td>
</tr>
<tr>
<td>Not Employed</td>
<td>50.0</td>
<td>56.9</td>
<td>43.9</td>
<td></td>
</tr>
<tr>
<td>Income (%)</td>
<td></td>
<td></td>
<td></td>
<td>0.53</td>
</tr>
<tr>
<td>$0 to $20,000</td>
<td>37.9</td>
<td>41.7</td>
<td>34.5</td>
<td></td>
</tr>
<tr>
<td>$20,001 to $39,000</td>
<td>41.7</td>
<td>39.6</td>
<td>43.6</td>
<td></td>
</tr>
<tr>
<td>$39,001 to $59,000</td>
<td>12.6</td>
<td>14.6</td>
<td>10.9</td>
<td></td>
</tr>
<tr>
<td>$59,001 or more</td>
<td>7.8</td>
<td>4.2</td>
<td>10.9</td>
<td></td>
</tr>
<tr>
<td>Acculturation+</td>
<td>3.0±1.3</td>
<td>3.2±1.4</td>
<td>2.9±1.3</td>
<td>0.16</td>
</tr>
<tr>
<td><strong>Child Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age, months*</td>
<td>53.2±4.5</td>
<td>53.6±4.2</td>
<td>52.8±4.7</td>
<td>0.33</td>
</tr>
<tr>
<td>BMI percentile*</td>
<td>66.5±29.2</td>
<td>66.5±29.5</td>
<td>66.5±29.2</td>
<td>0.99</td>
</tr>
<tr>
<td>Female (%)</td>
<td>49.3</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>78.3</td>
<td>73.1</td>
<td>83.9</td>
<td>0.26</td>
</tr>
<tr>
<td><strong>Activity Variables</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PACER Laps*</td>
<td>3.7±2.3</td>
<td>4.4±2.5</td>
<td>3.0±1.9</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>CMSP Score*</td>
<td>19.0±5.5</td>
<td>19.6±5.6</td>
<td>18.1±5.2</td>
<td>0.19</td>
</tr>
<tr>
<td>Number of Physical Activity Resources*</td>
<td>3.6±2.4</td>
<td>3.6±2.5</td>
<td>3.6±2.4</td>
<td>0.89</td>
</tr>
<tr>
<td>Parent’s Physical Activity Level (%)</td>
<td>3.6±2.4</td>
<td>3.6±2.5</td>
<td>3.6±2.4</td>
<td>0.89</td>
</tr>
<tr>
<td>None</td>
<td>11.3</td>
<td>16.0</td>
<td>7.1</td>
<td>0.40</td>
</tr>
<tr>
<td>1-2x per week light</td>
<td>51.9</td>
<td>54.0</td>
<td>50.0</td>
<td></td>
</tr>
<tr>
<td>3x per week moderate</td>
<td>22.6</td>
<td>20.0</td>
<td>25.0</td>
<td></td>
</tr>
<tr>
<td>Daily moderate</td>
<td>8.5</td>
<td>4.0</td>
<td>12.5</td>
<td></td>
</tr>
<tr>
<td>3x per week vigorous</td>
<td>2.8</td>
<td>2.0</td>
<td>3.6</td>
<td></td>
</tr>
<tr>
<td>Daily vigorous</td>
<td>2.8</td>
<td>4.0</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Encouraging Parenting Practices*+</td>
<td>3.4±0.7</td>
<td>3.4±0.7</td>
<td>3.4±0.7</td>
<td>0.76</td>
</tr>
<tr>
<td>Discouraging Parenting Practices*+</td>
<td>2.1±0.4</td>
<td>2.1±0.4</td>
<td>2.1±0.4</td>
<td>0.57</td>
</tr>
<tr>
<td>Promotion of Screen time*+###</td>
<td>2.4±0.7</td>
<td>2.4±0.8</td>
<td>2.3±0.6</td>
<td>0.32</td>
</tr>
<tr>
<td>Promotion of Inactivity*+###</td>
<td>1.8±0.6</td>
<td>1.9±0.7</td>
<td>1.8±0.6</td>
<td>0.17</td>
</tr>
<tr>
<td>Psychological Control*+###</td>
<td>1.6±0.6</td>
<td>1.6±0.6</td>
<td>1.6±0.5</td>
<td>0.97</td>
</tr>
<tr>
<td>Concern for Safety*+###</td>
<td>2.6±1.0</td>
<td>2.6±1.1</td>
<td>2.6±1.0</td>
<td>0.76</td>
</tr>
</tbody>
</table>

*Mean and standard deviation
+Score ranges from 1-5
###Subscale of Discouraging Parenting Practices
### Table 4.2 Bivariate Relationships between independent and dependent variables

<table>
<thead>
<tr>
<th></th>
<th>Full Sample</th>
<th></th>
<th></th>
<th>Boys</th>
<th></th>
<th></th>
<th>Girls</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PACER Laps</td>
<td>p-value</td>
<td>CSMP Score</td>
<td>p-value</td>
<td>PACER Laps</td>
<td>p-value</td>
<td>CMSP Score</td>
<td>p-value</td>
<td>PACER Laps</td>
</tr>
<tr>
<td><strong>Individual Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>0.373</td>
<td>&lt;.001</td>
<td>0.376</td>
<td>&lt;.001</td>
<td>0.269</td>
<td>0.025</td>
<td>0.327</td>
<td>0.017</td>
<td>0.500</td>
</tr>
<tr>
<td>Sex*</td>
<td>-0.239</td>
<td>&lt;.001</td>
<td>-0.139</td>
<td>0.188</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hispanic*</td>
<td>0.008</td>
<td>0.927</td>
<td>0.150</td>
<td>0.174</td>
<td>0.038</td>
<td>0.761</td>
<td>0.173</td>
<td>0.226</td>
<td>-0.160</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>-0.084</td>
<td>0.335</td>
<td>-0.106</td>
<td>0.336</td>
<td>-0.196</td>
<td>0.106</td>
<td>-0.193</td>
<td>0.167</td>
<td>0.059</td>
</tr>
<tr>
<td>Birth Country*</td>
<td>-0.086</td>
<td>0.375</td>
<td>-0.050</td>
<td>0.679</td>
<td>-0.210</td>
<td>0.132</td>
<td>-0.123</td>
<td>0.442</td>
<td>0.053</td>
</tr>
<tr>
<td><strong>Parent Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>-0.028</td>
<td>0.748</td>
<td>0.073</td>
<td>0.501</td>
<td>-0.058</td>
<td>0.635</td>
<td>0.143</td>
<td>0.424</td>
<td>-0.056</td>
</tr>
<tr>
<td>Married</td>
<td>0.042</td>
<td>0.664</td>
<td>-0.178</td>
<td>0.137</td>
<td>0.077</td>
<td>0.886</td>
<td>-0.178</td>
<td>0.264</td>
<td>-0.054</td>
</tr>
<tr>
<td>Employed*</td>
<td>0.037</td>
<td>0.705</td>
<td>0.103</td>
<td>0.401</td>
<td>0.133</td>
<td>0.352</td>
<td>0.069</td>
<td>0.676</td>
<td>0.000</td>
</tr>
<tr>
<td>Education</td>
<td>0.054</td>
<td>0.578</td>
<td>-0.040</td>
<td>0.741</td>
<td>-0.041</td>
<td>0.939</td>
<td>-0.179</td>
<td>0.262</td>
<td>0.169</td>
</tr>
<tr>
<td>Income</td>
<td>0.039</td>
<td>0.699</td>
<td>0.125</td>
<td>0.327</td>
<td>0.043</td>
<td>0.773</td>
<td>0.026</td>
<td>0.888</td>
<td>0.093</td>
</tr>
<tr>
<td>Accumulation</td>
<td>-0.011</td>
<td>0.910</td>
<td>0.051</td>
<td>0.672</td>
<td>-0.014</td>
<td>0.920</td>
<td>-0.074</td>
<td>0.647</td>
<td>-0.079</td>
</tr>
<tr>
<td>Parents PA</td>
<td>0.152</td>
<td>0.121</td>
<td>0.201</td>
<td>0.105</td>
<td>0.204</td>
<td>0.155</td>
<td>0.250</td>
<td>0.136</td>
<td>0.277</td>
</tr>
<tr>
<td><strong>Parenting Practices</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Encouragement of PA</td>
<td>-0.122</td>
<td>0.205</td>
<td>-0.043</td>
<td>0.724</td>
<td>-0.027</td>
<td>0.819</td>
<td>-0.071</td>
<td>0.665</td>
<td>-0.222</td>
</tr>
<tr>
<td>Promotion of Screen Time</td>
<td>0.295</td>
<td>0.002</td>
<td>0.042</td>
<td>0.042</td>
<td>0.250</td>
<td>0.063</td>
<td>0.189</td>
<td>0.243</td>
<td>0.333</td>
</tr>
<tr>
<td>Promotion of Inactivity</td>
<td>0.188</td>
<td>0.050</td>
<td>0.201</td>
<td>0.033</td>
<td>0.248</td>
<td>0.263</td>
<td>0.122</td>
<td>0.454</td>
<td>0.271</td>
</tr>
<tr>
<td>Psychological Control</td>
<td>-0.025</td>
<td>0.793</td>
<td>-0.020</td>
<td>0.872</td>
<td>0.012</td>
<td>0.766</td>
<td>0.050</td>
<td>0.761</td>
<td>-0.134</td>
</tr>
<tr>
<td>Concern for Safety</td>
<td>-0.028</td>
<td>0.017</td>
<td>-0.130</td>
<td>0.281</td>
<td>-0.290</td>
<td>0.037</td>
<td>-0.266</td>
<td>0.909</td>
<td>-0.131</td>
</tr>
<tr>
<td>PA Support</td>
<td>0.196</td>
<td>0.159</td>
<td>0.030</td>
<td>0.834</td>
<td>0.155</td>
<td>0.073</td>
<td>-0.015</td>
<td>0.909</td>
<td>0.117</td>
</tr>
</tbody>
</table>

Bolded values are significant (P < 0.05)

* Point-Biserial Correlation

PA = physical activity
### Table 4.3 Forward Selection Stepwise Linear Regression of Individual and Family Correlates for PACER

<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample</th>
<th></th>
<th>Boys</th>
<th>p-value</th>
<th>Girls</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>p-value</td>
<td>B</td>
<td>p-value</td>
<td>B</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Child Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s Sex</td>
<td>-0.96</td>
<td>0.03</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Child’s Age</td>
<td>0.17</td>
<td>&lt;0.01</td>
<td>0.23</td>
<td>0.02</td>
<td>0.20</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>-0.01</td>
<td>0.22</td>
<td>-0.02</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Birth Country</td>
<td>-1.21</td>
<td>0.24</td>
<td>-2.77</td>
<td>0.16</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Parent Demographics</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Age</td>
<td>-</td>
<td>-</td>
<td>-0.08</td>
<td>0.23</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parent Income</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.24</td>
<td>0.36</td>
</tr>
<tr>
<td><strong>Home Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promotion of Inactivity</td>
<td>0.66</td>
<td>0.08</td>
<td>-</td>
<td>-</td>
<td>0.58</td>
<td>0.18</td>
</tr>
<tr>
<td>Promotion of Screen Time</td>
<td>0.65</td>
<td>0.05</td>
<td>-</td>
<td>-</td>
<td>0.61</td>
<td>0.16</td>
</tr>
<tr>
<td>Concern for Safety</td>
<td>-0.36</td>
<td>0.09</td>
<td>-0.69</td>
<td>0.06</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PA Resource Total</td>
<td>0.14</td>
<td>0.12</td>
<td>-</td>
<td>-</td>
<td>0.32</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Data presented are models following block three for the full sample, for boys, and for girls.
Dashes indicate that that variable is not included within that model.
Variables not included in block 1 in any of the model are as follows: child’s ethnicity.
Variables not included in block 2 in any of the model are as follows: parents’ marital status, employment, education, acculturation and physical activity level.
Variables not included in block 3 in any of the model are as follows: parents’ encouragement of physical activity and parents’ psychological control.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Full Sample</th>
<th></th>
<th>Boys</th>
<th></th>
<th>Girls</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>P-value</td>
<td>B</td>
<td>P-value</td>
<td>B</td>
<td>P-value</td>
</tr>
<tr>
<td><strong>Child Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s Age</td>
<td>0.47</td>
<td>&lt;0.01</td>
<td>0.48</td>
<td>0.02</td>
<td>0.49</td>
<td>0.02</td>
</tr>
<tr>
<td>Non-Hispanic</td>
<td>-</td>
<td>-</td>
<td>2.77</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Birth Country</td>
<td>-1.46</td>
<td>0.56</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Parent Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parent Employed</td>
<td>2.29</td>
<td>0.07</td>
<td>-</td>
<td>-</td>
<td>4.92</td>
<td>0.01</td>
</tr>
<tr>
<td>Parent Age</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>0.23</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Home Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Promotion of Inactivity</td>
<td>1.45</td>
<td>0.14</td>
<td>2.04</td>
<td>0.14</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Model Fit R²</strong></td>
<td>0.29</td>
<td>&lt;0.01</td>
<td>0.27</td>
<td>0.02</td>
<td>0.44</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Final model following block three for the full sample, for boys, and for girls.

Dashes indicate that that variable is not included within that model.

Variables not included in block 1 in any of the model are as follows: child’s sex and BMI percentile.

Variables not included in block 2 in any of the model are as follows: parents’ marital status, education, income, acculturation, and physical activity level.

Variables not included in block 3 in any of the model are as follows: parents’ encouragement of physical activity, parents’ promotion of screen time, parents’ concern for safety, parents’ psychological control, physical activity resource total.
Figure 4.1 Demographic Difference in Gross Locomotor Scores
Data are represented as means and standard deviations
Youngest tertile (≥51 months), Middle tertile (>51 months to ≥56 months), Oldest tertile (>56 months)
A- Product-based measure (PACER laps) by age ($B=0.19; p$-trend $<.01$) and sex ($B=1.21; p$-trend $<.01$)
B- Process-based measure (CMSP criteria) by age ($B=0.20; p$-trend $<.01$)
<table>
<thead>
<tr>
<th></th>
<th>Child Sex</th>
<th>Child Age</th>
<th>BMI Percentile</th>
<th>Birth Country</th>
<th>Parent Age</th>
<th>Parent Income</th>
<th>Promotion of Inactivity</th>
<th>Promotion of Screen Time</th>
<th>Concern for Safety</th>
<th>PA Resource Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child's Sex</td>
<td>1</td>
<td>-0.088</td>
<td>-0.004</td>
<td>0.074</td>
<td>-0.090</td>
<td>0.104</td>
<td>-0.132</td>
<td>-0.106</td>
<td>0.044</td>
<td>-0.011</td>
</tr>
<tr>
<td>Child's Age</td>
<td>-</td>
<td>1</td>
<td>-0.057</td>
<td>-0.007</td>
<td>0.045</td>
<td>-0.127</td>
<td>-0.099</td>
<td>0.184</td>
<td>-0.055</td>
<td>0.106</td>
</tr>
<tr>
<td>BMI Percentile</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.151</td>
<td>-0.050</td>
<td>-0.054</td>
<td>0.074</td>
<td>-0.141</td>
<td>-0.049</td>
<td>-0.104</td>
</tr>
<tr>
<td>Birth Country</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.162</td>
<td>-0.079</td>
<td>-0.158</td>
<td>0.045</td>
<td>0.136</td>
<td>-0.162</td>
</tr>
<tr>
<td>Parent Age</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.058</td>
<td>0.119</td>
<td>-0.051</td>
<td>0.117</td>
<td>0.088</td>
</tr>
<tr>
<td>Parent Income</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.134</td>
<td>-0.027</td>
<td>0.201</td>
<td>0.118</td>
</tr>
<tr>
<td>Promotion of Inactivity</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.133</td>
<td>-0.048</td>
<td>0.037</td>
<td></td>
</tr>
<tr>
<td>Promotion of Screen Time</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.025</td>
<td>-0.124</td>
</tr>
<tr>
<td>Concern for Safety</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.072</td>
</tr>
<tr>
<td>PA Resource Total</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Bolded values are significant \( p < 0.05 \)
### Table 4.6 Correlations Between Variables in the final Model (CMSP)

<table>
<thead>
<tr>
<th></th>
<th>Child Age</th>
<th>Child Ethnicity</th>
<th>Birth Country</th>
<th>Parent Employment</th>
<th>Parent Age</th>
<th>Promotion of Inactivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child’s Age</td>
<td>1</td>
<td>-0.071</td>
<td>-0.007</td>
<td>-0.035</td>
<td>0.045</td>
<td>-0.009</td>
</tr>
<tr>
<td>Child’s Ethnicity</td>
<td>-</td>
<td>1</td>
<td>-0.125</td>
<td>0.119</td>
<td>-0.033</td>
<td>-0.032</td>
</tr>
<tr>
<td>Birth Country</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.165</td>
<td>-0.162</td>
<td>-0.158</td>
</tr>
<tr>
<td>Parent Employment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.122</td>
<td>0.093</td>
</tr>
<tr>
<td>Parent Age</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.119</td>
</tr>
<tr>
<td>Promotion of Inactivity</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

Bolded values are significant $p<.05$
<table>
<thead>
<tr>
<th>Sub-scale or Sub-scale Item</th>
<th>B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Promotion of Inactivity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carry your child because he/she does not want to walk?</td>
<td>0.234</td>
<td>0.395</td>
</tr>
<tr>
<td>Drive your child when it is easy to walk?</td>
<td>0.124</td>
<td>0.485</td>
</tr>
<tr>
<td>Push your child in a stroller instead of letting him/her walk?</td>
<td>0.182</td>
<td>0.445</td>
</tr>
<tr>
<td><strong>Promotion of Screen Time</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allow your child to watch TV for long periods of time?</td>
<td>-0.185</td>
<td>0.477</td>
</tr>
<tr>
<td>Allow your child to play a lot of video games?</td>
<td>0.121</td>
<td>0.625</td>
</tr>
<tr>
<td>Keep your child occupied by letting him/her watch TV?</td>
<td><strong>0.758</strong></td>
<td><strong>0.010</strong></td>
</tr>
<tr>
<td><strong>Concern for Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not let your child play outside because you are worried about traffic?</td>
<td>-0.257</td>
<td>0.123</td>
</tr>
<tr>
<td>Let your child go outside to play around your home?</td>
<td>0.049</td>
<td>0.774</td>
</tr>
<tr>
<td>Not let your child play outside because you are worried about crime?</td>
<td>-0.193</td>
<td>0.417</td>
</tr>
<tr>
<td>Not your child play outside because you are worried about strangers.</td>
<td>0.091</td>
<td>0.668</td>
</tr>
</tbody>
</table>

PPAPP- Preschool Physical Activity Parenting Practices

Bolded values are significant (p<0.05).
Table 4.8 Substitution of PPAPP items in place of subscales in final model (PACER-boys only)

<table>
<thead>
<tr>
<th>Sub-scale or Sub-scale Item</th>
<th>B</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Concern for Safety</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not let your child play outside because you are worried about traffic?</td>
<td>-0.299</td>
<td>0.268</td>
</tr>
<tr>
<td>Let your child go outside to play around your home?</td>
<td>0.268</td>
<td>0.410</td>
</tr>
<tr>
<td>Not let your child play outside because you are worried about crime?</td>
<td>0.064</td>
<td>0.865</td>
</tr>
<tr>
<td>Not your child play outside because you are worried about strangers.</td>
<td>-0.254</td>
<td>0.511</td>
</tr>
</tbody>
</table>

PPAPP- Preschool Physical Activity Parenting Practices

Bolded values are significant (p<0.05).
CHAPTER 5
MANUSCRIPT 3

Associations between Gross Locomotor Skills and the Early Care and Environment in
Predominantly Hispanic Preschool-aged Children

Jacob Szeszulski\textsuperscript{1}, Elizabeth Lorenzo\textsuperscript{2}, Michael Todd\textsuperscript{2}, Teresia O’Connor\textsuperscript{3}, Jennie Hill\textsuperscript{1}, Gabriel Q. Shaibi\textsuperscript{2}, Matthew P. Buman\textsuperscript{1}, Sonia Vega-López \textsuperscript{1,5}, Steven P. Hooker\textsuperscript{6} and Rebecca E. Lee\textsuperscript{2}

\textsuperscript{1} College of Health Solutions, Arizona State University, 550 North 3rd St, Phoenix, AZ, USA 85004; \textsuperscript{2} Center for Health Promotion and Disease Prevention, College of Nursing and Health Innovation, Arizona State University, Phoenix, Arizona; \textsuperscript{3} Baylor College of Medicine, Houston, TX, USA; \textsuperscript{4} University of Nebraska Medical Center, Omaha, NE; \textsuperscript{5} Southwestern Interdisciplinary Research Center, Arizona State University, Phoenix, AZ; \textsuperscript{6} San Diego State University, College of Health and Human Services, San Diego, CA, USA

Corresponding Author:
Jacob Szeszulski
425 N 5th St.
Phoenix, AZ, USA, 85004
jszeszul@asu.edu
ABSTRACT

Purpose: To examine the association of early care and education center (ECEC) environmental characteristics with product-based and process-based gross locomotor skills (GLS) in predominantly Hispanic preschool-aged children. Design: Cross-sectional. Methods: Outdoor play environment quality, outdoor play equipment total, indoor play environment quality, indoor play equipment total, screen time environment quality, and policy environment quality were determined through direct observation, teacher report, or director report. Questions were taken from the Nutrition and Physical Activity Self-Assessment for Child Care (NAPSACC) instruments or the Environment and Policy Assessment and Observation instrument. GLS were measured using the progressive aerobic cardiovascular endurance run (PACER) and the locomotor portion of the CHAMPS motor skills protocol (CMSP). Children (78.0% Hispanic; mean (SD) age 53.26±4.48 months) completed the PACER (n=142) and CMPS (n=91). Results: Mean (SD) scores for the PACER and CSMP were 3.69±2.32 laps and 19.02±5.46 criteria, respectively and were moderately correlated (r=.46; p<.01) with each other. Children’s age (B=0.19; p<0.01), being a girl (B=-1.21; p=0.02) and policy environment quality (B=-0.17; p=0.01) were significantly associated with number of PACER laps completed. Children’s age (B=0.49; p<0.01), non-Hispanic ethnicity (B=1.90; p=0.03), outdoor play environment quality (B=0.18; p=0.03), outdoor play equipment total (B=0.32; p<0.01) and screen time environment quality (B=0.60; p=0.02) were significantly associated with CMSP score. Conclusions: An improved outdoor play environment, more outdoor play equipment and a screen time environment with less televisions and computers offer potential avenues to promote GLS within the ECEC environment. Trial Registration: ClinicalTrials.gov Identifier: NCT03261492 (date of registration 8/25/17)
Introduction

Participation in physical activity (PA) is a positive preventive health behavior for multiple major chronic diseases including, obesity, cancer, diabetes, and cardiovascular disease (Physical Activity Advisory Committee, 2018). PA patterns begin to develop at birth and are influenced by young children’s environments, including the school environment, where children spend over half of their waking hours (McGurie et al., 2012). Despite the fact that more preschool-aged children are attending early care and education centers (ECECs) each year, only 2-3% of children’s time at ECECs is spent participating in moderate-to-vigorous PA (Pate et al., 2008). Additionally, the ECEC is the place where children spend the most inactive time throughout their week (Cerin et al., 2016). Early participation in PA is important to the development of young children’s motor competence, which then reinforces lifelong patterns of PA as they age; thus, environments that promote PA and motor competence need critical evaluation (Robinson et al., 2015; Stodden et al., 2008).

Studies that have examined the relationship between the ECEC environment and young children’s PA are numerous and support a relationship between better indoor and outdoor activity environments and better activity-related policies with increased PA participation (Dowda et al., 2009; Henderson et al., 2015; Tucker et al., 2017). PA has been shown to be consistently positively related to gross motor skills in preschool-aged children, and activities targeting gross locomotor skills (GLS), one of three domains (locomotor, object projection, and object deflection) of gross motor skills, account for a fifth of young children’s school day PA (Figueroa & An, 2017; Robinson et al., 2012). Taken together, this evidence suggests that the ECEC environment may also play a significant role in the development of preschool-aged children’s GLS.
To date, few studies have examined the relationship between the ECEC environment and preschool-aged children’s gross motor skills and none that have used both product- and process-based outcome measures. Product-based assessments evaluate the outcome of a movement and process-based assessments evaluate how a movement is preformed, but quantitative outcomes (i.e., how many running laps can be completed) may not always be related to the quality of the movement (e.g., a child’s running form), suggesting both types of assessments are needed for comprehensive assessment (Logan et al., 2017).

One study that assessed the relationship between the ECEC environment and gross motor skills, using only process-based measures, found that smaller classroom size/child ratio, higher teacher education, larger playground size, less field trips per month and more electronic media use were all associated with children GLS (True et al., 2017). In other studies, that used process-based measures, children’s geographic region and type of preschools (public vs. public) were also shown to play a role in the development of gross motor skills (Chow et al., 2013; Goodway et al., 2010). Of note, studies on regional differences, found that southwestern Hispanic children had significantly worse GLS than their African American mid-west counterparts, but reasons for differences between regions were not explored. Additionally, no studies thus far have used product-based GLS measures, suggesting that a deeper investigation of the associations between GLS and the ECEC environment is needed. Thus, the purpose of this study was to examine the association between ECEC environmental characteristics with product-based and process-based GLS measures in predominantly Hispanic (78.0%) preschool-aged children.
Methods

Participants

Baseline motor competence measures were added for 16 early care and education centers (ECECs) who were participating in a garden-based, PA intervention throughout Phoenix, Arizona. ECEC and participant recruitment methods for the parent study have been published (Lee et al., 2019). ECEC eligibility criteria included 1) licensure through the state of Arizona, 2) participation in the Child and Adult Care Food Program or National School Lunch Program, and 3) being physically located in Hispanic/Latino serving area (census tract with >30% Hispanic/Latino population). One classroom per ECEC was chosen by the ECEC director to participate, based on children’s age (3-5-years-old) and on the classroom teachers’ enthusiasm to receive a garden. One parent and one child per family were invited to participate in the study as long as both parent and child were willing to complete assessments. Parents provided signed, written informed consent for themselves and their child in English or Spanish prior to participation and children verbally assented to participate in motor skill protocols. All protocols and procedures were approved by the Institutional Review Board at Arizona State University.

Child Demographic Measurements

Questions from the Behavioral Risk Factor Surveillance System survey were used to collect children’s date of birth, ethnicity and sex (Nelson et al., 2001). Age (months) was determined as the difference between date of birth reported on the survey and the date that the classroom assessments occurred. Children’s ethnicity was condensed into Hispanic and non-Hispanic classifications. Surveys were provided in English or Spanish, based on parents’ preferred language, and available to be filled out online or in paper format.
**Height and Weight**

Two measurements of height and weight were taken for each child during a classroom visit. Height was measured to the nearest quarter inch using a portable Seca Stadiometer (model 213, Seca Corporation, Hamburg, Germany). Weight was measured to the nearest half pound using a Tanita body composition analyzer (model TBF-310, Tanita Corporation, Tokyo, Japan). All measurements were taken with shoes removed and pockets emptied. If measurements were more than one half pound or one quarter inch apart a third measurement was taken and the two closest measurements were averaged. Body mass index (BMI) percentile was calculated using the standard formula and CDC growth charts for children age 2- to 5-years-old (Kuczmarski et al., 2000).

**Environmental Assessments**

A three-part environmental assessment occurred at each ECEC to measure the quality of the ECEC related to outdoor play, physical activity and screen time. Assessments occurred using three methods: direct observation by research staff, self-report by teachers, and self-report by directors. A research team member, using seven questions from the outdoor play environment Nutrition and Physical Activity Self-Assessment for Child Care (NAPSACC), measured outdoor play environment quality (Ward et al., 2014). Questions were scored 0 (worst practice) to 3 (best practice). Scores were summed across questions to create an overall outdoor play environment score (possible range 0-21).

One ECEC teacher per classroom self-reported on the outdoor play equipment total, indoor play equipment total, indoor play environment, and screen time environment. Indoor and outdoor play equipment total were determined using a checklist that included 11 pieces of fixed play equipment and 11 pieces of portable play equipment, combined from the PA environment NAPSACC and the Environment and
Policy Assessment and Observation instrument (Ward et al., 2008; Ward et al., 2014). Teachers reported the presence or absence of each item and if the item was available inside, outside, or both. The total number of items available outdoors and indoors were summed to create an outdoor play equipment score (possible range 0-22) and an indoor play equipment score (possible range 0-22), respectively. Indoor play environment quality was determined using questions from the PA environment NAPSACC. One question scored the availability and quality of space for PA (scored 0-3) and three questions scored the availability of posters, books, and other learning materials that promote PA (each scored 0-3). Availability of posters, books, and other learning materials that promote PA were scored individually to improve sensitivity of the question, but were averaged together based on the NAPSACC scoring protocol. The average score for availability of posters, books, and other learning materials that promote PA was then added to the score for availability and quality of space for PA to get a final indoor play environment quality score (possible range 0-6). Finally, screen time environment quality (possible range 0-6) was determined using two questions from the screen time NAPSACC, which were also scored from 0 (worst practice) to 3 (best practice).

An ECEC director self-report questionnaire was used to determine outdoor play, screen time and PA policy quality. Directors viewed three lists of policy components from the NAPSACC outdoor play (7 components), screen time (6 components), and PA (8 components) self-assessments and recorded the presence or absence of each component in their ECEC’s policies. The total number of components present for each ECEC policy was scored 0 (worst practice) to 3 (best practice), based on the NAPSACC scoring protocol. Additionally, directors were asked to report the type of center they directed and responses were coded as either Head Start or child care center. Table 5.1 displays the
best and worst practices for each question used to create environmental assessment scores.

**Gross Locomotor Skills**

The 20-meter shuttle run and the CHAMPS Motor Skill Protocol (locomotor portion only) were used to measure children’s product- and process-based GLS, respectively. Despite the known reliability of the PACER test, it has not been validated as a measure of CVF in preschool-aged children; thus, it was used as a product-based measure of GLS in this study (Ortega et al., 2015). Testing occurred during a scheduled baseline visit to ECEC classrooms as part of the parent study. All testing occurred in a single day, the majority of which occurred during children’s recess period(s). Children completed the test in small groups of 2-3, after seeing a demonstration to familiarize them with the test. During the test, children ran back and forth 20-meters with an initial running speed of 8.5 km/hour and a progressive .5 km/hour increase in running speed every minute (Lerger et al., 1988). Children ran with one research team member to provide motivation, pacing and instructions. Children’s test was considered complete when they did not finish two laps in the required time or they indicated that they were too tired to continue. Children’s score was determined as the last lap successfully completed.

A subgroup of children completed the CMSP as a process-based measure of GLS (Williams et al., 2008). Due to the amount of time required to administer the CMSP (~5-10 minutes per child) children were randomly selected by the classroom teacher to participate and the number of children tested per classroom was determined by the available time that the teacher indicated testing could occur. As many children as possible were tested during the one-day visit. The CMSP has been shown to be reliable (R=0.88-0.97) and have strong concurrent validity with other tests of gross motor skills.
(\(R=0.95-0.98\)) (Williams et al., 2008). The gross locomotor portion of the CMSP consists of six skills (run, broad jump, slide, gallop, leap, and hop) that are scored twice based on 3-7 criteria for each skill. Each child saw two expert demonstration of the skills, one provided facing the child and one was provided in the direction that the child was asked to complete the skill, then we asked to complete each skill twice. A trained assessor checked-off each process-based characteristic (yes/no) that the child completed correctly. No feedback or additional demonstrations were provided. The two trials for each skill were averaged and a total process-based locomotor score was summed from the average of each skill (range 0-35).

**Statistical Analysis**

A design effect (DEFF) was calculated to determine the strength of clustering between schools. Although there were low levels of clustering for both PACER laps (ICC=0.04; DEFF= 1.44) and CMSP score (ICC<0.01; DEFF=1.11), due to several independent variables being measured at the ECEC level, a complex samples approach without replacement was used to control for potential clustering effects. Each case was weighted as one unit.

Descriptive characteristics were determined with means, standard deviations and percentages. Independent t-tests and chi-square tests were used to assess demographic differences by the test completed (CMSP vs. PACER only). Unadjusted general liner models were conducted to determine the association between each environmental measure and each GLS outcome. Forward selection stepwise linear regression models were used to determine important ECEC environmental characteristics related to each GLS measure (PACER or CSMP). Independent variables were entered into models in up to three blocks. Block one included individual demographic variables (child’s age, sex, BMI percentile and ethnicity). Block two included ECEC center type. Block three
included the six environmental characteristics. Models were evaluated after each block and non-significant variables were removed one by one at each stage based on the highest $p$-value ($p<0.20$). Due to the exploratory nature of this study, $p<.10$ was considered significant in the final model. All analyses were completed using SPSS version 24.

**Results**

Across 16 ECEC, 144 children participated in the GLS measures, including 144 who completed the PACER test and 91 who completed the CMSP test. Two children completed the CMSP but refused to participate in the PACER test. A higher proportion of boys (59.3%; $n=54$) completed the CMSP than girls (40.7%; $n=37$), due to one ECEC with majority girls (87.5%) opting not to participate in the CMSP ($\chi^2 =7.40; p=.01$). No other demographic differences existed between those who completed the CMSP ($n=91$) and those who did not ($n=53$; $ps>.05$). Overall, children completed a mean±SD 3.69±2.32 PACER laps and met 19.02±5.46 CMSP criterion. PACER and CMSP scores were moderately correlated ($r=.46; p<.01$). A descriptive summary of the participants who completed each test can be found in Table 5.2.

Unadjusted general linear models between each environmental characteristic and GLS outcome revealed that indoor play equipment total ($B=0.21; p=0.06$) was significantly associated with number of PACER laps completed. Policy environment ($B=-0.18; p=0.03$) was negatively associated with number of PACER laps completed. No ECEC environmental characteristics were associated with CMSP score in unadjusted bivariate models. A table of all unadjusted bivariate associations can be found in Table 5.3.

A forward selection stepwise linear regression model revealed that children’s age and sex were associated with PACER score at the individual level and that policy
environment quality was associated at the ECEC level. Individual level characteristics explained 21% of variance and addition of ECEC environmental characteristics increased this to 28%. Final models for the association of PACER score with individual level variables and ECEC environmental characteristics can be found in Table 5.4. In an effort to determine which policy was the most strongly related to GLS, individual policy scores (outdoor play, screen time, and physical activity) were substituted for the ECEC policy quality in the final model (Table 5.5).

A forward selection stepwise linear regression model revealed that at the individual level, children’s age and ethnicity were associated with CMSP score. ECEC environmental factors associated with CMSP score included outdoor play environment quality, outdoor play equipment total, and screen time environment quality. Individual level characteristics explained 18% of variance and addition of ECEC environmental characteristics increased this to 23%. Final models for the association of CMSP score with individual level variables and ECEC environmental characteristics can be found in Table 5.6.

Distribution of PACER scores approached normality, but the presence of a small floor effect was present. In sensitivity analysis, removal of the four most extreme PACER values (n=4; 100% boys) restored normality, but did not significantly affect final models. Additionally, independent variables included in the final models were statistically correlated to one another (Tables 5.7 and 5.8), but correlations were low to moderate and were no longer significant when each ECEC was represented as one observation (Table 5.9), which suggests low levels of multi-collinearity in the final models.

**Discussion**

Results from this study support a relationship between the ECEC environment and preschool-aged children’s GLS. Prior studies have shown that the size of the outdoor
play area and playground size/child ratio were associated with better gross motor skills (Chow et al., 2013; True et al., 2017). This study adds to these findings by demonstrating that a higher quality outdoor play environment and more outdoor PA equipment are also associated with higher process-based GLS. Based on these findings, future studies should examine the size, resources available (e.g., types of fixed and portable play equipment), and quality (e.g., shade, number of play areas, bike path quality) of an outdoor play environment, in order to determine the relationship of an ECEC’s outdoor play environment with preschool-aged children’s GLS.

To our knowledge this was the first study to assess the ECEC policy environment in relationship to GLS. Previously, research has found both positive and negative associations between ECEC policy quality and children’s participation in PA (Dowda et al., 2009; Erinosho et al., 2016). Findings from this study support the negative association between PA and PA policy quality reported by Erinosho and colleagues (2016), as higher policy quality was related to lower GLS in this sample. Of the three policies examined in this study (screen time, outdoor play, and PA), a higher quality PA policy had the strongest negative associations with preschool-aged children’s GLS. One reason for these findings may be due to the criteria which make up PA policy quality (e.g., amount of time, types of clothes worn, not taking away PA as punishment), none of which promote skill development, but instead promote opportunities to be active. Although policies that create more opportunities for children to be active are important, more detailed polices that promote engagement in GLS activities (e.g., running, jumping, skipping) may be needed to facilitate development of GLS in preschool-aged children. Additionally, Erinosho and colleagues (2016) cited teacher implementation and enforcement of policies as potential reasons that policies were not translated into
practice in their study, these factors could also be contributing the negative associations between policy quality and GLS found in this study.

Finally, this study found a positive association between a better screen time environment (i.e., less televisions and computers) and higher GLS. These findings conflict with True and colleagues (2017) study, which found that that more electronic media usage was associated with higher GLS in preschool-aged children. Current literature and best practice guidelines for improving PA within ECECs, suggest that more screen time is associated with less participation in PA and thus, based on the developmental model, would be associated with lower GLS scores (Stodden et al., 2008; Ward et al., 2014). Additionally, True and colleagues (2017) warned that their positive association between electronic media usage and GLS may be confounded by socioeconomic status (e.g., higher income children attending ECECs with more access to electronic media usage). This study attempted to include center type as a proxy measure of socioeconomic status this study, but it was not significant factor in the final results. Additionally, when individual policies were substituted for policy quality in the final model, a higher quality screen time policy trended towards a positive association with higher GLS scores, suggesting that both ECEC policy and environment may contribute to children’s GLS. More studies, specifically designed to examine multiple aspects of the relationship between screen time (i.e., environment, policy, usage) and GLS, should be conducted to determine the direction and strength of this association.

**Strengths**

Overall, CMSP scores in this study were similar to previous studies that have used the CMSP to measure process-based GLS in preschool-aged children, suggesting that the CMSP is a GLS measure that can be used reliably across research teams (True et al., 2017; Williams et al., 2008). A previous study found that Hispanic preschool-aged
children have lower GLS than their non-Hispanic peers (Goodway et al., 2010). Analyses from this study, conducted in a primarily Hispanic sample (78.0%), support that finding. In addition to having lower GLS scores, Hispanic preschool-aged children have also been shown to participate in less MVPA, and have high BMIs than their non-Hispanic peers (Trost et al., 2013; Skinner et al., 2018). Taken together, this evidence suggest that more studies should be conducted to examine reasons for developmental differences between Hispanic and non-Hispanic preschool-aged children.

This study also adds to the literature, by being one of the first to use both product- and process-based GLS measures to examine the association between GLS and the ECEC environment in preschool-aged children. Results from this study uncovered that GLS and ECEC environmental associations vary by the type of measure used, supporting assertions by Logan and colleagues (2017) that both product- and process-based assessments are needed to comprehensively assess human movement. Additionally, this study used the NAPSACC self-assessments to examine the quality of the ECEC environment (Ward et al., 2014). The NAPSACC is a tool designed for practitioners to assess the quality of their own ECEC. By using a tool that is both freely available (https://gonapsacc.org/self-assessment-materials) and easy to administer, ECEC teachers and directors can determine the quality of their ECEC in relationship to this sample.

**Limitations**

This study is not without limitations. First, distribution of PACER test scores demonstrated a small floor effect, suggesting that the measure was not a sensitive enough to capture the full range of product-based outcomes. Recent adaptions have been suggested for the PACER test to remedy this limitation. Mora-Gonzalez and colleagues (2017) recommend that children run with two research staff (one in front and one
behind), as opposed to one, and that initial running speed be reduced from 8.5 km/h to 6.5 km/hour for very young children (Mora-Gonzalez et al., 2017). These adaptations would likely have improved the sensitivity of the PACER test in this study and should be used in future studies that use the PACER test within preschool-aged populations. Second, teachers and directors self-reported on several of the ECEC environmental variables in this study, prior to participation in a PA intervention. Use of self-report measures could have led to social desirability bias to report environments that were more conducive to PA. Despite this fact, the use of a crossover design allowed for all schools to receive the intervention; thus, social desirability would have been equally captured across all ECECs. Finally, PA was not included in this analysis. PA and motor skills are correlated, which suggests that inclusion of PA in this analysis could have modified or erased the associations found in this study. Future studies that examine the association between the ECEC environment and GLS should include a measure of PA in their analysis.

**Conclusion**

Individual level factors include age, sex, and ethnicity explain a significant portion of preschool-aged children’s GLS, but GLS are also related to children’s ECEC environment. From an ECEC standpoint, a higher quality outdoor play environment and more types of outdoor play equipment are related to higher GLS scores in preschool-aged children. Additionally, limiting the amount of computers or televisions in the classroom is also related to higher GLS scores. By modifying the ECEC environment to reflect these best practice guidelines, ECEC teachers and directors may be able to promote positive GLS development in preschool-aged children attending their center. Additionally, researchers should also consider an ECECs outdoor play environment and
the screen time environment as possible intervention avenues to promote GLS development in young children.

**Practical Implications**

ECEC teachers may be able to support preschool-aged children’s GLS development, by ensuring their classrooms have many types of outdoor play equipment and by limiting televisions and computers in the classroom.

ECEC directors may be able to support preschool-aged children GLS development, by ensuring their center has quality outdoor facilities (i.e., space, shade, tricycle track, garden, and multiple play areas) where children can play.

Parents interested in their preschool-aged child’s GLS development, should ask about the amount of time child spend outdoors each day and about the types of outdoor play equipment available for their child to use when selecting an ECEC for their child to attend.

**Declarations**

Ethical approval: The research was approved by the institutional review board at Arizona State University.

Availability of data and materials: The datasets analyzed during the current study are available from the corresponding author on reasonable request.

Funding: This research was supported by the National Institutes of Health through the National Institutes on Minority Health and Health Disparities cooperative agreement 5U01MD010667-03 awarded to Dr. Rebecca E. Lee, the National Institute of Nursing Research grant 1F31NR017560-01 and Jonas Scholar Nurse Leader 2016-2018 Cohort awarded to Elizabeth Lorenzo, and the Arizona State University Graduate College Completion Fellowship awarded to Jacob Szczyszulski.
Author Contributions: JS conceptualized the analysis, analyzed and interpreted the results, drafted the manuscript and is accountable for all aspects of the content in this manuscript. EL was a major contributor to the revision of manuscript and approved the final version of this manuscript. MT, TO, JH, GQS, MPB, SVL, SPH, and REL provided guidance on the conceptualization of this analysis, were major contributors to the revision of manuscript and approved the final version of this manuscript. REL also obtained funding for this project.

Acknowledgements: Authors would like to acknowledge Timothy Debaise for his help with data collection, Anel Arriola as project manager, and all of the other students, community advisory board members, and early care and educations center teachers and directors who have contributed to the success of the Sustainability via Active Garden Education project.
| Table 5.1 NAP SACC Assessment Best Practices Worst Practices, and Average Score |
|---------------------------------|-------------------|-------------------|-------------------|
|                                 | Best Practice (3) | Worst Practice (0) | Average Score (Mean±SD, n=16) |
| **Outdoor Play Environment (possible range 0-21)** |                   |                   |                               |
| Amount of shade                 | More than ½ shaded | No shade          | 1.44±0.73                   |
| Size of open areas for outdoor, games, activities and events | Large enough for all children to run around safely | Not available | 2.38±0.62                   |
| Number of play areas            | 8 play areas or more | 1-2 play areas    | 1.31±1.08                   |
| Availability of a garden        | A garden that grows enough fruits and/or vegetables to provide children meals or snacks during 1 or more seasons | No garden           | .19±0.54                   |
| Quality of wheeled toy path     | Paved and 5 feet wide or wider | No path            | 1.88±1.09                   |
| Shape of wheeled toy path       | Curved and looped  | No path           | 1.69±1.20                   |
| Type of wheeled toy path connections listed below: | 3 types of connections | No path            | 1.75±1.18                   |
| Connects to building entrances  |                   |                   |                               |
| Connects the building to play areas |                   |                   |                               |
| Connects different play areas to each other |                   |                   |                               |
| **Indoor Play Environment (possible range 0-6)** |                   |                   |                               |
| Indoor Space Features listed below: | 3-4 features | None             | 2.8±0.40                    |
| Space for all activities including jumping, running and rotating |                   |                   |                               |
| Separate play areas for each age group |                   |                   |                               |
| Areas that allow play for individuals, pairs, small groups, and large groups |                   |                   |                               |
| Full access for children with special needs |                   |                   |                               |
| Collection of posters, books, and other learning materials that promote physical activity | A large variety with materials with items added or rotated seasonally. | Few or no materials | 0.98±0.65                   |
| **Screen Time Environment (possible range 0-6)** |                   |                   |                               |
| Televisions                     | No televisions; or televisions are stored outside of the classroom and not regularly available to the children | In every classroom | 2.2±1.18                    |
| Computers                       | No computers; or computers are stored outside of the classroom and not regularly available to the children | In every classroom | 0.63±1.09                   |
### Policy Environment (possible range 0-9)

#### Outdoor Play Policy Quality
1. Amount of outdoor playtime provided each day
2. Ensuring adequate total playtime on inclement weather days
3. Shoes and clothes that allow children and teachers to play outdoors in all seasons
4. Safe sun exposure for children, teachers, and staff
5. Not taking away outdoor playtime in order to manage challenging behaviors
6. Professional development on outdoor play and learning
7. Education for families on outdoor play and learning

<table>
<thead>
<tr>
<th>Topics</th>
<th>Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-7</td>
<td>No topics or no policy</td>
</tr>
</tbody>
</table>

#### Physical Activity Policy Quality
1. Amount of time provided each day for indoor and outdoor physical activity
2. Limiting long periods of seated time for children
3. Shoes and clothes that allow children and teachers to actively participate in physical activity
4. Teacher practices that encourage physical activity
5. Not taking away physical activity time or removing children from long periods of physically active playtime in order to manage challenging behaviors
6. Planned and informal physical activity education
7. Professional development on children’s physical activity
8. Education for families on children’s physical activity

<table>
<thead>
<tr>
<th>Topics</th>
<th>Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-8</td>
<td>No topics or no policy</td>
</tr>
</tbody>
</table>

#### Screen Time Policy Quality
1. Amount of screen time allowed
2. Types of programming allowed
3. Appropriate supervision and use of screen time in classrooms
4. Not using screen time as a reward or to manage challenging behaviors
5. Professional development on screen time
6. Education for families on screen time

<table>
<thead>
<tr>
<th>Topics</th>
<th>Quality Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-6</td>
<td>No topics or no policy</td>
</tr>
</tbody>
</table>

---

Availability of indoor and outdoor play equipment were scored 0-22 based on the presence or absence of 22 items (e.g., ball play equipment, climbing structures, floor play equipment sandbox, see-saw, etc.), but are not displayed in this table.
<table>
<thead>
<tr>
<th>Child Demographics</th>
<th>PACER</th>
<th>CSMP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, months*</td>
<td>53.26±4.48</td>
<td>53.14±4.44</td>
</tr>
<tr>
<td>BMI percentile*</td>
<td>66.38±29.43</td>
<td>66.39±28.46</td>
</tr>
<tr>
<td>Female (%)</td>
<td>49.3</td>
<td>40.7</td>
</tr>
<tr>
<td>Hispanic (%)</td>
<td>78.0</td>
<td>69.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Activity Variables*</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PACER Laps</td>
<td>3.69±2.32</td>
<td>-</td>
</tr>
<tr>
<td>CMSP Score</td>
<td>-</td>
<td>19.02±5.46</td>
</tr>
</tbody>
</table>

*Mean and Standard Deviation
Table 5.3 Bivariate Relationship Between Environmental Factors and GLS Measures

<table>
<thead>
<tr>
<th>Environmental Measure</th>
<th>PACER Test (B)</th>
<th>p-value</th>
<th>CMSP Test (B)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Play Environment</td>
<td>0.102</td>
<td>0.124</td>
<td>0.030</td>
<td>0.792</td>
</tr>
<tr>
<td>Outdoor Play Equipment Total</td>
<td>0.104</td>
<td>0.153</td>
<td>0.106</td>
<td>0.203</td>
</tr>
<tr>
<td>Indoor Play Environment</td>
<td>0.186</td>
<td>0.385</td>
<td>0.163</td>
<td>0.760</td>
</tr>
<tr>
<td>Indoor Play Equipment Total</td>
<td><strong>0.212</strong></td>
<td><strong>0.061</strong></td>
<td>0.208</td>
<td>0.266</td>
</tr>
<tr>
<td>Screen Time Environment</td>
<td>-0.135</td>
<td>0.535</td>
<td>0.294</td>
<td>0.321</td>
</tr>
<tr>
<td>Policy Environment</td>
<td><strong>-0.183</strong></td>
<td><strong>0.029</strong></td>
<td>-0.128</td>
<td>0.508</td>
</tr>
</tbody>
</table>

Bolded values are significant $p<.05$
<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual only</th>
<th></th>
<th></th>
<th>Individual and ECEC</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>p-value</td>
<td></td>
<td>B</td>
<td>p-value</td>
<td></td>
</tr>
<tr>
<td>Child Demographic</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s Age</td>
<td>0.19</td>
<td>&lt;0.01</td>
<td></td>
<td>0.21</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>Child’s Sex</td>
<td>-1.21</td>
<td>0.02</td>
<td></td>
<td>-1.18</td>
<td>&lt;0.01</td>
<td></td>
</tr>
<tr>
<td>ECEC Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Play Equipment Total</td>
<td></td>
<td></td>
<td></td>
<td>0.10</td>
<td>0.13</td>
<td></td>
</tr>
<tr>
<td>Policy Environment</td>
<td></td>
<td></td>
<td></td>
<td>-0.17</td>
<td>0.01</td>
<td></td>
</tr>
<tr>
<td>Model Fit R²</td>
<td>0.21</td>
<td>&lt;0.01</td>
<td></td>
<td>0.28</td>
<td>&lt;0.01</td>
<td></td>
</tr>
</tbody>
</table>

Individual only column displays results after block 1. Individual and ECEC column displays results after block 3.
No variables added in block 2 were retained in final models.
Variables not retained in block 1 included: BMI percentile and ethnicity.
Variables not retained in block 2 included: ECEC center type.
Variables not retained in block 3 included: outdoor play environment, indoor play environment, indoor play equipment total, and screen time environment.
### Table 5.5. Forward Selection Stepwise Linear Regression for PACER Laps (Policy Items)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual only</th>
<th></th>
<th>Individual and ECEC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>p-value</td>
<td>B</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Child Demographic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s Age</td>
<td>0.19</td>
<td>&lt;0.01</td>
<td>0.21</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Child’s Sex</td>
<td>-1.21</td>
<td>0.02</td>
<td>-1.18</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td><strong>ECEC Environment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Play Equipment Total</td>
<td></td>
<td></td>
<td>0.10</td>
<td>0.13</td>
</tr>
<tr>
<td>PA Policy Quality</td>
<td></td>
<td></td>
<td>-0.078</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Outdoor Play Policy Quality</td>
<td></td>
<td></td>
<td>-0.01</td>
<td>0.98</td>
</tr>
<tr>
<td>Screen Time Policy Quality</td>
<td></td>
<td></td>
<td>0.31</td>
<td>0.25</td>
</tr>
</tbody>
</table>

Model Fit $R^2$

<table>
<thead>
<tr>
<th>Individual only</th>
<th>Individual and ECEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.21</td>
<td>0.28</td>
</tr>
<tr>
<td>&lt;0.01</td>
<td>&lt;0.01</td>
</tr>
</tbody>
</table>

Individual only column displays results after block 1. Individual and ECEC column displays results after block 3.

No variables added in block 2 were retained in final models.

Variables not retained in block 1 included: BMI percentile and ethnicity.

Variables not retained in block 2 included: ECEC center type.

Variables not retained in block 3 included: outdoor play environment, indoor play environment, indoor play equipment total, and screen time environment.
Table 5.6 Forward Selection Stepwise Linear Regression for CSMP Criterion

<table>
<thead>
<tr>
<th>Variable</th>
<th>Individual only</th>
<th>Individual and ECEC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Child Demographic</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child’s Age</td>
<td>0.49</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Non-Hispanic Child</td>
<td>1.90</td>
<td>0.03</td>
</tr>
<tr>
<td><strong>ECEC Environment</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Play Environment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Play Equipment</td>
<td>0.18</td>
<td>0.03</td>
</tr>
<tr>
<td>Indoor Play Equipment</td>
<td>0.32</td>
<td>&lt;0.01</td>
</tr>
<tr>
<td>Screen Time Environment</td>
<td>-0.31</td>
<td>0.10</td>
</tr>
<tr>
<td>Model Fit R²</td>
<td>0.18</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Individual only column displays results after block 1. Individual and ECEC column displays results after block 3. No variables added in block 2 were retained in final models.

Variables not retained in block 1 included: sex and BMI percentile.
Variables not retained in block 2 included: ECEC center type.
Variables not retained in block 3 included: indoor play environment and policy environment.
<table>
<thead>
<tr>
<th></th>
<th>Child Age</th>
<th>Child Sex</th>
<th>Outdoor Play</th>
<th>Equipment</th>
<th>Policy</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Age</td>
<td>1</td>
<td>-0.084</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Child Sex</td>
<td>-0.127</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Outdoor Play</td>
<td>0.205*</td>
<td>0.054</td>
<td>-0.248**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Policy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Environment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Significant $p<0.05$

**Significant $p<0.01$
<table>
<thead>
<tr>
<th></th>
<th>Child Age</th>
<th>Child Ethnicity</th>
<th>Outdoor Play Environment</th>
<th>Outdoor Play Equipment</th>
<th>Indoor Play Equipment</th>
<th>Screen Time Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Age</td>
<td>1</td>
<td>-0.140</td>
<td>-0.113</td>
<td>-0.127</td>
<td>-0.164*</td>
<td>-0.123</td>
</tr>
<tr>
<td>Child Ethnicity</td>
<td>-</td>
<td>1</td>
<td>0.082</td>
<td>-0.016</td>
<td>0.437**</td>
<td>0.122</td>
</tr>
<tr>
<td>Outdoor Play Environment</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.395**</td>
<td>0.184*</td>
<td>-0.218**</td>
</tr>
<tr>
<td>Outdoor Play Equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.251**</td>
<td>-0.148</td>
</tr>
<tr>
<td>Indoor Play Equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.079</td>
</tr>
<tr>
<td>Screen Time Environment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

*Significant p<0.05
**Significant p<0.01
<table>
<thead>
<tr>
<th></th>
<th>Outdoor Play Environment</th>
<th>Outdoor Play Equipment</th>
<th>Indoor Play Environment</th>
<th>Indoor Play Equipment</th>
<th>Screen Time Environment</th>
<th>Policy Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outdoor Play Equipment</td>
<td>1</td>
<td>0.451</td>
<td>-0.172</td>
<td>0.129</td>
<td>-0.092</td>
<td>-0.330</td>
</tr>
<tr>
<td>Indoor Play Equipment</td>
<td>-</td>
<td>1</td>
<td>0.262</td>
<td>0.214</td>
<td>-0.148</td>
<td>-0.236</td>
</tr>
<tr>
<td>Indoor Play Environment</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.187</td>
<td>-0.409</td>
<td>0.129</td>
</tr>
<tr>
<td>Indoor Play Equipment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>-0.023</td>
<td>-0.201</td>
</tr>
<tr>
<td>Screen Time Environment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
<td>0.146</td>
</tr>
<tr>
<td>Policy Environment</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1</td>
</tr>
</tbody>
</table>

No correlations were statistically significant (ρ < .05)
CHAPTER 6
DISCUSSION

Results in Context

In chapter I, a model that embedded children’s developmental processes (i.e., PA, weight, CVF, perceived motor competence, and motor competence) in children’s critical environmental contexts (e.g., home, school, neighborhood) was proposed (Figure 1.1.). In chapter II, current evidence that supports the formation of this model was summarized (Robinson et al., 2015; Spence & Lee, 2003; Stodden et al., 2008). Chapters III, IV and V build upon the current evidence by testing pathways within the model through three separate investigations. This chapter will discuss the results from chapters III, IV and V, in the context of the synthesized model, and provide future research directions to continue to expand upon it.

In chapter III, a relationship was found between the total number of environments (microsystems) included within an intervention and the effectiveness of that school-based, PA interventions for improving CVF. In chapter IV, there were significant associations between the family microsystem and preschool-aged children GLS. In chapter V, there were significant associations between the ECEC microsystem and preschool-aged children’s GLS. In all three chapters, children’s environments played a role in their developmental outcomes beyond what individual level factors accounted for alone.

Taken together, this body of evidence supports the use of an ecological framework to examine environments that influence preschool-aged children’s developmental pathways (PA, CVF, motor competence, and perceived motor competence). Furthermore, the use of the EMPA as the guiding ecological framework has value (Spence & Lee, 2003). Chapter II’s literature review showed that individual
characteristics, the home microsystem, the ECEC microsystem and the neighborhood microsystem were related to preschool-aged children’s PA (Cerin et al., 2016; Pate et al., 2008; Xu et al., 2015). Additionally, growing evidence suggests that multi-level interventions are important for creating stronger PA intervention effects than interventions focused on a single microsystem (Mehtälä et al., 2014). The EMPA supports this finding through its hypothesized transfer linkages (Spence & Lee, 2003). Results from this dissertation provide support for the hypothesized transfer linkages in the EMPA by showing that interactions between microsystem environments (mesosystem level) can have synergistic effects on the PA-related health outcome of CVF, which has important implications for children’s development.

Stodden and colleagues’ (2008) developmental model, the second half of this dissertation’s proposed model, hypothesizes that CVF is a marker of health that tracks from childhood into adulthood and is related to a positive developmental trajectory. Development of CVF and motor skills at a young age allows children to overcome Seefeldt’s hypothetical proficiency barrier (Stodden et al., 2013). When the proficiency barrier is overcome, health-behavior tracking occurs and children continue to participate in PA as they age (Stodden et al., 2008; Stodden et al., 2013). Previous research has shown that children who engage in more PA have higher motor competence and higher CVF, also have better developmental outcomes (PA, CVF, and motor competence) when they are older (Malina, 2001; Stodden et al., 2013). Additionally, higher CVF and PA in adulthood are related to reduced diabetes, cancer and cardiovascular disease risk (Myers et al., 2015; PAG 2018; Schmid & Leitzmann, 2014). In chapters IV and V, results provide support for a potential pathway between several microsystems (home and ECEC) and CVF through improved motor competence, specifically gross locomotor competence. Through the process of embedding Stodden and colleagues’ developmental
model into the EMPA, this dissertation has laid out a framework for identifying connections between early childhood environments and important middle childhood, late childhood, and adult health outcomes.

Although a model specified for examining the influence of the environment on motor competence does not exist, the use of the EMPA provided substantial guidance in the identification of these relationships (Spence & Lee, 2003). Results from this dissertation revealed that aspects of the home and ECEC microsystems are associated with preschool-aged children’s GLS, which is supported by the work of others who have previously examined these associations without ecological models (Barnett et al., 2013; Chow et al., 2013; Cools et al., 2013; True et al., 2013). Although the body of work presented in this dissertation is in alignment with current literature and current ecological models, more longitudinal studies are needed to confirm the strength of these findings. Additionally, there is evidence for a longitudinal relationship between increased motor competence and improved PA, which would allow multiple pathways to improve CVF in preschool-aged children. CVF could be improved directly, through improved motor competence, and indirectly through increased PA (Lima et al., 2017). Future studies that aim to influence CVF in preschool-aged children should design interventions around both motor competence and PA pathways and examine the role of the environment in influencing these relationships. Only by identifying developmental relationships within an environmental context will future researchers be able to leverage preschool-aged children’s environments in the most efficient way to create long-term health benefits.

**Implications for Practice**

In chapter III of this dissertation, effective intervention strategies for improving developmental outcomes (PA, CVF, and GLS) within multiple microsystems were
identified. In the home microsystem, this included engaging the family through newsletters, discussions, orientation sessions, webinars, and homework. In the ECEC microsystem, strategies included training and incorporation of teachers into intervention delivery and installing play equipment into classrooms and play areas. Within the neighborhood microsystem, improvement of neighborhood play equipment, and neighborhood events for families were important components. At the policy level, new center-level play policies, improved curricula, and curricular monitoring showed promise. Although many strategies were identified for improving CVF throughout chapter III, the reporting of informational content included in these strategies was minimal. Results from chapters IV and V can be used to supply this content.

In chapter IV, parents’ concern for their child’s safety was one home microsystem characteristic that was found to be associated with lower GLS in children. Additionally, results show that children with higher GLS have parents who promote more inactivity and screen time, which could slow children’s future GLS development. The newsletters, discussions, webinars, orientation sessions, and homework identified in chapter III could be used as distribution channels for ECECs to provide parents critical information related to these findings; thus creating more effective mesosystem connections. For example, newsletters could provide inexpensive, local and safe places where parents could take their child to be physically active, connecting the home environment with the neighborhood environment. Discussions and webinars could be used to create a dialogue about how parents potentially reduce their children’s GLS through promotion of inactivity or screen time. Additionally, strategies to safely redirect highly active children’s behaviors that also enhance motor skill development could be provided. Intervention orientations sessions, occurring in ECECs, could discuss safe parenting and provide opportunities to teach parents games to engage in with their children, all of
which connect the home and ECEC environment. By combining the strategies across microsystems (mesosystem level) and by delivering content related to development that was identified throughout this dissertation, effective policies, practices and interventions could be created that positively influence children’s developmental pathway.

In chapter V, it was found that more types of outdoor play equipment within an ECEC microsystem and a higher quality outdoor play equipment are associated with higher GLS in preschool-aged children. A screen time environment that contains less access to televisions and computers was also related to higher GLS. Based on the strategies identified in chapter III, exosystem connections could be used to link these strategies. For example, the importance of these ECEC environmental characteristics could be taught to ECEC teachers, through off-site professional development seminars that focus on promoting positive developmental trajectories in preschool-aged children. By teaching ECEC teachers about the physical characteristics of their ECEC that can be leveraged to promote children’s development, teachers can make the best use of the resources currently available to them. Additionally, results from this dissertation can also help ECEC directors to identify the most valuable PA resources to purchase in the future.

Throughout all three studies of this dissertation, the presence of more PA resources was consistently related to improved PA, CVF, and GLS in preschool-aged children. ECEC directors, who approve purchasing decisions, and ECEC teachers who complete needs assessments, should take inventory of the PA resources within their center’s microsystem. Inventories can then be compared to the best practices described in the NAPSACC self-assessments, which would help to determine if more PA resources are needed and which types of resources are the most important to obtain (Ward et al., 2014). In addition to PA resources, a physically active curriculum was identified in
chapter III as an important factor related to children’s development. ECEC teachers and directors, who make curricular decisions each year, can use the results of this dissertation to guide those decisions. For example, chapter V identified characteristics of the outdoor environment (more play equipment and better environmental quality) and indoor environment (no televisions and computers) as related to higher GLS in preschool-aged children. Curricula that ensure adequate outdoor playtime and promote positive screen time practices can be adopted by ECEC directors and used by ECEC teachers to help consistently promote positive developmental trajectories.

Overall, the three manuscripts included in this discussion supply a roadmap for navigating various microsystems that have the potential to positively influence the development of preschool-aged children. Additionally, they provide some guidance on ways to connect multiple microsystem to create stronger mesosystem and exosystem level connections. Although each of the three studies show the need for assessment and interventions occurring at all levels of the ecological model, the ECEC setting has consistently been shown to be a focal point for influencing the developmental pathway. Millions of preschool-aged children each year spend a significant portion of their time at ECECs; thus, researchers should continue to examine potential pathways to leverage this critical environment to improve the health of young children.

**Implications for Policy**

In addition to recommended changes in the ECEC environment, based on the EMPA the results of this dissertation also have important higher-level policy implications. The EMPA posits that changes in policy influence children’s microsystems and subsequently their developmental outcomes (Spence & Lee, 2003). In chapter III, ECEC curriculums that incorporated more outdoor play and curriculum monitoring were found to have positive effects on preschool-aged children’s CVF. In chapter IV, children
born in Mexico had lower GLS than children born in the US; and in chapter V, ECEC policy quality was related to higher GLS. Each of these findings could be influenced by future policies and thus offer the potential to alter children’s developmental trajectories.

At the national level, current guidelines recommend, “preschool-aged children should be physically active throughout the day to enhance growth and development and that caregivers of preschool-aged children should encourage active play that includes a variety of activity types” (Physical Activity Guidelines, 2018). These guidelines are significantly improved from the 2008 guidelines, which combined preschool-aged children’s recommendations with older children and adolescents and suggested that children should get 60 minutes of PA per day, including muscle and bone strengthening exercises (Physical Activity Guidelines, 2008). Results from this dissertation emphasize the importance of caretakers both within the home and within the ECEC as important influencers of preschool-aged children’s development, providing further evidence to support the new PA guidelines. In addition, the new PA guidelines stress the importance of growth and development, which highlights both the importance of PA and motor competence. Although the new PA guidelines (2018) are substantially better than previous guidelines (2008), this dissertation found outdoor play is particularly important for development of GLS. Additionally, it provides some evidence that families who live in unsafe outdoor areas may be preventing children’s GLS development through their parenting practices. Although more evidence is needed to confirm these findings, in addition to utilizing recommendations made by the current PA guidelines, future policies should consider emphasizing the importance of outdoor play for young children.

At the local level, each state sets licensing requirements for ECECs and each center adopts assessments to track the developmental and academic progress of preschool-aged children. Although some assessments already track developmental
outcomes (e.g., NAEYC, teaching strategies GOLD®), this dissertation provides evidence that Mexican born or Hispanic preschool-aged children score lower on tests of GLS than their United States born and non-Hispanic counterparts, suggesting that current standards may not be ideally designed for children from these families (Chandler et al., 2012; Lambert et al., 2015). Hispanic families have been shown to have family dynamics that influence the relationship between the home environment and PA outcomes (O’Connor et al., 2013). This dissertation adds to that work by showing that the Hispanic culture may also be related to GLS development through the home and ECEC Microsystems. State licensing bodies and companies that develop testing assessments should be made aware of differences that exist in GLS by ethnicity, and polices should be put into place that help to adapt or create new culturally competent GLS assessments suited for use in both Hispanic and non-Hispanic preschool-aged children.

At the ECEC level, chapter III revealed curricular monitoring to be a useful strategy for improving developmental outcomes; thus, ECEC directors should implement policies that stress curricular monitoring. This dissertation also found that ECEC screen time polices (e.g., limiting screen time) were positively related to GLS scores and that ECEC PA policies (e.g., promoting opportunities to be active) were inversely related to GLS. Although creation of policies at the ECEC level are important, polices that are poorly monitored are often not enforced, highlighting the connection between policy and the ECEC microsystem. Based on evidence from this dissertation, more ECEC policies that focus on motor competence are needed and systems to monitor and enforce current polices should be created.
**Strengths and Limitations**

**Importance of the ECEC in Multi-level Interventions**

Across all three investigations and in the literature, the role of the ECEC microsystem in influencing the development of preschool-aged children’s health has consistently been emphasized (Lessard et al., 2018). As previously stated, over 12 million children are currently enrolled in ECECs across the United States and children spend on average 24.8 hours per week at their ECECs (Iruka et al., 2006; Shape America, 2015). No other microsystem within children’s environments offers the same potential to affect so many young children in such a coordinated, systematic way. Although school-based interventions have long been a focal point for researchers attempting to influence children’s health, there are a many barriers and facilitators for implementing interventions within school systems, including ECECs (Naylor et al., 2015). The body of work included in this dissertation, has identifying several barriers for researchers wishing to work within ECECs.

In chapter III’s meta-analysis, all eight studies that contributed an effect size described their intervention as effective, but three of the studies’ effect sizes were no longer significant once a clustering effect was controlled for. Additionally, statistical control for clustering within school-based interventions is lacking throughout the literature (Harris et al., 2009; Kropski et al., 2008). Clustering is described as participants of one group being more like one another then participants of another group and always has the possibility of being present in school-based interventions. Children in one classroom are more alike than children from another classroom, and children in one school district are more alike than children in another school district. Although the assessment of clustering has become more common over the years, many intervention studies still do not control for clustering and very few cross-sectional studies even
examine it. In chapters IV and V, a cross-sectional analysis was carried out following an examination of clustering. Chapter IV’s analyses did not require statistical control for clustering, but an ICC was still reported. In chapter V a complex samples approach was used to control for clustering. At minimum, all future school-based examinations should report the level of clustering for study outcomes, regardless of study design used.

In addition to clustering within the ECEC microsystem, a multi-level analysis that includes multiple Microsystems, mesosystems, exosystems, and macrosystems presents additional barriers when conducting school-based studies. Throughout the literature, multi-level approaches are commonly used in interventions that aim to influence children’s PA behavior (Mehtälä et al., 2014), but are less common in interventions for motor competence (Veldman et al., 2016). Use of multi-level models can be a research barrier for many reasons, including the statistical expertise and the large sample sizes (schools and participants) required for these types of models. Additionally, multi-level statistical models must also control for clustering within schools, school districts and potentially neighborhoods, and should be able to measure predictors occurring at each of these levels. Chapter III identified several studies that intervened on multiple-levels, but predictors were generally measured in the context of the individual only. In one example by Zhou and colleagues (2014), interventions components targeted schools, families, and neighborhoods, but individual CVF outcomes were the only outcome reported. Additionally, the Zhou and colleagues (2014) intervention was implemented as a package and no attempt was made to discern which components of that package were responsible for creating intervention effects. Similarly, in chapters IV and V, individual Microsystems associated with GLS were examined, but sample size limitations, clustering complications, measurements occurring at multiple levels, and potential moderation effects were barriers to examining the possible microsystem interactions between the
family and ECEC environments. A further limitation that prevented the use of multi-level models in this dissertation was the time and effort required to recruit participants and assess environments within each microsystem. Due to the study population being hard to reach and difficulties with retention, participant burden had to be minimized, which limited the amount of data that could be collected within each of the various Microsystems.

Overall, multi-level interventions are an important next step for influencing preschool-aged children’s developmental pathway, but the barriers that prevent research from occurring at multiple levels are substantial. Previous research has already shown that the ECEC microsystem accounts for a significant variance beyond the individual level (Pate et al., 2004; Pate et al., 2008). This dissertation adds to that by showing that both the home and ECEC environment account for significant GLS variance beyond what is account for by demographic characteristics. Similar to the studies found in chapter III, anchoring a multi-level intervention at the ECEC level, with interventions components occurring at other levels, may be the most effective way to create and test multi-level interventions in preschool-aged populations. Future studies should continue to use this process, but substantial improvements are needed in the development, assessment, and reporting of multi-level studies.

**Research on Hispanic Preschool-aged Children**

Although not the aim of this dissertation, one common theme that emerged was the importance of ethnicity as it relates to the developmental pathway. Hispanic preschool-aged children have been shown to have worse GLS, participate in less MVPA, and have high BMIs then their non-Hispanic peers (Goodway et al., 2010; Trost et al., 2013; Skinner et al., 2018). In the context of the developmental pathways, this evidence suggest that Hispanic preschool-aged children may also have lower CVF, lower perceived
motor competence and are more likely to engage in worse health habits as they age (Stodden et al., 2008). Evidence from this dissertation provided some preliminary support for that hypothesis.

In chapters IV and V, associations between GLS and the home or ECEC environments was assessed within a group (n=144) of predominantly (~78.0) Hispanic preschool-aged children. In chapter IV, it was found that children who were born in Mexico scored one laps worse on the PACER test and one and a half criteria lower on the CMSP test than children born in the US. Additionally, boys born in Mexico scored almost three laps lower on the PACER test than their US born peers, and Hispanic boys scored three points lower on the CSMP than their non-Hispanic counterparts. In chapter V, Hispanic children scored two points lower on the CMSP than their non-Hispanic peers in final models, but there were no associations between ethnicity and PACER scores. Of added note, stratified analyses did not find any associations between birth country or ethnicity and GLS for girls. Although findings vary slightly across studies, when Hispanic children’s environments are assessed in conjunction with their ethnicity, results show that Hispanic preschool-aged children may have lower GLS that their peers.

Results from this dissertation found that Hispanic and foreign-born children had worse GLS than non-Hispanic and US born children, but these differences are not well understood. Only one study in chapter II found that ethnicity was related to gross motor skills development in preschool-aged children, but this study did not examine reasons for these differences (Goodway et al., 2010). No other studies prior to this dissertation have reported on the relationship between ethnicity and GLS in preschool-aged populations. Similar to the findings of Goodway and colleagues (2010), this dissertation found GLS differences by ethnicity, but due to the large proportion of Hispanic children in this study, reasons for ethnic difference were difficult to explore. Current models
related to motor skill development do not discuss the role of ethnicity and few ECEC-based interventions to improve PA or motor competence exist for Hispanic preschool-aged populations (Alhassan et al., 2018; Clark & Metcalfe, 2002; Robinson et al., 2015; Seefeldt et al., 1980; Stodden et al., 2008). More research is needed to determine the extent to which ethnicity and birth country play a role in the developmental pathways. If in fact Hispanic preschool-aged children do have worse GLS than their non-Hispanic peers, more cultural specified interventions may be needed to influence developmental outcomes.

Overall, this dissertation adds several importance pieces of evidence supporting developmental differences between Hispanic and non-Hispanic preschool-aged children, including potential environmental differences. The EMPA suggest that these differences may occur within microsystems, but could also be influenced by regional differences cultural macrosystems and regional policies (Mexico vs. United States). The Hispanic population is one of the fastest growing populations in the United States, and Hispanic families have different cultural and family dynamics that may affect children’s participation in PA (Abascal et al., 2015; O’Connor et al., 2013). Results from this dissertation suggest that Hispanic family’s dynamics may also affect children’s GLS, but further research is needed determine the specific environmental characteristics that affect children’s GLS and if this dissertation findings are consistent across other studies.

**Measurement Issues in Preschool-aged Children**

Another common theme, which emerged across all three studies included in this dissertation, was a concern about measurement issues. Preschool-aged children have unique characteristics (developing physiology, limited vocabulary, and short attention spans) that make measurement of constructs within their developmental pathways challenging (Oliver et al., 2007). Related to CVF, no studies have validated field-based
tests of CVF, and few field-based tests are considered reliable enough for use in preschool-aged populations (Ortega et al., 2015). Related to PA, parents from the SAGE parent study expressed concerns about keeping accelerometers on their child (Lee et al., 2019). Additionally, the dramatic reduction in sample size found when attempting to include PA in this dissertation’s analysis prevented use of this data. Related to motor skills, current testing batteries emphasize product- or process-based tests, not both, and current measurement protocol attempt to measure all gross motor skill domains, as opposed to domain specific outcomes (gross locomotor, object projection, object deflection). Additionally, product- and process-based motor assessments are not perfectly correlated ($r=0.46$ in this study), and research recommends that both are needed to comprehensively assess motor competence (Capio et al., 2013; Logan et al., 2017). Each of these current measurement limitations in important to discuss in the context of this dissertation.

In chapter III, all eight studies measuring CVF used field-based tests of CVF. In general, these field-based tests fell into three categories: heart-rate responses to a set workload, shuttle run tests, and timed distance runs, with each type having a substantially different pooled effect size. Reasons for different effect sizes may be related to the lack of validity of these tests in preschool-aged populations, which Ortega and colleagues (2015) cited when recommending the 20-meter shuttle run test (PACER) be used to measure CVF. The 20-meter shuttle run test, which was used in this study, has been shown to have high criterion related validity for measuring CVF in adults ($r_p = 0.94, 0.87-1.00$) and only slightly lower criterion related validity for children ($r_p = 0.78, 0.72-0.85$) when validated against laboratory-based tests (Mayorga-Vega et al., 2015). Additionally, the 20-meter shuttle run has been used in over 177 studies and with over 1 million children, suggesting a familiarity among practitioners (Lang et al., 2017).
Although the 20-meter shuttle run has been validated to measure CVF in children, the 20-meter shuttle run tests has not been validated to measure CVF in very young children (3-5 years old), but is still considered to be highly reliable (Ortega et al., 2015).

Within chapters IV and V, the PACER test was used as a product-based test of GLS, as opposed to a measure of CVF, due to its lack of validity in preschool-aged populations. Additionally, analyses in chapter IV and V found a small floor effect when attempting to normalize the distributions of PACER scores, which suggests that the PACER test does not have sufficient sensitivity for use in preschool-aged children. Others have also found this floor effect in the literature (Cadenas-Sanchez et al., 2014). Furthermore, children’s PACER test scores in this dissertation were significantly lower then what is reported in the literature for children who are only one year older, which supplies additional support for a sensitivity issue in preschool-aged populations (Niederer et al., 2012). Since this dissertation’s testing began, adaptions have been recommended to the PACER protocol for preschool-aged children (Mora-Gonzalez et al., 2017). These adaptions include running with two research staff (one in front and one behind) and a reduction in the initial running speed from 8.5 km/h to 6.5 km/hour (Mora-Gonzalez et al., 2017). This new testing protocol, with a reduction in initial running speed, has since been validated against the original protocol and using heart rate monitoring (children reached ~98% estimated heart rate max), but has still not been validated using laboratory-based tests (Cadenas-Sanchez et al., 2014; Mora-Gonzalez et al., 2017). Results from this dissertation confirm the sensitivity issue reported in the literature and support the use of the updated protocol in preschool-aged populations. Future studies should validate the PACER test for measurement of CVF in preschool-aged children.
Although the use of the PACER test is a limitation of this study, the use of the CMSP to measure process-based GLS is a strength. The CMSP was specifically designed for use within preschool-aged populations and has been found to be highly reliable when children were scored on two attempts of each skill, as opposed to four (Williams et al., 2008). Additionally, the CMSP has strong concurrent validity with other tests of gross motor skills, which allows for comparisons across populations (Williams et al., 2008). Preschool-aged children’s results on the GLS portion of CMSP in this dissertation are comparable with results from other studies in preschool-aged populations (Williams et al., 2008). These findings suggest that the CMSP was appropriate and conducted with methodological rigor in this dissertation. Additionally, the short amount of testing time required to administer the GLS portion of the CMSP allowed for a sufficient subsample of children to be tested. Results from this dissertation provide continued support for the use of the CMSP in preschool-aged populations.

Finally, the use of both product- and process-based assessment for chapters IV and V was a strength of this dissertation. The correlation between the PACER test and the CMSP was $r=0.46$. Additionally, there were differential associations between aspects of the environment (home and ECEC) and GLS based on the assessment type used (product- or process-based). These results supports assertions by Capio and colleagues (2013), and Logan and colleagues (2017) for the importance of both product- and process-based assessments. A majority of the literature reviewed in this dissertation used either product-based assessments or process-based assessments, but by using both types of assessments this dissertation uncovered additional home and ECEC factors that may be related to preschool-aged children’s GLS than would have been found if only one type of assessment was used. Future studies should continue to use both product- and process based assessments when assessing GLS in preschool-aged children.
Future Research Directions

Returning to the model proposed in chapter I, this dissertation adds new information to several aspects of that model. Results from chapter III support the use of more levels of the EMPA for more effective ECEC-based PA interventions. Chapter III also supports the assertion that the interactions occurring between microsystems (mesosystems level) have the ability to influence CVF outcomes through PA. Chapters IV and V provided support for links between two microsystems (home and ECEC) and GLS in preschool-aged children, which have previously understudied in the GLS literature. Although these three studies make important contributions to the literature, many other pathways need to be tested.

Based on the proposed model, one area of research that deserves more attention is the exosystem factors that influence preschool-aged children’s developmental pathways. According to the EMPA, exosystem factors are microsystems outside child’s own microsystem that interact with one of the child’s microsystems to influence PA or motor competence (Spence & Lee, 2003). Based on the importance of the ECEC microsystems throughout this dissertation, ECEC teacher and ECEC director microsystems may influence preschool-aged children’s developmental pathways. For example, engaging ECEC teachers in more PA may improve their use of PA curricula at the ECEC. Another example would be improvement in ECEC director’s job satisfaction, which would increase their willingness to participate in PA interventions. These exosystem factors play an important role in the uptake of interventions and subsequently the effective implementation of interventions with the ECEC. Thus, to make the most impact on preschool-aged children’s developmental outcomes, exosystems factors need further exploration.
A second area of research that need further exploration in children’s developmental pathway is the relationship between PA and motor competence, within the context of interventions. ECEC-based PA interventions are becoming increasingly common in the literature, but components of these interventions may also influence gross motor competence. By carefully tracking components of PA interventions, including amount of PA, fidelity of the intervention, and use activities that promote motor skill development within these interventions, research will be able to determine the components of the intervention that are most effective for increasing gross motor competence. Once interventions components that influence PA, motor competence, or both are identified, future programs will be able to custom, tailor their interventions to the needs of each individual preschool-aged child.

Overall, the proposed model in chapter I has important implications for children, their parents, ECEC teachers and directors, policy makers, and researchers. Focus on changing developmental outcomes (PA, CVF, and GLS) at the individual level has limited utility. This dissertation has consistently shown the multiple environments including the home, ECEC, and neighborhood microsystems are related to developmental outcomes and in some cases explain as much variance as individual level demographic factors alone. To continue to improve preschool-aged children developmental pathway, individuals within children microsystems need to understand the important effects that environments can create on development. Additionally, these same individuals must strive to provide the most beneficial environments for children to live in. By utilizing each environment in the most efficient way possible, children’s development will improve at an early age, which will set a course of positive development for the rest of their lives.
REFERENCES


Cerin, E., Baranowski, T., Barnett, A., Butte, N., Hughes, S., Lee, R. E., ... & O’Connor, T. M. (2016). Places where preschoolers are (in) active: an observational study on


Institute of Medicine (IOM). Fitness measures and health outcomes in youth, Washington, Institute of Medicine (IOM), 2012.


Martinez-Tellez, B., Sanchez-Delgado, G., Cadenas-Sanchez, C., Mora-Gonzalez, J., Martín-Matillas, M., Löf, M., ... & Ruiz, J. R. (2016). Health-related physical fitness is associated with total and central body fat in preschool children aged 3 to 5 years. Pediatric obesity, 11(6), 468-474.


APPENDIX A

PRISMA REPORTING GUIDELINES FOR SYSTEMATIC REVIEW AND META-ANALYSIS
<table>
<thead>
<tr>
<th>Section/topic</th>
<th>Item No</th>
<th>Checklist item</th>
<th>Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>1</td>
<td>Identify the report as a systematic review, meta-analysis, or both</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Abstract</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Structured summary</td>
<td>2</td>
<td>Provide a structured summary including, as applicable, background, objectives, data sources, study eligibility criteria, participants, interventions, study appraisal and synthesis methods, results, limitations, conclusions and implications of key findings, systematic review registration number</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Introduction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rationale</td>
<td>3</td>
<td>Describe the rationale for the review in the context of what is already known</td>
<td>yes</td>
</tr>
<tr>
<td>Objectives</td>
<td>4</td>
<td>Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS)</td>
<td>yes</td>
</tr>
<tr>
<td><strong>Methods</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protocol and registration</td>
<td>5</td>
<td>Indicate if a review protocol exists, if and where it can be accessed (such as web address), and, if available, provide registration information including registration number</td>
<td>yes</td>
</tr>
<tr>
<td>Eligibility criteria</td>
<td>6</td>
<td>Specify study characteristics (such as PICOS, length of follow-up) and report characteristics (such as years considered, language, publication status) used as criteria for eligibility, giving rationale</td>
<td>yes</td>
</tr>
<tr>
<td>Information sources</td>
<td>7</td>
<td>Describe all information sources (such as databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched</td>
<td>yes</td>
</tr>
<tr>
<td>Search</td>
<td>8</td>
<td>Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated</td>
<td>yes</td>
</tr>
<tr>
<td>Study selection</td>
<td>9</td>
<td>State the process for selecting studies (that is, screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis)</td>
<td>yes</td>
</tr>
<tr>
<td>Data collection process</td>
<td>10</td>
<td>Describe method of data extraction from reports (such as piloted forms, independently, in duplicate) and</td>
<td>yes</td>
</tr>
<tr>
<td>Item</td>
<td>Description</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data items</strong></td>
<td>List and define all variables for which data were sought (such as PICOS, funding sources) and any assumptions and simplifications made.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk of bias in individual studies</strong></td>
<td>Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Summary measures</strong></td>
<td>State the principal summary measures (such as risk ratio, difference in means).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Synthesis of results</strong></td>
<td>Describe the methods of handling data and combining results of studies, if done, including measures of consistency (such as I² statistic) for each meta-analysis.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk of bias across studies</strong></td>
<td>Specify any assessment of risk of bias that may affect the cumulative evidence (such as publication bias, selective reporting within studies).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional analyses</strong></td>
<td>Describe methods of additional analyses (such as sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Study selection</strong></td>
<td>Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Study characteristics</strong></td>
<td>For each study, present characteristics for which data were extracted (such as study size, PICOS, follow-up period) and provide the citations.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk of bias within studies</strong></td>
<td>Present data on risk of bias of each study and, if available, any outcome-level assessment (see item 12).</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Results of individual studies</strong></td>
<td>For all outcomes considered (benefits or harms), present for each study (a) simple summary data for each intervention group and (b) effect estimates and confidence intervals, ideally with a forest plot.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Synthesis of results</strong></td>
<td>Present results of each meta-analysis done, including confidence intervals and measures of consistency.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Risk of bias across studies</strong></td>
<td>Present results of any assessment of risk of bias across studies (see item 15).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional analysis</td>
<td>23</td>
<td>Give results of additional analyses, if done (such as sensitivity or subgroup analyses, meta-regression) (see item 16)</td>
<td>yes</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td><strong>Discussion</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Summary of evidence</td>
<td>24</td>
<td>Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (such as health care providers, users, and policy makers)</td>
<td>yes</td>
</tr>
<tr>
<td>Limitations</td>
<td>25</td>
<td>Discuss limitations at study and outcome level (such as risk of bias), and at review level (such as incomplete retrieval of identified research, reporting bias)</td>
<td>yes</td>
</tr>
<tr>
<td>Conclusions</td>
<td>26</td>
<td>Provide a general interpretation of the results in the context of other evidence, and implications for future research</td>
<td>yes</td>
</tr>
<tr>
<td>Funding</td>
<td>27</td>
<td>Describe sources of funding for the systematic review and other support (such as supply of data) and role of funders for the systematic review</td>
<td>yes</td>
</tr>
</tbody>
</table>
APPENDIX B

PARTICIPANT CONSENT FORM (ENGLISH)
Consent Form

Title of research study: Partnering to prevent early childhood obesity: Sustainability via Active Garden Education (SAGE)

Principal Investigator: Dr. Rebecca E. Lee

Why am I being invited to take part in a research study?
We invite you to take part in this research study, because your child’s early care and education center will be implementing the Sustainability via Active Garden Education (SAGE) program. SAGE teaches children about the importance of physical activity and eating fruits and vegetables in order to grow healthy and strong. Your child will taste new fruits and vegetables and will learn how to plant, water, and harvest in a real garden. In addition, SAGE provides a safety curriculum that teaches children about various safety topics including sun, fire, water, and pedestrian safety.

Why is this research being done?
The purpose of this study is to determine whether a garden-based physical activity and nutrition education program in early care and education centers will increase physical activity and improve dietary habits among 3-5-year-old preschool children to meet national guidelines for good health.

How long will the research last?
This research study will last one year. We expect that children will spend about one year participating in the proposed activities, which will take place at your child’s early care and education center. The SAGE Garden and Safety curricula last for 13 weeks. There will be one to two weeks of measurement before the program begins, after that your child will complete each curriculum over the course of the school year. We may contact you later to measure your child again and ask follow-up questions. If we contact you after one year, we will have a new consent form for you to review and sign, if you wish to continue participation. There is more information about this below in this document.

How many people will be studied?
We expect between 15 and 40 children and their parents from each of the ten centers will participate in SAGE.

What happens if I say yes, I want to be involved with this research?
If you say yes, your child will be asked to participate in the SAGE program, which includes a garden and a safety curriculum. The garden curriculum is a physical activity, and nutrition education program. Your child will learn how to plant, water, weed, mulch and harvest the garden, as well as learn simple food preparation activities such as washing, cleaning and sampling garden produce. You will receive newsletters to show key concepts about the garden and what your child is learning will be sent home weekly to keep you informed about the SAGE gardening program at your child’s early care and education center. We will also send you text messages in look for the newsletters from your child, to update you on what is happening at school and to remind you about measurements. The safety curriculum includes topics on sun, fire, water, and pedestrian safety. Both curricula are delivered in your child’s early care and education center.
We will ask your child and you to complete surveys and measures to determine whether participation in the program increased your child’s physical activity and the amount of fruit and vegetables that she or he eats. We will ask you to complete these measurements four times during the project, at the beginning of the school year; in late July - early August; in November or December; at the end of the school year, in April or May; and at the beginning of the following school year, June or July next year.

Children measurements (at school); 4 times in a year

- At the center, your child will participate in an age-appropriate assessment of their hunger and fullness, as well as age appropriate assessments of finess and motor skills.
- We will measure your child’s and your height, weight, waist circumference.
- We will also observe what your child eats at the center periodically.

Parent measurements (at school); 4 times in a year

- We will measure your child’s and your height, weight, waist circumference, blood pressure, and body fat with a scale.

At home measures for children and parents

- Physical activity monitor: Your child’s and your physical activity will be measured using a small electronic device like a pedometer called an accelerometer. The accelerometer is completely safe for children and adults to wear. Your child and you will wear a physical activity accelerometer on the hip for 7 days, continuously, except during bathing or swimming.

- Sleep monitor: You may be asked to place a sleep monitor on your child’s non-dominant ankle for 7 nights. The sleep monitor should be worn from bedtime to the time that your child gets out of bed in the morning. If your child is left-handed then you will place the sleep monitor around your child’s left ankle. If your child is left-handed, then you will place the sleep monitor around your child’s right ankle. Sleep monitors are completely safe and are similar to wearing a “Fitbit” type of device.

- Physical activity and sleep log: We will ask you to complete a 7-day log of the times when the accelerometers were removed for bathing or swimming, and what times your child went to bed and got up for the day, each day.

- Surveys: We will also ask you to complete short surveys that tell us about the amount fruit and vegetables that are available in your home, your physical activity and nutrition parenting practices, and your child’s sleep habits. We will also ask you some demographic questions about how you describe both your child and you, yourself. You may complete these surveys either during parent meetings or at home using an electronic survey on a computer, tablet, phone or a paper survey. These surveys will take approximately 30-60 minutes to complete.

We will ask you to complete these measurements **only four times during the project**:

1. First measurements, in late July - early August
2. Second measurements, in November or December
3. Third measurements, April or May
4. Fourth measurements, June or July
Additional measures

You may have the opportunity to be part of a small group of mothers who will provide us with additional information. We will invite 100 mothers to give a small blood sample (finger stick) to measure blood fats (cholesterol and triglycerides), sugar and other indicators of how cholesterol and sugar are transported and processed in the body. Mothers who agree to have their blood sample measured will need to be fasting for at least 10 hours. The blood sample process will take about 5 minutes. We will also ask you to complete an active transportation log to track any time you walk or bike to or from a destination during the 7 days when you wear an accelerometer. This will be used to determine if a relationship exists between active transportation and blood fats and sugar. You may experience minor discomfort and/or bruising at the site of the finger stick. You will also be given a copy of the results of your blood test for you to share with your health care provider, and a list of clinics that provide free or reduced-price health care will be given to you in the event you do not have a primary care provider.

What happens if I say yes, but I change my mind later?

Your child and you can leave the research study at any time, and it will not be held against you. You are free to decide whether you wish to participate in this study. Your participation is voluntary and you may refuse to participate or withdraw at any time without penalty or loss of benefits to which you are otherwise entitled. You may also refuse to answer any question or complete any portion of the assessments if you choose.

Is there any way being in this study could be bad for me?

There are minimal risks associated with this study associated with physical activity. While participating in SAGE, children will be running and jumping, which pose risks like those that children may experience during recess at school (i.e., falls, scrapes, and exacerbate asthma). There will be constant oversight of the children as they engage in the garden program. We will never use fertilizer or other toxic chemicals or large metal garden tools in the presence of the children while in the garden. You may experience boredom or fatigue from completing surveys also, you may experience mild discomfort when getting your blood pressure measured, similar to what you experience during a visit to the doctor.

Will being in this study help me in any way?

While you will not directly benefit, your participation may help investigators understand how to improve physical activity and dietary habits in preschoolers to help improve health outcomes and meet federal guidelines.

What happens to the information collected for the research?

We will make every effort to protect your family’s and your confidentiality. All identifying information (like your child’s and your name or contact information) will be assigned a code number by the principal investigator and project manager. The code number will appear on all written materials. The list pairing identifying information to the assigned code number will be kept separate from all research materials in a locked and safe location and will be available only to the SAGE research team. Confidentiality will be maintained within legal limits. We cannot promise complete secrecy. An organization that may view or copy your information is the University institutional review board that reviews research. This board ensures that researchers are doing their jobs correctly and protecting your information and rights.
Information that you give us will be combined with the information from other research participants like your family and you. Information will be aggregated together so that no single individual can be identified. Findings based on this combined information from this study will be presented at scientific meetings and published in scientific journals, and may be published by the popular media or used on web sites.

What else do I need to know?
This research is being funded by the National Institute on Minority Health and Health Disparities at the National Institutes of Health (NIH).

How much does it cost to participate?
The SAGE program is free and has no cost to you.
We are grateful for your participation, and we recognize that your participation may pose some inconvenience for you. In order to recognize the time that you will take to participate in the study, you will receive up to a total of $25 for completing all of the first measurements, $30 for completing all of the second measurements, $35 for completing all of the third measurements, and $40 for completing all of the fourth and last measurements, for completing the questionnaires, and having your child wear the accelerometer for 7 days.
If you participate in the group of parents who will wear an accelerometer for 7 days at T1 and T2, or T2 and T3, you will receive an additional $10.
If you participate in the group of parents who will have their child wear a sleep monitor at night for 7 nights, you will receive an additional $5.
If you participate in the group of mothers who will provide us with a small blood sample to measure blood fats, you will receive an additional $10.

Who can I talk to?
If you have questions, concerns, or complaints, please call 602-496-2011 to speak to a member of the research team.
This research has been reviewed and approved by the ASU Social Behavioral IRB. You may contact them at (480) 965-6788 or by email at research.integrity@asu.edu for any of these reasons:
- Your questions, concerns, or complaints are not being answered by the research team.
- You cannot reach the research team.
- You want to talk to someone besides the research team.
- You have questions about your rights as a research participant.
- You want to get information or provide input about this research.
# Contact Form

Parent full name

Child full name

Street address

City

State

Zip code

Home phone number

Cellular phone number

Email

**Alternate contact information (in case we are not able to contact you)**

Alternate contact full name

Street address

City

State

Zip code

Home phone number

Cellular phone number

Email

**Alternate contact information (in case we are not able to contact you)**

Alternate contact full name

Street address

City

State

Zip code

Home phone number

Cellular phone number

Email
Additional Permissions & Waivers

Photographs: We would like to know whether we may use photographs of your child during their participation in the SAGE garden program. These photographs will be used for scientific presentations and/or publications, and to show community partners and potential participants what we do in the SAGE program. We may add these photographs to our SAGE website (sageauwwebly.com), flyers and brochures, and to the weekly newsletters that you will receive during the SAGE program. If you agree, please check “yes” below, giving us permission to use photographs of your child.

_____ Yes, I agree for the SAGE team to take photographs of my child

_____ □ Complete Photo release form.

_____ No, I do not agree for the SAGE team to take photographs of my child.

Phone calls and text messages: We would like to know whether it is okay to call you to complete the 24hr diet recalls and to send you text messages during data collection periods to remind and see if you have any questions or concerns about the assessments, accelerometers, and sleep monitor. We will also send you texts during your child’s participation in the SAGE program. This will be about once or twice a week.

_____ Yes, I agree to receive phone calls.

_____ No, I do not want to receive phone calls.

_____ Yes, I agree to receive text messages.

Phone Carrier: ____________________________

_____ No, I do not want to receive text messages.

Participating in future research studies or follow-up interviews: We may want to contact you in the future to ask you follow up questions about your child’s or your experience in SAGE. Please indicate below if you agree to be contacted in the future.

_____ Yes, I agree to be contacted in the future.

_____ No, I do not want to be contacted in the future.

Street address and nearest cross streets: We would like to know if it is okay if we obtain the walkability score of the census block group where your street address and/or nearest cross streets are located. This information will be used for statistical analyses for the SAGE program and will be kept confidential.

_____ Yes, I agree that you use my street address and nearest cross streets to obtain walkability scores

Nearest cross streets: ______________________ and ______________________

_____ No, I do not agree that you use my street address and nearest cross streets to calculate walkability
Signature Block for Parental Permission for Children
Your signature documents your permission for the named child to take part in this research.

Printed name of child

Signature of parent or individual legally authorized to consent to the child’s general medical care

Date

☐ Parent
☐ Individual legally authorized to consent to the child’s general medical care

Printed name of parent or individual legally authorized to consent to the child’s general medical care

Note: Investigators are to ensure that individuals who are not parents can demonstrate their legal authority to consent to the child’s general medical care. Contact legal counsel if any questions arise.

Signature Block for Capable Adult
Your signature documents your permission to take part in this research.

Signature of participant

Date

Printed name of participant

Signature of person obtaining consent

Date

Printed name of person obtaining consent

My signature below documents that the information in the consent document and any other written information was accurately explained to, and apparently understood by, the participant, and that consent was freely given by the participant.

Signature of witness to consent process

Date

Printed name of person witnessing consent process
Formulario de Consentimiento Informado

Título del estudio de investigación: Alianza para prevenir la obesidad en la infancia temprana: Sustentabilidad a través de la Educación Activa en el Jardín (SAGE)
Investigadora principal: Dra. Rebecca E. Lee

¿Por qué me invitan a participar en un estudio?
Le invitamos a participar en el estudio Sustentabilidad a través de la Educación Activa en el Jardín (SAGE por las siglas en inglés) que el centro de cuidado y educación temprana de su hijo(a) implementara. SAGE se enmarca a los niños acerca la importancia de la actividad física y comer frutas y verduras para crecer sanos y fuertes. Su hijo probará frutas y verduras nuevas y aprenderá a plantar, regar y cosechar en un jardín de verdad. Además, SAGE también provee un plan de estudios sobre la seguridad infantil, el cual educará a los niños pequeños sobre la seguridad peatonal, contra incendios, acuática, solar.

¿Por qué se está realizando este estudio?
El propósito de este estudio es determinar si un programa de educación en actividad física y nutrición que está basado en jardines en los centros de atención temprana y educación aumentará la actividad física y mejorará los hábitos alimenticios entre los niños en edad preescolar, 3-5 años, para cumplir con las guías nacionales para la buena salud.

¿Cuánto tiempo durará la investigación?
Este estudio durará un año. Esperamos que la participación de los niños en estas actividades dure alrededor de un año. Las actividades se llevarán a cabo en el centro de atención y educación temprana. El plan de estudios SAGE y Seguridad durarán 13 semanas. Habrá aproximadamente de una a dos semanas de medición antes de que empiece el programa. Después de eso, su hijo(a) completará cada plan de estudios a través del año escolar. Puede que le contactemos más adelante para volver a tomar medidas de su hijo(a) y para hacerle preguntas de seguimiento. Si nos ponemos en contacto con usted después de un año, tendremos un nuevo formulario de consentimiento informado para que usted lo pueda revisar y firmar, solo si desea continuar participando. Hay más información sobre esto a continuación en este documento.

¿Cuántas personas participarán en el estudio?
Esperamos que entre 15 y 40 niños y padres de cada uno de los diez centros participen en SAGE.

¿Qué pasa si digo que sí quiero participar en este estudio?
Si usted dice que sí, se le pedirá a su hijo(a) que participe en el programa SAGE, el cual incluye un plan de estudios de jardín y otro de seguridad. El plan de estudios de jardín incluye educación de actividad física y nutrición. Su hijo(a) aprenderá cómo plantar, regar, cuidar plantas y a cosechar el jardín. También aprenderá a cocinar para la preparación de alimentos tales como lavar, limpiar y probar la cosecha del jardín. Recibirán boletines que mostrarán conceptos clave acerca del jardín y lo que está aprendiendo su hijo(a). Enviaremos los boletines a casa semanalmente para mantenerle informado(a) sobre el programa de jardinería SAGE en el centro de su

ASU IRB # STU00002861 / Approval Period 1/6/2016 – 1/6/2020
hijo(a). También le mandaremos mensajes de texto para recordarle que mire los boletines, para mantenerle al día con lo que está pasando en la escuela, y para recordarle cuando le toquen las medidas. El plan de estudios de seguridad incluye temas sobre la seguridad personal, contra incendios, acuática, solar. Ambos planes de estudio se llevan a cabo en el centro de atención y educación temprana donde va su hijo(a).

Le pediremos a su hijo(a) y a usted que completen encuestas y medidas para determinar si la participación en el programa aumentó la actividad física de su hijo(a) y la cantidad de frutas y verduras que el o ella come. Le pediremos que complete estas mediciones solamente cuatro veces durante el proyecto: al principio del año escolar, a final de julio, principios de agosto, en noviembre o diciembre, a final del año escolar, en abril o mayo; y al principio del siguiente año escolar, en junio o julio del próximo año.

Medidas para los niños (en la escuela): 4 veces en un año
- En el centro, su hijo participará en una evaluación de hambre y saciedad, un físico y habilidades motoras apropiadas a su edad.
- Mediremos la altura, el peso, la circunferencia de la cintura.
- Observaremos lo que su hijo(a) come periódicamente en el centro.

Medidas para mamá o papá (en la escuela): 4 veces en un año
- Mediremos altura, peso, circunferencia de la cintura, presión arterial, y porcentaje de grasa corporal usando una báscula.

Medidas en Casa para padres y niños
- Monitor de actividad física: La actividad física de su hijo y de usted se medirá usando un pequeño dispositivo electrónico como un podómetro que se llama acelerómetro. El acelerómetro es completamente seguro para niños y adultos. Su hijo(a) y usted usarán un acelerómetro en su cadera durante 7 días, continuamente, excepto cuando se baño o si va a nadar.
- Monitor del sueño: Puede que le pidamos que ponga un monitor del sueño en el tobillo no dominante de su hijo(a) por 7 noches. El monitor del sueño debe de ser usado desde la hora de dormir hasta que su hijo(a) se levanta en la mañana. Si su hijo(a) usa la mano derecha para comer y escribir o dibujar, entonces tendrá que poner el monitor del sueño en el tobillo izquierdo. Si su hijo(a) es zurdo, entonces el monitor del sueño deberá ir en el tobillo derecho. Los monitores de sueños son completamente seguros y son similares a los aparatos "Fit Bit".
- Registros de actividad física y del sueño: Le pediremos que tiene un registro por 7 días con las horas en que se pasaron y/o quitaron los acelerómetros para bañarse o nadar, y a qué horas su hijo(a) se fueron a dormir y se levantaron cada día.
- Encuestas: Le pediremos que complete encuestas cortas que nos informen sobre la cantidad de frutas y verduras que están disponibles en su hogar, sobre sus prácticas de crianza en actividad física y nutrición, y sobre los hábitos de sueño de su hijo(a). También le haremos algunas preguntas demográficas sobre cómo se describen ambos, su hijo(a) y usted. Puede completar estas encuestas durante la junta de padres o en casa a través de un formulario electrónico, usando una computadora, tableta, o teléfono, o en papel. Estas encuestas tomarán aproximadamente 30-60 minutos para completarse.
Le pediremos que complete estas medidas **sólo cuatro veces durante el proyecto**:

1. **Primeras medidas**: al final de julio, principios de agosto
2. **Segundas medidas**: en noviembre o diciembre
3. **Terceras medidas**: abril o en mayo
4. **Cuartas medidas**: junio o julio

**Medidas adicionales para mamás**

Es posible que tenga la oportunidad de ser parte de un pequeño grupo de mamás que nos den información adicional. Invitaremos a 100 mamás a que den una pequeña muestra de sangre (punición capilar) para medir las grasas en la sangre (colesterol y triglicéridos), azúcar y otros indicadores de cómo el colesterol y el azúcar se transportan y procesan en el cuerpo. Las mamás que acepten participar en esta medida necesitarán ayunar por al menos 10 horas. El proceso de muestra de sangre tomará aproximadamente 5 minutos. También le pediremos que complete un registro de transporte activo para ver cada que camina o usa bicicleta hacia o desde un destino durante los 7 días cuando usa un acelerómetro. Esto se usará para determinar si existe una relación entre el transporte activo y las grasas en la sangre y el azúcar. Puede experimentar molestias leves y/o mareos en el sitio del dedo donde se hace la prueba capilar. También se le entregará una copia de los resultados de su análisis de sangre para que la comparta con su proveedor de atención médica, y se le brindará una lista de clínicas que le brindan atención médica gratuita o de precio reducido en caso de que no tenga un proveedor primario de atención médica.

**¿Qué sucede si digo que sí, pero cambio de opinión más tarde?**

Su hijo(a) y usted pueden dejar el estudio en cualquier momento, y no será usado en su contra. Usted es libre de decidir si desea participar en este estudio. Su participación es voluntaria y usted puede negarse a participar o retirarse en cualquier momento sin penalización o pérdida de beneficios a los que tiene derecho. También puede negarse a contestar cualquier pregunta o completar cualquier porción de las evaluaciones si lo desea.

**¿Hay alguna forma en el que estar en este estudio podría ser malo para mí?**

Hay riesgos mínimos en este estudio en relación a la actividad física. Los niños que participan en SAGE van a correr y brincar. Esto podría causar lesiones similares a las que pueden ocurrir durante el recreo en la escuela (i.e. caídas, raspones, y la agravación del asma). No hay riesgos previsibles para su hijo(a) por participar en este estudio. Habrá una supervisión constante de los niños mientras participan en el programa de jardín. Nunca utilizaremos fertilizantes u otros productos químicos tóxicos, o grandes herramientas metálicas de jardín en presencia de los niños mientras estén en el jardín. Puede experimentar aburrimiento o fatiga cuando complete encuestas también. Usted puede experimentar molestias leves al medirle la presión arterial, similar a una experiencia de una visita al médico.

**¿Estoy en este estudio me ayudara en alguna forma?**

Aunque no se beneficiara directamente, su participación puede ayudar a los investigadores a entender cómo mejorar la actividad física y los hábitos alimenticios en los niños preescolares para ayudar a mejorar los resultados de salud y cumplir con guías federales.

**¿Qué sucede con la información recopilada para la investigación?**
Haremos todo lo posible para proteger la confidencialidad de su familia y usted. A toda la información de identificación (como el nombre de su hijo/a y usted o información de contacto) se le asignará un número de código por el investigador principal y administrador del proyecto. El número de código aparecerá en todos los materiales escritos. La lista de información de identificación asignada al número de código será mantenida separada de todo material de investigación en una ubicación bajo llave y seguro y estará disponible únicamente para el grupo del proyecto SAGE. La confidencialidad será mantenida dentro de los límites legales. No podemos prometer una confidencialidad completa. Una organización que puede ver o copiar su información es la junta de revisión institucional de la universidad que revisa la investigación. Esta junta asegura que los investigadores están haciendo su trabajo correcamente y están protegiendo su información y sus derechos.

La información que nos proporcione será combinada con la información de otros participantes en el estudio al igual que usted y su familia. La información se agrupará de manera que no se pueda identificar a ningún individuo. Los hallazgos basados en esta información combinada de este estudio serán presentados en reuniones científicas y publicados en revistas científicas, y pueden ser publicados por los medios de comunicación populares o utilizados en sitios web.

¿Qué más necesita saber?
Este estudio está siendo financiado por el Instituto Nacional sobre la Salud de las Minorías y Disparidades de Salud en los Institutos Nacionales de Salud (NIH).

¿Cuánto cuesta participar?
El programa SAGE es gratuito y no tiene ningún costo para usted. Estamos agradecidos por su participación, y reconocemos que su participación puede posar algunos inconvenientes para usted. Con el fin de reconocer el tiempo que usted tomará para participar en el estudio, recibirá hasta un total de $25 por completar las primeras medidas, $30 por completar todas las medidas la segunda vez, $35 por completar todas las medidas la tercera vez, y $40 por completar todas las medidas la cuarta y última vez. Las medidas son llenar los cuestionarios, que su hijo(a) use el acelerómetro por 7 días.
Si decide participar en el grupo de padres que usarán un acelerómetro por 7 días, en las primeras y segundas medidas, o las segundas y terceras medidas, usted recibirá $10 adicionales.
Si usted decide participar en el grupo de padres que le pondrá a su hijo(a) el monitor del sueño por 7 noches, usted recibirá $5 adicionales.

Si usted decide participar en el grupo de madre que nos dará una pequeña muestra de sangre para medir grasa en la sangre, usted recibirá $10 adicionales.

¿Con quién puedo hablar?
Si tiene preguntas, inquietudes o quejas, llame al 602-496-2011 para hablar con un miembro del equipo del estudio.
Esta investigación ha sido revisada y aprobada por la junta IRB de Comportamiento Social. Usted puede hablar con ellos llamando al (480) 965-6788 o por correo electrónico a research.integrity@asu.edu

Sus preguntas, inquietudes o quejas no están siendo respondidas por el equipo de investigación.
No puede comunicarse con el equipo de investigación.
Quiere hablar con alguien además del equipo de investigación

ASU IRB IRB # STUDY00015761 | Approval Period 2/8/2016 – 2/2/2026
• Tiene preguntas sobre sus derechos como participante en una investigación.
• Quiere recibir información o proporcionar información acerca de esta investigación.
Formulario de Contacto

<table>
<thead>
<tr>
<th>Nombre completo del padre o madre</th>
<th>Nombre completo de su hij(a)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domicilio</td>
<td></td>
</tr>
<tr>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>Telefone de casa</td>
<td>Número de teléfono de celular</td>
</tr>
<tr>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>Ciudad</td>
<td>Estado</td>
</tr>
<tr>
<td>( )</td>
<td></td>
</tr>
<tr>
<td>Código postal</td>
<td>Correo electrónico</td>
</tr>
</tbody>
</table>

Información de contacto alterno (en caso que no le podamos contactar)

<table>
<thead>
<tr>
<th>Nombre completo de contacto alterno</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domicilio</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Telefone de casa</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Número de teléfono de celular</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Correo electronico</td>
</tr>
</tbody>
</table>

Información de contacto alterno (en caso que no le podamos contactar)

<table>
<thead>
<tr>
<th>Nombre completo de contacto alterno</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domicilio</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Telefone de casa</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Número de teléfono de celular</td>
</tr>
<tr>
<td>( )</td>
</tr>
<tr>
<td>Correo electronico</td>
</tr>
</tbody>
</table>

6

AGU IRB IRB# STUDY30000761 | Approval Period 2/3/2016 - 2/3/2020
Permisos Adicionales y Concesiones

Fotografías: Nos gustaría saber si podemos usar fotos que tomemos durante la participación de su hijo(a) en el programa de SAGE. Estas fotos las usaremos para presentaciones científicas y/o publicaciones, y para enesar el trabajo que hacemos en el programa de SAGE a nuestros socios comunitarios y posibles participantes. Puede que pongamos estas fotos en nuestra página web (sagesu weebly.com), volantes, folletos, y boletines semanales que usted y otros padres recibirán durante su participación en el programa SAGE.

☐ Sí, estoy de acuerdo en que el equipo de SAGE le tome fotos a mi hijo(a).
☐ No, no estoy de acuerdo con que el equipo de SAGE le tome fotos a mi hijo(a).

Llamadas y mensajes de texto: Nos gustaría saber si nos permite llamarle para completar los recordatorios de comida de 24 horas, y mandarle mensajes de texto durante el tiempo de mediciones para recordarle y ver si tiene preguntas acerca de las encuestas, acelerómetros, y monitores de sueño. También le mandaremos mensajes de texto durante la participación de su hijo(a) en el programa SAGE. Esto será aproximadamente una dos veces por semana.

☐ Sí, estoy de acuerdo en recibir llamadas por teléfono.
☐ No, no quiero recibir llamadas por teléfono.

☐ Sí, estoy de acuerdo en recibir mensajes de texto.
☐ No, no estoy de acuerdo en recibir mensajes de texto.

Participación en estudios o entrevistas de seguimiento en el futuro: Puede que queramos contactarle en el futuro y hacerle preguntas de seguimiento acerca de la experiencia que su hijo(a) y usted tuvieron en SAGE. Por favor diganos si está de acuerdo en que le contactemos en el futuro.

☐ Sí, estoy de acuerdo en que me contacten en el futuro.
☐ No, no estoy de acuerdo en que me contacten en el futuro.

Dirección y la intersección más cercana: Nos gustaría saber si está de acuerdo en que usemos su dirección y la intersección más cercana, alrededor de ½ milla de distancia, para determinar qué tan seguro es su vecindario para salir a caminar. Esta información será usada para análisis estadísticos para el programa de SAGE y la mantendremos confidencial. Sí, estoy de acuerdo que use su dirección y la intersección más cercana para determinar qué tan seguro es su vecindario para salir a caminar.

☐ Sí, estoy de acuerdo que use mi dirección y la intersección más cercana para determinar qué tan seguro es su vecindario para salir a caminar.
☐ No estoy de acuerdo que use mi dirección y la intersección más cercana para determinar qué tan seguro es su vecindario para salir a caminar.

7
Su firma documenta su permiso para que el niño(a) nombrado tome parte en esta investigación.

**Nombre impreso del niño(a)**

**Firma del padre, madre o persona autorizada legalmente para dar su consentimiento para la atención médica del niño(a)**

**Fecha**

☐ Papa/Mama

☐ Persona autorizada legalmente para dar su consentimiento para la atención médica del niño

**Nombre impreso del padre, madre o persona autorizada legalmente para dar su consentimiento para la atención médica del niño(a)**

Nota: Los investigadores deben asegurarse de que las personas que no son padres puedan demostrar su autoridad legal para dar su consentimiento para la atención médica general del niño. Póngase en contacto con un asesor legal si se presentan algunas preguntas.

**Bloque de firmas para el adulto capacitado**

Su firma documenta su permiso para tomar parte en esta investigación.

**Firma del participante**

**Fecha**

**Nombre impreso del participante**

**Firma de la persona que obtiene el consentimiento**

**Fecha**

**Nombre impreso de la persona que obtiene el consentimiento**

Mi firma a continuación documenta que la información en el documento de consentimiento y cualquier otra información escrita fue explicada con precisión y aparentemente entendida por el participante, y que el consentimiento fue libremente dado por el participante.

**Firma del testigo de proceso de consentimiento**

**Fecha**

**Nombre impreso de la persona siendo testigo del proceso de consentimiento**
APPENDIX D

SUSTAINABILITY VIA ACTIVE GARDEN EDUCATION INSTITUTIONAL REVIEW

BOARD APPLICATION
1. **Preschool Title**

2. **Background and Objectives**

   Provide a scientific or preliminary background for rationale, hypothesis, and significance of the research based on the existing literature and how it will add to existing knowledge.

   - Describe the purpose of the study.
   - Describe any relevant preliminary data or case studies.
   - Describe any past studies that are in conjunction to the study.

**Background**

Early childhood is a critical period for the formation of healthy behaviors, including physical activity (PA) and dietary habits, which track through childhood. There are inverse associations between PA and childhood obesity across all age groups, and expenditure to a healthy diet early in life can promote a lifetime of healthy dietary habits. The trajectory toward obesity is established as early as the age of 5, making early childhood (15 years) a vulnerable time in the lifespan and a key opportunity for behaviorally based primary prevention. However, most children do not meet PA guidelines and spend a large portion of their waking time in sedentary activities, particularly in the early-care and education (ECCE) setting. 

   - Large scale: from discussions of possible solutions are ECCE-specific educational curriculum for promoting healthy behaviors among young children in early care and education centers (ECCEs). Previous work by our team shows that over-activity is not a natural occurrence; the issue is the lack of physically active ECCEs. People of Hispanic Latino (HL) ethnicity are the largest ethnic minority group in the US and HLs are often found in underserved areas across a range of health outcomes linked to overweight and obesity.

   - In the present study, we attempted to increase PA and reduce sedentary time and risk of obesity. The city of Phoenix is the 5th largest city in the US and 34% HLs in Arizona tend to have poorer educational outcomes and are more likely to live in lower socioeconomic status (SES) areas than are whites in Arizona, suggesting a need to enhance educational settings and have elements (e.g., bilingual accessibility) appropriate for them. The interrelated challenges of physical inactivity and poor dietary habits, and related issues require multilevel, multifaceted, collaborative strategies for a sustainable solution, that is, a holistic, multidisciplinary perspective. Although these models have been previously applied, the study context and setting must be considered. We address this issue by the multilevel, dynamic process.

**Preliminary Data**

Sustainability via Active Garden Education (SAGE) was conceptualized in a 3-year CSER partnership development project and tested and refined in an additional 2-year CSER pilot (described below), for a total of 5 years of research that involved the whole community.

   - The CSER partnership was developed through opportunity receptions to introduce the community to the obesity challenge.

   - Community members tasked obesity as the most important community health problem and focus on childhood obesity, school programs, and community events for recruiting children to food banks as potential targets.

   - The result of this 2-year study was the development of Sustainability via Active Garden Education (SAGE). Functional interactions with 10 ECCE directors identified the need for an innovative curriculum that focused on nutrition and health to comply with ECCE accreditation guidelines. The resulting SAGE curriculum is a 16-week PA and nutrition educational program and presently includes 12 lessons that can be delivered once a week. SAGE 1 was delivered in 4 centers in Houston (3-4 year old preschoolers). Lessons learned from Pilot 1 were documented and feedback was used to modify the intervention for SAGE Pilot 2 at two centers in Phoenix (N=24). In SAGE Pilot 1, we made progress toward IOM guidelines of increasing PA measured by accelerometry from 5 minutes at baseline to 14 during the main session and 11 minutes per week to standardize the 2-minute baseline value from 4:10 to 3:10 minutes during the intervention and 2:0 minutes posttest (complete data sample N=41). This was based on complete data N=41. (P<0.05), in Pilot 2 to increase PA by 10 minutes from 19 to 29 minutes during the intervention and 23 minutes posttest; sedentary time went from 4:10 to 10 minutes during the intervention and 20 minutes posttest (complete data sample N=21). In Pilot 1, we developed parent newsletters (English-Spanish) with home activities and community resources to increase parental engagement. We saw not significant but promising results with this modification, with increases from 0.5 to 1.5 servings of vegetables and 1 to 1.7 servings of fruit. In Pilot 2, we developed parent newsletters (English-Spanish) with home activities and community resources to increase parental engagement. We saw not significant but promising results with this modification, with increases from 0.5 to 1.5 servings of vegetables and 1 to 1.7 servings of fruit.
(SAGE 1.4%, SAGE 2=0.2%) suffered from low power, they provide insight into potential intervention effects in a proxy powered investigation with larger enrolment on event occurrence. The next step in this CBPR project is to test SAGE in a fully powered, cluster RCT investigating multi-level effects and potential for sustainability.

**Purpose**

This CBPR-cluster randomized controlled trial that determine factors that contribute to early life, death, and sustainability as guided by the RE-AIM (Reach, Efficacy/Efficiency, Adoption, Implementation, Maintenance) framework. Our research team brings expertise derived both from science and practice on community building and shares research for increased capacity and responsiveness to identified needs to reduce health disparities. The specific aims are as follows:

1. Determine the short- and long-term primary effects of SAGE on health in children (predominantly Latino) aged 3-5 years.
2. Study the secondary impact of SAGE on child safety and child safety environment.
3. Study the secondary impact of SAGE on school and child safety environment.
4. Study the secondary impact of SAGE on school and child safety environment.
5. Study the secondary impact of SAGE on school and child safety environment.

**Exploratory Sub-aim 1:** Explore the primary impact of SAGE on the Pediatrician's Care and Treatment of Physical Activities.  
**Exploratory Sub-aim 2:** Explore the potential relationship between primary care and treatment of physical activities and SAGE on health in children.  
**Exploratory Sub-aim 3:** Explore the potential relationship between primary care and treatment of physical activities and SAGE on health in children.

**Methodology**

A randomized controlled trial (RCT) is designed to test the hypothesis that SAGE will improve physical activities, academic performance, and social and emotional well-being in children aged 3-5 years. The trial will be conducted in two phases: a baseline assessment followed by an intervention phase. The intervention phase will include a structured curriculum focusing on physical activities and social skills. The outcome measures will include physical activity levels, academic performance, and social and emotional well-being. The study will be conducted in partnership with local community organizations and schools. The study will be powered to detect a moderate effect size with 80% power and a significance level of 0.05.

**Data Use**

Data collected from this study will be used for publications, conference presentations, and will be shared with community partners and the Arizona Board of Education. Data may also be used for future dissertations, theses, and undergraduate honors projects. Data will be available to inform future grant proposals.

**Inclusion and Exclusion Criteria**

- **Inclusion Criteria:**
  - Children aged 3-5 years
  - Families willing to participate in the intervention

- **Exclusion Criteria:**
  - Families unable to commit to the intervention
  - Children with serious medical conditions

**Data Confidentiality**

All data collected in this study will be stored in a secure, password-protected database. Access to the data will be limited to authorized personnel only. All data will be de-identified before publication or presentation.
| SOCIAL BEHAVIORAL INSTRUCTIONS AND TEMPLATE |
|-----------------|-----------------|---------------------|
| **NUMBER** | **DATE** | **PAGE** |
| 181 | | |

**Community Advisory Board (CAB)**

- CAB members will discuss the project at a meeting. CAB members at the meetings will provide feedback.

**Survey Instrument**

- CAB meetings will include feedback.

**Recruitment Methods**

- Community members will be recruited through email and social media.

**Dissemination Plan**

- CAB meetings will be recorded and shared online.

**Data Analysis**

- CAB members will be involved in the analysis of data.

---

**Number of Participants**

- Total number of participants recruited: 1,100

---

**Recruitment Methods**

- Community members will be recruited through email and social media.

---

**Dissemination Plan**

- CAB meetings will be recorded and shared online.

---

**Data Analysis**

- CAB members will be involved in the analysis of data.

---

**Number of Participants**

- Total number of participants recruited: 1,100
7 Procedures Involved
Describe all research procedures being performed, who will facilitate the procedures, and when they will be performed. Describe procedures including:

- The duration of time participants will spend in each research activity.
- The period or span of time for the collection of data, and any long term follow up.
- Surveys or questionnaires that will be administered (Attach all surveys, interview questions, scripts, data collection forms, and instructions for participants to the online application).
- Interventions and assessments (Attach supplemental materials to the online application).
- Lab procedures and tasks and related instructions to participants.
- Video or audio recordings of participants.
- Previously collected data sets that will be analyzed and identify the data source (Attach data use agreement(s) to the online application).

The proposed project will take place over 5 years (see timeline below). Year 1: Form partnership and convene CSPR meetings, hire and train staff, recruit ECEC; adapt and translate project materials; conduct emphasis using Nominal Group Technique (NCT; see below); formulate parent text messages. Year 2: begin the RACE intervention starting with a pilot in February 2017 at our community partner’s ECEC where two classrooms will receive the RACE intervention. This group will only complete T1 and T3 assessment measures. T1 assessment will be completed before the intervention and after 10 weeks. T2 assessment will be completed. The purpose of this pilot is to refine intervention and assessment. In August 2017, the RACE intervention will begin in one of two cohorts coinciding with the typical school year. As community partners suggested, centers will be pair matched and then randomized to the RACE intervention or an attention control condition. After 16 weeks, and at the T3 assessment, ECEC staff will switch and the factor associated with delivering and implementing the RAP will begin. Cohort T1, T3, T1, and T4 assessment, parents of participants will complete questionnaires on parenting practices that promote PA, and fruit and vegetable consumption, as well as questionnaires to assess demographics, parenting practices, home fruit and vegetable availability, food security, and home food inventory. We will also measure parents and children’s height, weight, waist circumference, blood pressure, and body fat with a scale.

Year 3: Cohort 2 will begin in August 2018 and will follow the same data collection processes as Cohort 1. Data collection for the delivery, sustainability assessment, and partnership and community advisory board (CAB) activities, with data processing, analysis, and interpretation, will continue in Years 2–3. See timeline below.

The Partnership: Previous work developing RACE has shown us that the Partnership is essential for the creating, implementing, evaluating, and sustaining this culturally appropriate strategy to reduce disparities. The Partnership will extend the reach of the CAB and scientific work to help address its short- and long-term goals. We will use our current partners to help find additional partners to achieve a diverse and engaged Partnership within the first year of the timeline. Partners will be invited complete the Wider Collaboration Factors Inventory annually online to evaluate the development of the Partnership. We will share, as in the pilot work, send partner quarterly newsletters describing on-site activities, including those related to the project, since the newsletters become a valuable resource for partners to keep informed about RACE activities and to keep them informed.

Community Advisory Board (CAB): The Partnership will be supported by the infrastructure of the CAB to guide Partnership activities. Although
preparation of documents, collection of information, and preparation of materials are the primary responsibility of the Center’s staff. The Center is comprised of trained staff members from various disciplines. A Center director is responsible for implementing the project, which includes the following:

1. **Sustainability Action Plan (SAP):** This study will focus on developing a SAP that will influence the micro-environment of the Center to enhance program sustainability. The SAP will include:
   - Identifying key factors that influence the sustainability of the project.
   - Developing strategies to address these factors.
   - Implementing interventions to maximize sustainability.

2. **Project Implementation:** The project will be implemented in phases, with each phase focusing on a specific component of the project. The phases will include:
   - Phase 1: Preparation and planning.
   - Phase 2: Implementation and monitoring.
   - Phase 3: Evaluation and refinement.

3. **Participatory Planning:** The project will involve participatory planning, which will include:
   - Engaging community members in the planning process.
   - Soliciting feedback from community members.
   - Incorporating community feedback into the project.

4. **Data Collection:** Data will be collected using a variety of methods, including:
   - Surveys.
   - Focus groups.
   - Interviews.

5. **Monitoring and Evaluation:** The project will be monitored and evaluated to ensure that it is achieving its goals. This will include:
   - Regular assessments of project progress.
   - Adjustments to the project as needed.

6. **Dissemination:** The results of the project will be disseminated through:
   - Publications.
   - Presentations.
   - Reports.

The Center will work with local partners to ensure that the project is sustainable and meets the needs of the community. The project will be funded through a combination of local and federal grants. The Center will also seek partnerships with other organizations to enhance the sustainability of the project.
administer the SNA again at SAGE sessions 3 the second time (when the SAGE intervention during ECCE teacher implementation of the program) to assess the degree of institutionalization (see SAP step 1 above), each center's scores will be interpreted separately to facilitate action planning with the corresponding center director in Step 2. The Teacher Self-Assessment will be completed by the teachers at week 5 of the SAGE intervention. The Teacher Self-Assessment will allow teachers to evaluate themselves on their implementation of the SAGE curriculum using the PRIME principles. This information will be used to design teacher training booster sessions (see SAP step 1 below).

SAP Step 2: Examine the current state of program sustainability at the center, organizational, and community levels, while identifying resources or modifications to improve sustainability of SAGE. This information can be used to create SAGE modification recommendations. This will be implemented at each center through an action planning meeting and teacher booster session. The research team will compile and analyze the results from the Sustainability Needs Assessment for every center while it is participating in the SAGE Garden curriculum. A master copy will be developed and the results will be reviewed at each center and scientific team meetings. Each team will make suggestions or ways to improve the sustainability of SAGE to be implemented in this step and Step 1 of the SAP. The staff will be asked to provide additional information on community resources available to help centers increase the likelihood of sustaining SAGE. Information from CAB and staff meetings will be captured over meeting minutes, and ideas on how to improve the sustainability of SAGE will be transformed into an action plan to be run through the scientific team and will be submitted as a modification to the annual approval. The annual plan will be submitted to ECCE to provide suggestions on how to sustain SAGE within their center.

The SAGE team will compile and analyze data from teacher self-assessments. These data will be used to determine priorities to be included in the teacher training booster sessions. Results from each center’s Sustainability Needs Assessment will be reviewed with the center’s director and staff involved with SAGE implementation to develop an action plan. Results will be presented as a score from 0 to 5 to help assess areas where the center needs to improve their sustainability (to be considered for action planning) and areas where they are already doing well (should be examined for enabling strategies). These scores will be analyzed by center, organizational, and community level factors and presented as a one-page summary. An average score of all SAGE ECCE will also be included in the summary. Directors will review the center’s scores and a tip sheet developed and approved by the CAB and scientific team to help with decisions about changes needed to improve the sustainability of SAGE at their ECCE. Each center will focus on one center, organizational, and community level goal. Goals will be written into the SAGE Action Plan document. Each SAGE will complete the enabling strategies document and the action plan activity. Emphasis will be placed on individualizing SAGE to fit each center’s needs, while still retaining the core principles of SAGE. ECCE directors from a previous study identified need IOT technical support in many areas, including creating and processing documents for accreditation and licensing organizations, updating of curriculum, parent engagement, and classroom delivery. Thus, the SAP will include ongoing technical support from the CAB and information about community resources such as teacher training. Copies of all documents will be kept by the research team and ECCE to monitor process toward goals.

A 10-minute teacher booster session will take place at all ECCE. These sessions take place before, during, or after school, based on teacher needs and preferences. These sessions will focus on building skills of the intervention and requested items identified in the Teacher Self-Assessment survey, facilitating the transition from implementation by the SAGE team to the ECCE teachers.

SAP Step 2: Review the progress of the current action plan, create a plan for long-term sustainability and re-assess the sustainability needs checklist, assess teacher implementation and program sustainability performance. Long-Term Action Planning will begin in SAP step 2. The research team will meet with the center director and implementation teams to review the results from the previous action plan and evaluate progress in achieving center, organizational, and community level goals. The team will discuss how the process went and what next steps will look like. As long-term goals were not completed, center directors will decide if they will continue working towards achieving the goal in the long-term action plan or if it should be discarded. Each center will complete the Long-Term Action Plan document. This guide focuses on planning in 6 categories of activities that can increase the likelihood of the program being sustained once initial funding has ceased. This document will be used to provide some organizational direction and personal accountability for SAGE. The resulting action plan will be used by both the ECCE and the SAGE team to monitor progress toward goals. Re-assessment of the Sustainability Needs Assessment, teacher self-assessment and program sustainability self-efficacy questionnaires will occur. Data from the Sustainability Needs Assessment will be compiled by the research team into a final one-page summary to be sent to the ECCE. Results from the Teachers Self-Assessment will be scored and analyzed to determine technical assistance that may be needed. The program sustainability and self-efficacy questionnaires will be reassessed in step 3, at the end of the school year, and at the start of the next school year. This will be completed by teachers and directors involved with SAGE at each ECCE as described above.

Disseminating SAGE to the larger community. The SAGE and scientific team will assemble a one-page brief of SAGE and SAP progress guided by the 4 RE-4RI categories. We will work with ECCE to develop narrative for our own case study description challenges and successes with SAGE and the SAP. Our CAB said these are influential in building momentum for broad-based community awareness and adoption. These will be disseminated on a public website, in partnership with the research team, to the partners for feedback, and to municipal policy makers in health and education. These will be disseminated on a public website. The one-page brief in SAP step 3 and after SAP implementation progress documents and materials were developed in Year 1 and are submitted as a modification for the approval.
Parent Engagement

We are engaging parents via parent-ECBC meetings, text messages, and newsletters. Teachers will be trained to describe upcoming activities to parents and test them about the study. We will provide technical support to answer questions that teachers or parents may have. Because 20% or Phoenix residents speak Spanish at home, we will present information in English and Spanish to parents to help increase understanding of the project goals and objectives and build support for their role in the study assessments and in promoting garden sustainability. We will contact parents in the SAGE intervention group using text messages. Culturally appropriate message language and timing has been generated via the CAR /NEW procedure (above) to notify parents about curriculum, suggest home strategies to increase PA and FV consumption, prompt them to complete scheduled assessments (described above) and disseminate summaries of SAGE research findings when appropriate. We have developed standardized text messages in English and Spanish to establish test practices, and will deliver them about twice a week using an automated computer program. Enthusiastic parents respond to messages with questions or comments requiring a response, we respond within one business day. Other newsletters, that emphasize culturally appropriate themes in English and Spanish, are distributed weekly at drop-off or pick-up. Newsletters are consistent with curriculum and test-message topics to keep parents engaged and knowledgeable about SAGE, offer easy ideas for culturally tailored home activities and recipes, and highlight community resources that promote PA and FV consumption. Text messages have been developed with the assistance of the CAS in Year 2 and are submitted as a modification for PI3 approval.

Child Safety Attendance Comparison

The attention comparison arm will participate in a child safety curriculum. The goal of this comparison group is to provide centers with an engaging, useful, clear-cut sequence, and easy-to-deliver curriculum so that information to this group does not influence attention or reach and serves as a placebo (unlikely to affect outcomes of interest). The curriculum will include concepts and lessons for educating young children on fire, pedestrian, water, household, neighborhood, and playground safety. The curriculum includes handouts, coloring sheets, games, and songs that can be implemented with minimal training and preparation. We will review with centers in this condition for one 10-min training session, with additional time for questions and technical support as needed. We will provide a check-in phone call with attention comparison centers per month to help keep engagement high. This arm will not participate actively in the SAGE.

Process of Delivery, Measurement, and Analysis ( Aim 3)

To determine the process of the delivery of the SAGE intervention ( Aim 3), we will combine quantitative and qualitative methods to define key characteristics of selection, reach, and implementation. We will gather information on the characteristics of the ECBC (e.g., age, service area) via the Environmental Assessment and interview teachers (e.g., gender, years of employment) agreeing to participate in the delivery of the intervention to compare with publicly available information via center websites and promotional materials (e.g., bullet points that outline the centers' mission and services to determine how representative they are of the population of centers, directors, and teachers. We will measure the ratio or the number of ECBC and staff who agree to participate compared with the number of staff who were invited to participate.

Reach (proportion of the target population) determines if the intervention attracts a large and generalizable sample from the intended audience of individuals. We will operationalize reach as the ratio of the number of children and parent participants compared with the number of interested parent-teacher meeting attendees and children at centers where parents do not consent or participate in meetings. We will compare the participants' demographic characteristics to those of the ECBC child population to further clarify the sample's representativeness.

Implementation. We will measure the degree to which the intervention is delivered as intended (dose and fidelity) and potential adaptations. We will measure dose as the proportion of content, context, and materials actually delivered and fidelity as the proportion of the content, context, and materials delivered compared with what was planned. We have adapted fidelity checklists to document these data. We will conduct exit interviews with ECBC directors, champions, and teachers after the study to investigate factors impacting each to participants, adoption by centers and teachers, and implementation. A semi-structured exit interview guide addressing implementation will be developed at the end of the first cohort in Year 2 and will be submitted as a modification for PI3 approval. Interview will be taped, transcribed, and analyzed in NVivo 8 & 9 (2009) using thematic content analysis. We will identify emergent themes using a constant comparison approach, allowing us to develop explanations through parents and allowing the cooler to frame the discussion, prior knowledge, or research to answer a research question.
SOCIAL BEHAVIORAL INSTRUCTIONS AND TEMPLATE

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DATE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRP-501a</td>
<td>3/4/2019</td>
<td>8 of 12</td>
</tr>
</tbody>
</table>

Sustainability Analysis (Organizational Level Maintenance; Aim 4)
The degree of sustainability helps to determine whether proposed project activities can be sustained and disseminated beyond the funding period. A Complexity Checklist that includes participant counts, contact, intervention components, and materials will be developed in Year 3 (not included with this application as we are only in Year 1; instead, this will be submitted as an R5 modification at that time) to determine the level of complexity. Data will be derived from meeting agendas and minutes, fidelity checklists, field notes, daily reports, and materials checklists.

Complexity Checklist components will then be weighted by number of times each item on the checklist occurs. Institutionalization indicates how likely it is that an intervention can be adopted into the existing physical, organizational, and community environment. We will define the potential for organizationalization based on SAP completion by comparing the number or needs identified by the Sustainability Needs Assessment (SNA) administered in SAP Step 1 with the number of needs identified by the same SNA throughout the four assessment points. Cost to deliver the intervention will be estimated in constant dollars using the Prospective Payment System Input Price index. We will examine (1) costs of identifying and recruiting participants, including CEC staff, (2) direct implementation labor costs, including participant time, (3) personnel, recruitment, and training costs, and (4) materials and supply costs (e.g., printed material, patient supplies). We will document what was done, who did it, how long it took to complete, and what nonhuman resources were required. Some will be taken to accuracy, and we will estimate costs from the institutionalization costs. We will create a cost-to-benefit spreadsheet and abstract/take note of the production of supplies, receipts of supplies, and times for training, delivery, and administration, and T&E costs will be factored per participant to determine a cost to deliver the intervention for each participant. Assuming a 10% cost reduction, the cost to deliver per 1,000 participants will also be computed.

We will maintain meeting minutes and field notes to document concerns about sustainability raised in the implementation and CAB sessions and with staff and teachers. As our sample of centers is too small to perform adequate statistical analysis, and different centers may identify different SAP costs, we will tabulate our field notes with level and extent of replicability and institutionalization to qualitatively examine the relationship between sustainability and chronic outcomes.

Partnership Development (Aim 3)
To evaluate the success of the Partnership and CAB, we will measure three indicators: (1) Participation, by quantifying the existing community/university linkages to ensure in new connections. We will also develop a method of understanding between the SBCC scientific team and at least 5 organizations in the community for implementing, evaluating, and disseminating SAGE. Minutes at all meetings will capture ideas presented from the community and determine fidelity to the ideas of the presenters (e.g., guidelines, strategies). (2) Representativeness, by collecting survey data to evaluate the number and demographic representativeness of the Partnership using prequestions designed for the Behavior Risk Factor Surveillance System that have shown good reliability and validity. (3) Collaboration, by using the Voller Collaboration Factor Inventory to measure the success of the collaboration along six dimensions: collaboration purpose, member characteristics, communication, processes/structure, environment, and resources.

<table>
<thead>
<tr>
<th>Project Timeline</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quartet</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>Project start up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Adoptable families</td>
<td>X  X  X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Identify, recruit CECs</td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NGO groups with CAB, parents</td>
<td>X  X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Train CEC staff</td>
<td></td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact: Transfer measures Cohort 1</td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Cohort 1</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Impact: Transfer measures Cohort 2</td>
<td></td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intervention Cohort 2</td>
<td></td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process assessments</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Action Plan 1</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Action Plan 2</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability Action Plan 3</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exit interviews with CEC staff</td>
<td></td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability assessments</td>
<td></td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analyses</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reports to collaborators and funders</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All investigator-P2P meetings</td>
<td></td>
<td>X  X  X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

186
Study Measures

Efficacy and individual-level maintenance impact and transfer assessments occurred at T1, T2, T3, and T4 for those starting in August 2017 and 2018. Assessments will take place at ECCC for children and at home for all ECCC for parents. Research team members will complete an ECCC data collection and record the data in electronic forms on study sites (e.g., RAs) coded by ID number only. To ensure A1, the short, and longest-term primary impact, and Aim 2, secondary impact, participants will complete assessments that measure PA, sedentary time, F&V consumption, and eating in the absence of hunger. Parents will complete questionnaires to assess demographics, parenting practices, home F&V availability, and food security at parent-teacher meetings, after consent, parents will receive information and instructions or completing measures (see below). Parents may return surveys to research team members that night (if completed) or during child drop-off/pickup at the center the next week in exchange for a mobile phone reminder (see below). All assessments will be prompted by text messages and be completed at the ECCC or in the home of an eligible child. Surveys may be returned via texting child drop-off/pickup or at any time convenient to parents. Surveys may also be completed over the phone.

Physical Activity (PA), Sedentary Time, Sleep, locomotor skills, F&V: Total minutes of light, moderate, vigorous PA, sedentary time, and sleep patterns will be measured by accelerometers. They are valid and reliable state-of-the-art devices that offer an objective measure of PA and sleep, and have been well received by the community. Parents and children will wear a small (paper-sized) accelerometer at their hip during all waking hours for 7 days to assess PA and sedentary time, removed only when underwater. The random subsample of children will wear an accelerometer around their non-dominant ankle during all nocturnal sleeping hours for 7 nights to assess sleep patterns. Parents will place the sleep accelerometer on their child's ankle at bedtime and remove it when the child has their final awakening in the morning. Parents will receive a log to record on time and a Frequently Asked Questions sheet. Additionally, children will participate in age-appropriate assessments of physical activity during the school day. Each child will be asked to demonstrate several locomotor skills (running, jumping, hopping, rolling, skipping, climbing, and throwing), as well as complete a fitness test. For the fitness test children will be asked to move back and forth between cones, at a standardized pace. Children will determine when they stop the fitness test as they become tired. We will collect street addresses and nearest cross streets to be used to calculate neighborhood walkability scores within 1.5 mile buffer for all consenting participants in the 5000 program.

Fruit & Vegetable (F&V) Consumption

Child F&V consumption within the ECCC will be measured by direct observation using a standardized checklist. Research assistants at the ECCC will observe the child's consumption at meal and snack times, which will minimize burden on ECCC staff and account for foods not consumed in the presence of the parent. Inconsistencies in the meal or snack will be assessed on a random day at least once at each site. The child's F&V consumption outside the ECCC will be measured with a brief, seven-day, fruit and vegetable screener completed by parents. The Nutrition Data System for Research (NDSR) will be used to assess all measures of F&V consumption. All consumption data will be entered into NDSR and analyzed to provide a full assessment of consumption for a given day.

Eating in the Absence of Hunger

Assessments of the epiphenomena, outcome of child eating in the absence of hunger will occur in the classroom at the ECCC. The eating in the absence of hunger test, a validated and age-appropriate assessment, was modified for use in community settings in the 5000 pilot. In the current adapted field protocol, we assess children immediately after lunch and ask them if they are hungry. If they are hungry, we then provide them with food and/or drink. We ask them if they are still hungry, and if so, we offer more food and/or drink. After 15 minutes, children go to the next activity. After 15 minutes, we will weigh the snack in grams to determine how much they ate.

Parenting Practices

Parenting practices and home environment. The Parenting Practices (PPAC) measures parenting practices that encourage or discourage children to be physically active. Recalled and questions were asked to assess the validity (0.65–0.83) was moderate to excellent. The Parenting Practices (PPAC) measures five categories of PA (e.g., mealtime activities, practical activities, physical activity, discipline, restrictions of junk foods), and enhanced availability and accessibility. Internal consistencies of items varied 0.4–0.65. The PA Home Availability questionnaires are self-report questionnaires that measures PA at home and shows internal consistency coefficients among parents of preschoolers and validity with home inventory checks with parents of 4th and 6th graders. Parents will also be asked to complete a survey assessing food security in the home.

Physical Activity Resource Assessment Tool (PARR)

The PARR instrument provides an objective assessment of physical activity resources (PAR). This tool assesses the types, features, amenities, and quality of PA such as parks, churches, schools, sports facilities, fitness centers, community centers, and trails. The PARR will be used to develop PA within neighborhoods, and the potential influence those differences may have on PA. Features (basketball courts, playgrounds, soccer fields) and amenities (tennis courts, lighting, sidewalks) of PARR are used and rated as most present, "poor," "not present," "not available." Physical activity resources (PAR) will be rated as "poor" present, "not present," "not available." Each neighborhood will be assigned a Quality of Physical Activity Resources (QPAR) index score. The QPAR score equals the sum of the features and amenities ratings.
### Walkability Indices

Walkability indices will be obtained for each census block group based on participants’ home address, which have already calculated.

**CardioChek Plus**

Finger stick blood samples will be collected after 10 hours of fasting using the CardioChek Plus (BioMeer Technology Systems Inc., Indianapolis, Indiana). Capillary glucose, HDL, and triglycerides will be measured, which are less invasive than venous blood draws and meet industry standards for accuracy. These finger-stick capillary blood samples will be obtained from a participant’s index finger. This will only be completed by cohort 2 by 110 inches during ’11. Participants will be instructed to begin fasting ten hours prior to their scheduled appointment. During the appointment for the finger stick, participants will be asked their preferred hand for the finger stick of the index finger. After the finger stick, a dressing will be applied to the site.

### Active Transportation Log

Participants will be asked to complete a log for seven days to document date, time, the type of active transportation, what the destination was, time spent in active transportation, and distance of the trip.

### Compensation or Credit

- Describe the amount and timing of any compensation or credit to participants.
- Identify the source of the funds to compensate participants.
- Justify that the amount given to participants is reasonable.
- If participants are receiving course credit for participating in research, alternative assignments need to be put in place to avoid coercion.

For their time and contributions, and if not in violation of agency regulations, CAS members will be paid a modest honorarium of $100 annually, and the chair, $50.

Parents that complete and return surveys receive a modest compensation at each data collection time point: $30 at T1, $50 at T2, $75 at T3, and $100 at T4 for parents starting in the RHA2 intervention study in August 2017 and 2018. Parents who agree to have their child wear the sleep monitor for 7 days, will receive $10 extra at T1 and T2. Parents who agree to have their child wear the sleep monitor for 7 days, will receive $15 extra at T1 and T2.

For the 100 mothers who complete the active transportation log and provide finger stick blood samples for the dissertation project, participants will be paid $100.

### Risk to Participants

List the reasonably foreseeable risks, discomforts, or inconveniences related to participants in the research. Consider physical, psychological, social, legal, and economic risks.
### Social Behavioral Instructions and Template

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DATE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRP-503a</td>
<td>3/1/2013</td>
<td>15 of 12</td>
</tr>
</tbody>
</table>

There are minimal risks in this study. Averse events associated with surveys are minimal. Participants may experience boredom or fatigue. All children will be supervised at all times by project staff and trained centers staff members. All children will be supervised during physical activity to prevent accidents, on manage adverse events if they should occur. All participants in the gardening intervention will be advised to wear hats, sunscreen and sunglasses while they are participating. As well, all participants will be provided drinking water to stay hydrated while outside on warm days. MECs maintain a list of children and any food (or other allergies). We will not use any nuts, fish, tree nuts or others in the absence of allergies that are on the allergy list. There were no adverse events in any children in either of the two pilot studies conducted in Phoenix (June-July 2013) or in Phoenix (February-March 2014). In the event of any emergencies, we will follow established center emergency plans. All research team staff who work at centers are trained in child CPR and center emergency plans. All research team staff who work at centers will be outfitted with a cellular telephone and instructions to call 911 immediately in any child emergency.

Research Electronic Data Capture (REDCap) databases will be developed to securely receive and store data from iPads at the ASU site. REDCap is an open-source, web-based software solution that allows the creation of secure online data forms for collection, management and analysis. Electronic data collection has advantages over paper data collection as it minimizes the steps from collection to analysis, has been shown to be more cost-effective, can improve research compliance, and is generally easier to use. Research staff will sign check off documents to receive project iPads and data agreements to provide to keep iPads and their data security stored at all times between downloads. Data from iPads will be downloaded remotely on a regular basis, or more frequently if activity is heavy, stored on our secure data capture system and stored on a microcomputer. Data will be stored on a microcomputer database management system and paper data will be secured in secure file cabinets. Adverse events will be monitored, and a case safety and monitoring team will be established. Confidentiality will be maintained throughout the study, and records will be stored by identification number only. Three levels of security are provided to prevent unauthorized persons from accessing the data: password protection, computer or file cabinet locks, and a locked office. Participants who provide finger stick blood samples may experience discomfort during the finger stick procedure, and possible bruising to the site afterward.

### 10 Potential Benefits to Participants

Realistically describe the potential benefits that individual participants may experience from taking part in the research. Include if there is no direct benefit. Do not include benefits to society or others.

Increasing physical activity and improving dietary habits is associated with numerous health benefits including long-term health outcomes such as reducing the risk of cardiovascular disease, diabetes, breast and colon cancers directly and other cancers indirectly and short-term outcomes such as improvements in mood, stress and coping. Participants and families may experience increased knowledge that may contribute to improved eating habits, increased physical activity and improved food security. Community-based programs that facilitate partnerships with researchers also increase social capital of the community and enhance long-term sustainability of the program. In addition, increases in social capital may benefit participants in other ways (e.g., enhanced municipal resources, etc.). However, we will not document these outcomes because it is beyond the scope of this proposal.

### 11 Privacy and Confidentiality

Describe the steps that will be taken to protect subjects' privacy interests. Privacy interest refers to a person's desire to place limits on whom they interact with and whom they provide personal information. Click here for additional guidance on [ASU Data Storage Guidelines](#).

Describe the following measures to ensure the confidentiality of data:

- **Who will have access to the data?**
- **Where and how data will be stored (e.g., ASU secure server, ASU cloud storage, filing cabinets, etc.)?**
- **How long the data will be stored?**
- **Describe the steps that will be taken to secure the data during storage, use, and transmission (e.g., limiting, authorization of access, password protection, encryption, physical controls, certificates of confidentiality, and separation of identifiers and data, etc.)?**
- **If applicable, how will audio or video recordings will be managed and secured.**
- **Define the duration of time these recordings will be kept.**
- **If applicable, how will the consent, assent, and/or parental permission forms be secured.**
- **Describe how these forms separate from the rest of the study data.**
- **Define the duration of time these forms will be kept.**
- **If applicable, describe how data will be linked or unlinked (e.g., master lists, contact lists, reproductive participant ID, randomized ID, etc.).**

If your study has previously collected data sets, describe who will be responsible for data security and monitoring.

189
**Social Behavioral Instructions and Template**

<table>
<thead>
<tr>
<th>NUMBER</th>
<th>DATE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPP-0638</td>
<td>3/4/2019</td>
<td>12 of 12</td>
</tr>
</tbody>
</table>

Confidentiality will be maintained throughout the study, and records will be stored by identification number only. Three levels of security are provided to prevent unauthorized persons from accessing the data: password protection, computer or cabinet lock, and a locked office. As a randomized controlled trial, we will establish a data and safety monitoring board (DSMB) comprised of the principal investigator (Dr. Lee), the Co-Investigators (Dr. Shafi, Bruning, Todd, and Lisa Sellers), consultant (Dr. O'Connor), and sub-board investigators (Dr. Estabrooks and Hill). The DSMB will meet quarterly via teleconference. The proposed study is not a Phase III clinical trial; however, should an external DSMB become necessary, three suitably qualified individuals with appropriate knowledge and experience will be sought to participate in an external board that will meet according to Arizona State University’s published guidelines. Study data and safety progress will be reviewed weekly by the PI and protocol director. Minutes of these meetings will be recorded and filed as a document record of meetings. Any potential data or adverse events that arise will be documented using established Arizona State University forms and protocols, and reported to the Institutional Review Board. Should participants suffer unusual consequences from the project, they will be immediately advised to stop and referred to a health care professional. As described earlier, data will be kept confidential using the three levels of security method, and data will be identified by identification number only. Participants will be instructed to contact a health care professional in the event that they suffer any health problems.

**Consent Process**

Describe the process and procedures you will use to obtain consent. Include a description of:

- Who will be responsible for consenting participants?
- Where will the consent process take place?
- How will consent be obtained?
- If participants who do not speak English will be enrolled, describe the process to ensure that the oral and/or written information provided to those participants will be in that language. Indicate the language that will be used by those obtaining consent.

Translated consent forms should be submitted after the English is approved.

Parents will be invited to attend a center parents’ night meeting where they will receive information about the study and will be invited to participate. Parents will receive consent documents, research team members will be present to explain and answer questions regarding the consent form. Verbal consent will be obtained from the parents to remind them about data collection via text message and/or telephone. Mothers presenting for data collection who agree to allow the research team to contact them regarding other studies will receive information about cantaloupe disease and be asked to participate in the dissemination project. Research team members will be present to thoroughly explain the consent form and answer any questions they may have. Signed consent forms will be submitted and approved by Arizona State University’s Institutional Review Board.

Consent will be obtained from EDCO directors, champions, directors, and teachers prior to participating in interviews. Research team members will be present to explain and answer questions regarding the consent form.

**Training**

Provide the date(s) the members of the research team have completed the CITI training for human participants. This training must be taken within the last 4 years. Additional information can be found at [Training](#).

Rebecca Lee-2/27/2020
Gabriel Shah-2/19/2020
Heradoc Brantley-5/18/2020
Michael Todd-3/4/2020
T therapist-1/9/2013
Tania Marigold-1/20/2020
Jenni Hill-10/26/2014
Paul Estabrooks-10/26/2014
Annel Ambros-4/1/2021
Elizabeth Lanzano-07/18/14
Jaslin Dzuncuszak-01/16/19
Hagan Pepper-01/13/2021
Amy Hutchens-7/30/2019
Parent ID #_________ Parent and Child Demographic Survey Child ID #_________

Instructions: Thank you for completing our parent survey! These first few questions are ABOUT YOU, and we will ask you more about your child later.

1. During the past 30 days, which statement best describes the kinds of physical activity that you usually did? Do not include the time you spent working at a paid job. Read all six statements before selecting ONE.

   [ ] 1. I did not do much physical activity. I mostly did things like watching television, reading, playing cards, or playing computer games. Only occasionally, no more than once or twice a month, did I do anything more active such as going for a walk or playing tennis.

   [ ] 2. Once or twice a week, I did light activities such as getting outdoors on the weekends for an easy walk or stroll. Or once or twice a week, I did chores around the house such as sweeping floors or vacuuming.

   [ ] 3. About three times a week, I did moderate activities such as brisk walking, swimming, or riding a bike for about 20-30 minutes each time. Or about once a week, I did moderately difficult chores such as raking or mowing the lawn for about 45-60 minutes. Or about once a week, I played sports such as softball, basketball, or soccer for about 45-60 minutes.

   [ ] 4. Almost daily, that is five or more times a week, I did moderate activities such as brisk walking, swimming, or riding a bike for 30 minutes or more each time. Or about once a week, I did moderately difficult chores or played sports for 2 hours or more.

   [ ] 5. About three times a week, I did vigorous activities such as running or riding hard on a bike for 30 minutes or more each time.

   [ ] 6. Almost daily, that is five or more times a week, I did vigorous activities such as running or riding hard on a bike for 30 minutes or more each time.

2. During the last 7 days, on how many days did you bicycle for at least 10 minutes at a time to go from place to place?

   ___________ days per week

3. How much time did you usually spend on one of those days to bicycle from place to place?

   ___________ hours and ___________ minutes per day

4. During the last 7 days, on how many days did you walk for at least 10 minutes at a time to go from place to place?

   ___________ days per week

5. How much time did you usually spend on one of those days walking from place to place?

   ___________ hours and ___________ minutes per day
These next few questions are about food and physical activity at home.

6. How often are there fresh or frozen fruits available in your home?
   - [ ] Very Often
   - [ ] Somewhat Often
   - [ ] Not very Often
   - [ ] Never

7. How often are there fresh or frozen vegetables available in your home?
   - [ ] Very Often
   - [ ] Somewhat Often
   - [ ] Not very Often
   - [ ] Never

8. During an average week, how often do you or someone else in your family cook food at home for the evening meal? By “cook food,” we mean preparing a meal from basic ingredients. We do not mean warming up pre-cooked food.
   - [ ] Never or Almost Never
   - [ ] 1 to 2 days a week
   - [ ] 3 to 4 days a week
   - [ ] 5 to 6 days a week
   - [ ] Every day

9. During the school week, how many days do you (mom/dad) eat breakfast?
   - [ ] 0
   - [ ] 1
   - [ ] 2
   - [ ] 3
   - [ ] 4
   - [ ] 5

10. Please indicate which items you have in your home, yard, or apartment complex. (Check all that apply)
    - [ ] Bicycle, tricycle, or scooter
    - [ ] Basketball hoop
    - [ ] Jump rope
    - [ ] Sports equipment
    - [ ] Swimming pool
    - [ ] Roller skates
    - [ ] Fixed play equipment
    - [ ] Home aerobic equipment
    - [ ] Weight lifting equipment
    - [ ] Water or snow equipment
    - [ ] Yoga/exercise mats
    - [ ] Exercise/play/recreation room
    - [ ] Trampoline
    - [ ] Stairs
These next few questions ask about the neighborhood where you live.

11. What is the ZIP Code where you live? __________

12. Please choose the answer that best applies to you and your neighborhood.

<table>
<thead>
<tr>
<th>Places for Walking or Cycling</th>
<th>Strongly Disagree</th>
<th>Somewhat Disagree</th>
<th>Somewhat Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) There are sidewalks on most of the streets in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b) Sidewalks are separated from the road/traffic in my neighborhood by parked cars.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c) There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d) My neighborhood streets are well lit at night.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e) Walkers and bikers on the streets in my neighborhood can be easily seen by people in their homes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f) There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Traffic Hazards</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h) The speed of traffic on most nearby streets is usually slow (30 mph or less).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i) Most drivers exceed the posted speed limits while driving in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Crime</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>j) There is a high crime rate in my neighborhood.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k) The crime rate in my neighborhood makes it unsafe to go on walks during the day.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l) The crime rate in my neighborhood makes it unsafe to go on walks at night.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

You are doing great—already 20% completed!
These next few questions ask about your experiences with your child when your child is not at preschool.

13. Please choose the best answer for how often you complete each of the following physical activity practices with your 3-5 year old child.

<table>
<thead>
<tr>
<th>How often do you...</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>always</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Take your child to sport practice or game in which he/she is enrolled?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b) Set an example for your child by exercising in front of him/her?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c) Play active games with your child (such as playing ball or racing)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d) NOT let your child play actively for fear of him/her getting dirty?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e) Take your child to the park?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f) Tell your child he/she is not good enough at sports or active games?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>g) Go on a walk with your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>h) Allow your child to watch TV for long periods of time?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>i) Find age appropriate games that get your child moving?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>j) Say positive things to motivate your child to be more active?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>k) Carry your child because he/she does not want to walk?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>l) Teach your child new and different ways to be active?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>m) Play a sport or active game together as a family?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>n) Give your child choices of what physical activities to do?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>o) Set aside time for active play?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>p) Drive your child, when it was easy to walk?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>q) Allow your child to pick an active game to do together?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>r) Allow your child to play a lot of videogames?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>s) Dance with your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>t) Tell your child he/she will get hurt if he/she plays actively?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
### How often do you...

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>always</th>
</tr>
</thead>
<tbody>
<tr>
<td>u) Play sports games with your child (such as soccer or baseball)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>v) Discipline your child for being too active?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>w) NOT register your child for sports or dance due to lack of money?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>x) NOT let your child play outside because you are worried about traffic?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>y) Push your child in a stroller instead of letting him/her walk?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>t) Let your child go outside to play around your home?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>aa) Teach your child that being active is good for his/her health?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>bb) Reward your child for being still?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>cc) Have outdoor toys available for your child?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>dd) NOT let your child play outside because you are worried about crime?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ee) NOT let your child play outside because you are worried about strangers?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ff) Keep your child occupied by letting him/her watch TV?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

14. Please choose the best answer for how often you do each of the following fruit and vegetable practices with your 3-5 year old child.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>always</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Place fruit and vegetables where your child can easily reach them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b) Encourage your child to try a couple of bites of the fruit or vegetable.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c) Make eating fruit and vegetables fun, like cutting into shapes.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d) Ask your child to select fruit and vegetables at the grocery store.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e) Beg your child to eat fruit and vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f) Tell your child to eat fruit or vegetables, but not eat any yourself.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>How often do you...</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>always</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>g) Make fruit and vegetables easy to eat, such as cutting, cleaning, or peeling them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>h) Tell your child eating fruit or vegetables will make him/her strong and healthy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>i) Offer fruit or vegetables without forcing your child to eat them.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>j) Tell your child that his/her favorite cartoon characters eat fruit and vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>k) Tell your child how much effort it took to make the fruit or vegetable dish.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>l) Serve several fruit or vegetables and let your child decide which he/she would eat.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>m) Reward your child with sweets if he/she eats his/her fruit and vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>n) Praise your child when you see him/her eat fruit or vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>o) Ask your child to help with fruit or vegetable preparation.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>p) Promise your child something other than food if he/she finishes his/her fruit and vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>q) Buy fruit and vegetables instead of cookies, chips, and candy.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>r) Keep your child from having sweets if he/she doesn't finish his/her vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>s) Include some form of fruit and vegetables in most meals.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>t) Physically struggle with your child to get him/her to eat fruit or vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>u) Yell at your child for not eating his/her fruit or vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>v) Ask your child to choose the fruit and vegetables for meals and snacks.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>w) Allow your child to serve himself/herself fruit or vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>x) Show your child that you enjoy eating fruit and vegetables.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>How often do you...</td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>always</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------</td>
<td>--------</td>
<td>-----------</td>
<td>-------</td>
<td>--------</td>
</tr>
<tr>
<td>y)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>z)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>aa)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>bb)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>cc)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>dd)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ee)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

15. These next questions are about the food eaten in your household in the last 12 months, and whether you were able to afford the food that you need. For these statements, please tell me whether the statement was often true, sometimes true, or never true for your household.

a) The first statement is, “The food that (I/we) bought just didn’t last, and (I/we) didn’t have money to get more.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- [ ] 1 Often true
- [ ] 2 Sometimes true
- [ ] 3 Never true

b) “(I/we) couldn’t afford to eat balanced meals.” Was that often, sometimes, or never true for (you/your household) in the last 12 months?

- [ ] 1 Often true
- [ ] 2 Sometimes true
- [ ] 3 Never true

c) In the last 12 months, since last (name of current month), did (you/you or other adults in your household) ever cut the size of your meals or skip meals because there wasn’t enough money for food?

- [ ] 1 Yes
- [ ] 0 No (skip to question e)

d) [IF YES ABOVE] How often did this happen—almost every month, some months but not every month, or in only 1 or 2 months?

- [ ] 1 Almost every month
- [ ] 2 Some months but not every month
- [ ] 3 Only 1 or 2 months
e) In the last 12 months, did you ever eat less than you felt you should because there wasn’t enough money for food?

[ ] 1 Yes
[ ] 0 No

f) In the last 12 months, were you ever hungry but didn’t eat because there wasn’t enough money for food?

[ ] 1 Yes
[ ] 0 No

Your survey is now over 50% completed! Keep up the good work!

These next questions are about your child that is participating in the SAGE program.

16. In what country was your child born?

[ ] 1 United States
[ ] 2 Mexico
[ ] 3 Other (Please describe: ____________________________)

17. How would you describe your child’s weight?

[ ] Severely underweight
[ ] Underweight
[ ] Normal weight
[ ] Overweight
[ ] Severely Overweight

18. During the school week, how many days does your child eat breakfast at home?

[ ] 0
[ ] 1
[ ] 2
[ ] 3
[ ] 4
[ ] 5

19. During the school week, how many days does your child eat breakfast on the way to school?

[ ] 0
[ ] 1
[ ] 2
[ ] 3
[ ] 4
[ ] 5
[ ] 999 I prefer not to answer
20. How many days per week does your child eat breakfast at school?

[ ] 0
[ ] 1
[ ] 2
[ ] 3
[ ] 4
[ ] 5

The following questions are about your child’s sleep habits and possible difficulties with sleep. Think about the past week in your child’s life when answering the questions. If last week was unusual for a specific reason (such as your child had an ear infection and did not sleep well or the TV set was broken) choose the most recent typical week.

21. Write in child’s bedtime: ____________
22. Write in child’s usual wake time: ____________
23. Child’s usual amount of sleep each night (no naps): ________ hours and ________ minutes
24. Child’s usual amount of sleep each day (naps): ________ hours and ________ minutes

For these next questions...

- Answer USUALLY if something occurs 5 or more times in a week.
- Answer SOMETIMES if it occurs 2-4 times in a week.
- Answer RARELY if something occurs never or 1 time during a week.

25.

<table>
<thead>
<tr>
<th></th>
<th>Usually (5-7)</th>
<th>Sometimes (2-4)</th>
<th>Rarely (0-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Child wakes up by him/herself</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Child wakes up in a negative mood</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>c) Adults or siblings wake up my child</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>d) Child has difficulty getting out of bed in the morning</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>e) Child takes a long time to become alert in the morning</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f) Child seems tired in the morning</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>g) Child snores loudly</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>h) Child seems to stop breathing during sleep</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>i) Child snores and/or gasps during sleep</td>
<td>1  2  3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
26. Child has appeared very sleepy or fallen asleep during the following (check all that apply):

<table>
<thead>
<tr>
<th>0 Not Sleepy</th>
<th>1 Very Sleepy</th>
<th>2 Falls Asleep</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Watching TV</td>
<td>□</td>
<td>□</td>
</tr>
<tr>
<td>b) Riding in a car</td>
<td>□</td>
<td>□</td>
</tr>
</tbody>
</table>

You have completed 75% of the survey! Almost finished!

These next few questions ask you to describe yourself and your family.

27. What language do you speak?
[ ] 1 Only Spanish
[ ] 2 Spanish better than English
[ ] 3 Both English and Spanish equally well
[ ] 4 English better than Spanish
[ ] 5 Only English
[ ] 6 Asian language (Please describe: ______________________)
[ ] 7 Some other language (Please describe: ______________________)

28. What language do you read?
[ ] 1 Only Spanish
[ ] 2 Spanish better than English
[ ] 3 Both English and Spanish equally well
[ ] 4 English better than Spanish
[ ] 5 Only English
[ ] 6 Asian language (Please describe: ______________________)
[ ] 7 Some other language (Please describe: ______________________)

29. Where did you live from childhood to 21 years of age?
[ ] 1 Only in Latin America (Mexico, Central America, South America) or the Caribbean (Cuba, Puerto Rico, etc.)
[ ] 2 Mostly in Latin America or the Caribbean
[ ] 3 Equally in Latin America/the Caribbean & in the United States
[ ] 4 Mainly in the United States and some time in Latin America/the Caribbean
[ ] 5 Only in the United States

30. How would you describe your current circle of friends?
[ ] 1 Almost exclusively Hispanics/Latinos (Chicanos/Mexican Americans, Puerto Ricans, Cubans, Colombians, Dominicans, etc.)
[ ] 2 Mainly Hispanics/Latinos
[ ] 3 Equally Hispanics/Latinos and Americans from the United States
[ ] 4 Mainly Americans from the United States
[ ] 5 Almost exclusively Americans from the United States
31. How would you say you feel in relation to having a Latino/Background? (if applicable)

[ ] 1 Very Proud
[ ] 2 Proud
[ ] 3 Somewhat Proud
[ ] 4 Little Proud
[ ] 5 No pride
[ ] **Not applicable**

32. What is your marital status?

[ ] 1 Married
[ ] 2 Living with someone like we were married, but not legally married
[ ] 3 Separated, divorced, or widowed
[ ] 4 Single (never married)

33. What is the highest grade or year of school that you've completed?

[ ] 1 I never went to school
[ ] 2 8th grade or less
[ ] 3 Some high school, but I did not graduate
[ ] 4 High school (or I got a GED)
[ ] 5 Some college or community college, but I did not graduate from a four-year college
[ ] 6 Trade or Vocational School
[ ] 7 College Graduate (2 year degree)
[ ] 8 College graduate (from a four-year college or university) or more

34. Did a doctor, nurse or other health care worker ever tell you that you had any of the following health problems and/or do you take medication for these health problems?

<table>
<thead>
<tr>
<th>Health Problem</th>
<th>No</th>
<th>No, but I take medication</th>
<th>Yes, but I don't take medication</th>
<th>Yes, and I do take medication</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Diabetes (high blood sugar), not during pregnancy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. Hypertension (high blood pressure), not during pregnancy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. High cholesterol</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

35. Are you currently working?

[ ] 1 Employed for wages
[ ] 2 Self-employed
[ ] 3 Out of work for 1 year or more
[ ] 4 Out of work for less than 1 year
[ ] 5 A Homemaker
[ ] 6 A Student
[ ] 7 Retired

*Page 11 of 12*
36. What was your total family income last year before taxes? Please mark one box below that includes your total family income, including your income and the income of your husband or partner (if living with you last year) and your children. (Please include income from all sources, including jobs, welfare, Disability, Unemployment, child support, interest, dividends, and support from family members.)

- $0 to $16,000
- $16,001 to $20,000
- $20,001 to $24,000
- $24,001 to $28,000
- $28,001 to $31,000
- $31,001 to $36,000
- $36,001 to $39,000
- $39,001 to $47,000
- $47,001 to $55,000
- $55,001 to $59,000
- $59,001 to $63,000
- $63,001 to $71,000
- $71,001 to $78,000
- $78,001 to $83,000
- $83,001 to $94,000
- $94,001 to $107,000
- $107,001 to $110,000
- $110,001 to $126,000
- $126,001 to $142,000
- $142,001 or more

37. How many adults, including yourself, live in your house?

____________________

38. How many children live in your house?

____________________

39. When was your most recent baby born?

________  ________  ________
month  date  year

Thank you for completing the survey!
APPENDIX F

SUSTAINABILITY VIA ACTIVE GARDEN EDUCATION PARENT SURVEY (SPANISH)
Parent ID #__________  Encuesta demográfica de padres e hijos  Child ID #__________

Instrucciones: ¡Gracias por completar nuestra encuesta de padres!
Estas primeras preguntas son SOBRE USTED, y le preguntaremos más sobre su hijo más tarde.

1. Cuál de las siguientes afirmaciones describe mejor los tipos de actividad física que usted realizó habitualmente durante los últimos 30 días? No incluya el tiempo que usted ocupa en un trabajo pago.

Lea las seis declaraciones antes de seleccionar UNA de ellas.

[ ] No realicé muchas actividades físicas. Durante la mayor parte del tiempo, hice cosas como mirar la televisión, leer, jugar a las cartas, o jugar juegos de computadora. Sólo de vez en cuando, no más de una o dos veces al mes, hice cosas más activas, como, por ejemplo, caminar o jugar al tenis.

[ ] Una o dos veces por semana, realicé actividades livianas, como, por ejemplo, salir a dar una caminata corta al aire libre durante los fines de semana. O bien, una o dos veces por semana, me ocupé de quehaceres domésticos, como, por ejemplo, barrer pisos o pasar la aspiradora.

[ ] Alrededor de tres veces por semana, realicé actividades moderadas, como, por ejemplo, dar caminatas rápidas, nadar o montar en bicicleta durante 15 a 20 minutos cada vez. O bien, como una vez a la semana, me ocupé de quehaceres moderadamente difíciles, como, por ejemplo, rastrillar o cortar el césped durante 45 a 60 minutos. O bien, como una vez a la semana, practiqué deportes, como, por ejemplo, softball, baloncesto o fútbol, durante más o menos 45 a 60 minutos.

[ ] Casi todos los días, o sea, cinco veces por semana o más, realicé actividades moderadas, como, por ejemplo, dar caminatas rápidas, nadar o montar en bicicleta durante 30 minutos o más cada vez. O bien, como una vez por semana, realicé quehaceres moderadamente difíciles o practiqué deportes durante 2 horas o más.

[ ] Alrededor de tres veces por semana, realicé actividades vigorosas, como, por ejemplo, correr o hacer un recorrido rápido en bicicleta por 30 minutos o más cada vez.

[ ] Casi todos los días, o sea, cinco veces por semana o más, realicé actividades vigorosas, como, por ejemplo, correr o hacer un recorrido rápido en bicicleta por 30 minutos o más cada vez.

2. Durante los últimos 7 días, ¿Cuántos días montó usted en bicicleta por al menos 10 minutos continuos para ir de un lugar a otro?

_____________________________________________ días por semana

3. Usualmente, ¿Cuánto tiempo gastó usted en uno de esos días montando en bicicleta de un lugar a otro?

_______________________________________ horas y _____________ minutos por día

4. Durante los últimos 7 días, ¿Cuántos días caminó usted por lo menos 10 minutos continuos en su tiempo libre?

_________________________________________ días por semana

5. Usualmente, ¿Cuánto tiempo gastó usted en uno de esos días caminando de un lugar a otro?

_______________________________________ horas y _____________ minutos por día
Las siguientes preguntas son acerca de comida y actividad física en el hogar.

6. ¿Con qué frecuencia hay frutas frescas o congeladas disponibles en su casa?
   - [ ] 1 Con mucha frecuencia
   - [ ] 2 Con alguna frecuencia
   - [ ] 3 Con poca frecuencia
   - [ ] 4 Nunca

7. ¿Con qué frecuencia hay verduras frescas o congeladas disponibles en su casa? No incluya papas
   - [ ] 1 Con mucha frecuencia
   - [ ] 2 Con alguna frecuencia
   - [ ] 3 Con poca frecuencia
   - [ ] 4 Nunca

8. Durante una semana típica, ¿con qué frecuencia cocina usted u otro miembro de su familia alimentos en su casa para la cena? Cuando decimos "cocina alimentos", queremos decir preparar una comida desde los ingredientes básicos. No queremos decir calentar alimentos ya preparados.
   - [ ] 1 Nunca o casi nunca
   - [ ] 2 1 a 2 días por semana
   - [ ] 3 3 a 4 días por semana
   - [ ] 4 5 a 6 días por semana
   - [ ] 5 Todos los días

9. ¿Durante los días de escuela, cuántos días desayuna usted (mamá/papá)?
   - [ ] 0
   - [ ] 1
   - [ ] 2
   - [ ] 3
   - [ ] 4
   - [ ] 5

10. Por favor indique cuales artículos tiene en su hogar, patio/jardín, o edificio de departamentos. (Marque todos los que apliquen)
   - [ ] Bicicleta, triciclo, o scooter
   - [ ] Aro de baloncesto
   - [ ] Cuerda para saltar
   - [ ] Equipo de deporte
   - [ ] Alberca
   - [ ] Patines
   - [ ] Juegos de recreo fijos
   - [ ] Aparatos aeróbicos para la casa
   - [ ] Equipo para levantamiento de pesas
   - [ ] Equipo para estar en el agua o en la nieve
   - [ ] Colchonetas/almohadas de gimnasia
   - [ ] Cuarto de ejercicio/juegos/recreación
   - [ ] Trampolín
   - [ ] Escaleras

Pagina 2 de 13
Las siguientes preguntas son acerca del vecindario donde vive.

11. ¿Cuál es el código postal donde vive? __________

12. Por favor escoja la respuesta que mejor se aplique a usted y a su vecindario.

<table>
<thead>
<tr>
<th>Peligros de tráfico</th>
<th>Totalmente en desacuerdo</th>
<th>Algo en desacuerdo</th>
<th>Algo de acuerdo</th>
<th>Totalmente de acuerdo</th>
</tr>
</thead>
<tbody>
<tr>
<td>a)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>d)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>e)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>f)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>g)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>h)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>i)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>j)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>k)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>l)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

¡Ya muy bien – ya lleva 20% completo!
Las siguientes preguntas son acerca de sus experiencias con su hijo(a) cuando no está en la escuela.

13. ¿Con qué frecuencia usted hace cada uno de lo siguiente con su niño(a) de 3-5 años de edad? Por favor escoja la mejor respuesta.

<table>
<thead>
<tr>
<th>Con que frecuencia usted...</th>
<th>Nunca</th>
<th>Raramente</th>
<th>A veces</th>
<th>Frequentemente</th>
<th>Siempre</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) ¿Inscribe a su niño(a) en los deportes?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b) ¿Pone el ejemplo haciendo ejercicios en frente de su niño(a)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c) ¿Juega activamente con su niño(a) (ej. jugando pelota, bailando, etc.)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d) ¿No permite que su niño(a) juegue activamente por miedo a que él/ella se ensucie?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e) ¿Lleva a su niño(a) al parque?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f) ¿Le dice a su niño(a) que él/ella no es suficientemente bueno en los deportes o juegos activos?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>g) ¿Sale a caminar con su niño(a)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>h) ¿Permite que su niño(a) mire la TV por largos periodos de tiempo?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>i) ¿Encuentra juegos que hacen que su niño(a) esté en movimiento y que son apropiados para su edad?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>j) ¿Dice cosas positivas para motivar a su niño(a) a ser más activo?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>k) ¿Toma a su niño(a) en brazos porque él/ella no quiere caminar?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>l) ¿Enseña a su niño(a) nuevas y diferentes maneras de ser activo?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>m) ¿Juega un deporte o juego activo juntos en familia?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>n) ¿Le da a su niño(a) opciones sobre las actividades físicas que pueda hacer?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Con que frecuencia usted...</td>
<td>Nunca</td>
<td>Raramente</td>
<td>A veces</td>
<td>Frecuentemente</td>
<td>Siempre</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>o) ¿Programa tiempo para el juego activo?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>p) ¿Lleva a su niño(a) en el auto cuando caminar era fácil?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>q) ¿Permite que su niño(a) escoja un juego activo para hacerlo juntos?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>r) ¿Permite que su niño(a) juegue muchos juegos de video?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>s) ¿Baña con su niño(a)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>t) ¿Le dice a su niño(a)(a) que él/ella se puede lastimar si juega activamente?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>u) ¿Juega deportes con su niño(a) (ej. futbol, béisbol, etc.)?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>v) ¿Castiga a su niño(a) por ser muy activo?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>w) ¿NO matricula a su niño(a) en deportes o baile por falta de dinero?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>x) ¿NO deja que su niño(a) juegue afuera porque usted está preocupado con el tráfico?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>y) ¿Empuja a su niño(a) en el coche en vez de dejarlo caminar?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>z) ¿Deja que su niño(a) salga a jugar alrededor de su casa?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>aa) ¿Enseña a su niño(a) que ser activo es bueno para la salud?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>bb) ¿Premia a su niño(a) por estar quieto?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>cc) ¿Tiene juguetes disponibles para su niño(a) para jugar al aire libre?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>dd) ¿No deja que su niño(a) juegue afuera porque usted está preocupado con la delincuencia?</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ee) ¿No deja que su niño(a)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
![Table](image)

**14. ¿Con qué frecuencia hace las siguientes prácticas de frutas y verduras con su niño(a) de 3-5 años de edad? Por favor escoja la mejor respuesta.**

<table>
<thead>
<tr>
<th>Con que frecuencia usted...</th>
<th>Nunca</th>
<th>Raramente</th>
<th>A veces</th>
<th>Frecuentemente</th>
<th>Siempre</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Coloca las frutas y las verduras donde su niño(a) pueda alcanzarlas fácilmente.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>b) Anima a su niño(a) a probar un par de mordidas de la fruta o la verdura.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>c) Hace que sea divertido comer frutas y verduras, por ejemplo cortándolas en figuras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>d) Le pide a su niño(a) que seleccione frutas y verduras en el supermercado</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>e) Le ruega a su niño(a) que coma frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>f) Le dice a su niño(a) que coma frutas o verduras pero no come ninguna usted mismo.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>g) Hace que las frutas y verduras sean fáciles de comer, como cortándolas, limpiándolas y pelándolas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>h) Le dice a su niño(a) que comer frutas y verduras lo(a) hará fuerte y sano(a).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>i) Ofrece fruta o verduras sin forzar a su niño(a) a que los coma.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>j) Le dice a su niño(a) que sus personajes de caricaturas favoritos comen frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>k) Le dice a su niño(a) cuanto esfuerzo le costó preparar el plato de frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>l) Sirve varias frutas y verduras y</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Con que frecuencia usted...</td>
<td>Nunca</td>
<td>Raramente</td>
<td>A veces</td>
<td>Frecuentemente</td>
<td>Siempre</td>
</tr>
<tr>
<td>----------------------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>----------------</td>
<td>---------</td>
</tr>
<tr>
<td>Con que frecuencia usted...</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m) Recompensa a su niño(a) con dulces si come todas sus frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>n) Felicita a su niño(a) cuando lo ve comiendo frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>o) Le pide a su niño(a) que ayude a preparar las frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>p) Le promete a su niño(a) algo aparte de comida si termina sus frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>q) Compra frutas y verduras en vez de galletas, papitas, o dulces.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>r) No permite que su niño(a) coma dulces si no termina sus verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>s) Incluye alguna clase de fruta y verdura en la mayoría de las comidas.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>t) Batalla físicamente con su niño(a) para conseguir que coma sus frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>u) Le levanta la voz a su niño(a) si no come sus frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>v) Le pide a su niño(a) que escoja la fruta y las verduras para las comidas y &quot;snack&quot; (botanas, bocadillos, colaciones, meriendas, etc.).</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>w) Le permite a su niño(a) que se sirva sus frutas o verduras a sí mismo.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>x) Le muestra a su niño(a) que usted disfruta comer frutas y verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>y) Hace que su niño(a) se sienta culpable cuando no come sus frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>z) Usa frutas y verduras para la merienda (botanas, bocadillos) de su niño.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>aa) Le dice a su niño(a) que las</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Con que frecuencia usted...</td>
<td>Nunca</td>
<td>Raramente</td>
<td>A veces</td>
<td>Frecuentemente</td>
<td>Siempre</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-------</td>
<td>-----------</td>
<td>---------</td>
<td>----------------</td>
<td>--------</td>
</tr>
<tr>
<td>frutas y verduras saben deliciosas.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>bb) Le da a su niño(a)las frutas o las verduras que le gustan.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>cc) Insiste que su niño(a)permanezca en la mesa hasta que coma sus frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>dd) Mezcla frutas y verduras con otras comidas que le gustan a su niño.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>ee) No deja que su niño(a)vaya a jugar si no come sus frutas o verduras.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

15. Estas preguntas son acerca de los alimentos que ha comido en su casa en los últimos 12 meses, y si hubo suficiente dinero para la comida que necesitó. Para cada de las siguientes oraciones, por favor indíque si esto fue frecuentemente cierto, a veces cierto, o nunca cierto en su hogar.

a) Durante los últimos 12 meses, los alimentos que compramos no duraron mucho y no teníamos suficiente dinero para comprar más.

[ ] 1 Frecuentemente
[ ] 2 A veces
[ ] 3 Nunca

b) En los últimos 12 meses, no teníamos recursos suficientes para comer comida variada y nutritiva.

[ ] 1 Frecuentemente
[ ] 2 A veces
[ ] 3 Nunca

c) En los últimos 12 meses, ¿Ud. redujo alguna vez la cantidad de sus comidas o dejó de desayunar, almorzar o cenar porque le faltaba dinero para alimentos?

[ ] 1 No (Siga a la pregunta e)
[ ] 2 Sí

d) (Si contestó “Sí” a la pregunta e) ¿Con qué frecuencia sucedió esto?

[ ] 1 Casi todos los meses
[ ] 2 Algunos meses, pero no todos
[ ] 3 Solamente en 1 o 2 meses

e) En los últimos 12 meses, ¿Comió Ud. alguna vez menos de lo que pensaba que debía comer porque le faltaba dinero para alimentos?
f) En los últimos 12 meses, ¿Tuvo Ud. hambre alguna vez pero no comió porque le faltaba dinero para alimentos?

<table>
<thead>
<tr>
<th></th>
<th>1 No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 Sí</td>
</tr>
</tbody>
</table>

¡La encuesta está 50% completa! ¡Siga adelante con el buen trabajo!

Las siguientes preguntas son acerca de su hijo(a) quien está participando en el programa de SAGE

16. ¿En cuál país nació su niño?

<table>
<thead>
<tr>
<th></th>
<th>1 Estados Unidos</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2 México</td>
</tr>
<tr>
<td></td>
<td>3 Otro (Por favor, diganos: _______________________)</td>
</tr>
</tbody>
</table>

17. ¿Cómo describiría el peso de su hijo(a)?

<table>
<thead>
<tr>
<th></th>
<th>Severamente por bajo de peso</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bajo de peso</td>
</tr>
<tr>
<td></td>
<td>Peso normal</td>
</tr>
<tr>
<td></td>
<td>Sobrepeso</td>
</tr>
<tr>
<td></td>
<td>Severamente sobrepeso</td>
</tr>
</tbody>
</table>

18. ¿Durante la semana escolar, cuántos días desayuna en casa su niño?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

19. Durante la semana escolar, ¿Cuántos días desayuna en camino a la escuela su niño(a)?

<table>
<thead>
<tr>
<th></th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>5</td>
</tr>
</tbody>
</table>

20. ¿Cuántos días por semana come desayuna en la escuela su niño(a)?

|   | 0 |

Pagina 9 de 13
Las siguientes declaraciones son acerca de los hábitos del sueño de su niño(a) y posibles dificultades del sueño. Para responder las siguientes preguntas considere los hábitos de su hijo(a) durante la semana pasada. Si la semana pasada fue inusual, por alguna razón específica (por ejemplo, si su hijo tuvo una infección del oído y no durmió bien, o la televisión estaba descompuesta), piense en la semana más reciente que fue usual para su niño(a).

21. Escribe la hora de acostarse de su niño(a): ____________

22. Escribe la hora de levantarse de su niño(a): ____________

23. Escribe la cantidad de tiempo que su niño(a) usualmente duerme cada noche (no incluya siestas): _________ horas y _________ minutos

24. Escribe la cantidad de sueño que su niño(a) usualmente duerme durante el día (siestas): _________ horas y _________ minutos

Para las siguientes preguntas...

- Responda NORMALMENTE si es algo que ocurre 5 veces o más a la semana.
- Responda A VEces si es algo que ocurre 2 a 4 veces en una semana
- Responda RARAMENTE si es algo que nunca ocurrió o ocurrió 1 vez durante la semana.

25.  

<table>
<thead>
<tr>
<th></th>
<th>Normalmente (5-7)</th>
<th>A Vezes (2-4)</th>
<th>Raramente (0-1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) El(a) niño(a) despierta por sí mismo(a)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>b) El(a) niño(a) despierta de mal humor</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>c) Adultos o hermanos despiertan al niño(a)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>d) El(a) niño(a) tiene dificultades para salir de la cama en la mañana.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>e) El(a) niño(a) toma mucho tiempo en las mañanas para estar alerta.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>f) El(a) niño(a) parece cansado(a) en la mañana.</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>g) ¿Ronca durante la noche?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>h) ¿Dejó de respirar o hizo pausas en la respiración mientras dormía?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>i) ¿Tiene una respiración ruidosa durante el sueño?</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

26. ¿Su hijo(a) parece tener mucho sueño o se duerme durante las siguientes ocasiones? (marque todo lo que aplica):
<table>
<thead>
<tr>
<th></th>
<th>0 No Tiene Sueño</th>
<th>1 Tiene Mucho Sueño</th>
<th>2 Se duerme</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Mirando televisión</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b) Viajando en el coche</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¡Ha completado el 75% de la encuesta! ¡Ya casi termina!

Las siguientes preguntas le pedirán que se describa a usted mismo y a su familia.

27. ¿Qué lenguaje habla?
   
   [ ] 1 Solamente español
   [ ] 2 Español mejor que inglés
   [ ] 3 Inglés y español por igual
   [ ] 4 Inglés mejor que español
   [ ] 5 Solamente inglés
   [ ] 6 Lenguaje asiático (Por favor, diganos: ________________________ )
   [ ] 7 Algún otro lenguaje (Por favor, diganos: ________________________ )

28. ¿En qué lenguaje lee?

   [ ] 1 Solamente español
   [ ] 2 Español mejor que inglés
   [ ] 3 Inglés y español por igual
   [ ] 4 Inglés mejor que español
   [ ] 5 Solamente inglés
   [ ] 6 Lenguaje asiático (Por favor, diganos: ________________________ )
   [ ] 7 Algún otro lenguaje (Por favor, diganos: ________________________ )

29. ¿Dónde vivió su niñez hasta los 21 años de edad?

   [ ] 1 Solamente en Latinoamérica (México, Centroamérica, Sudamérica) o en el caribe (Cuba, Puerto Rico, etc.)
   [ ] 2 La mayor parte en Latinoamérica o el Caribe
   [ ] 3 Latinoamérica/Caribe, y en los Estados Unidos por igual
   [ ] 4 La mayor parte en los Estados Unidos y algún tiempo en Latinoamérica/Caribe
   [ ] 5 Solamente en los Estados Unidos

30. ¿Cómo describiría a su círculo de amistades?

   [ ] 1 Casi exclusivamente hispanos/latinos (Chicanos/mexicoamericanos, puertorriqueños,
colombianos, dominicanos, etc.)

31. ¿Cómo se siente de ser de origen latino? (si aplica)
   [ ] 1 Muy orgulloso(a)
   [ ] 2 Orgulloso(a)
   [ ] 3 Algo orgulloso(a)
   [ ] 4 Un poco orgulloso(a)
   [ ] 5 No orgulloso(a)
   [ ] 6* No aplica

32. ¿Cuál es su estado civil?
   [ ] 1 Casad(a)
   [ ] 2 Vive con alguien como si estuviéramos casados, pero no estábamos legalmente casados
   [ ] 3 Separado/a, divorciado/a, viudo/a
   [ ] 4 Soltero/a (nunca se ha casado)

33. ¿Cuál es el grado o año escolar más alto que usted ha completado?
   [ ] 1 Nunca asistí a la escuela
   [ ] 2 Sólo grado o menos
   [ ] 3 Asistí algún tiempo a la escuela secundaria, pero no me gradué
   [ ] 4 Me gradué de la secundaria o completé el GED
   [ ] 5 Asistí algún tiempo a una universidad o un junior college, pero no me gradué de la universidad
   [ ] 6 Escuela vocacional
   [ ] 7 Graduado de la universidad grado de dos años
   [ ] 8* Me gradué de la universidad o hice estudios de postgrado

34. ¿Le ha dicho alguna vez un doctor, enfermera u otro profesional de salud que usted tenía alguno de los siguientes problemas de salud?

<table>
<thead>
<tr>
<th>Condición</th>
<th>No</th>
<th>No, pero tomo medicamento</th>
<th>Sí, pero no tomo medicamento</th>
<th>Sí, y también tomo medicamento</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Diabetes (alto contenido de azúcar en la sangre), excluyendo durante un embarazazo</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>b. Hipertensión (tensión arterial alta), excluyendo durante un embarazado</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>c. Colesterol alto</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

35. Es usted actualmente ...
36. ¿Cuál fue el ingreso total de su familia el año pasado antes de impuestos? Por favor marque una de las cajas abajo que indique el ingreso total de su familia, incluyendo su ingreso, el de su esposo o pareja (si vivía con usted el año pasado) y de sus hijos. (Por favor incluya todas las fuentes de ingresos incluyendo trabajos, asistencia social, estampillas de desempleo, manutención, intereses, dividendos, y ayuda de familiares).

| $0 to $16,000   |   |
| $16,001 to $20,000 |   |
| $20,001 to $24,000 |   |
| $24,001 to $28,000 |   |
| $28,001 to $31,000 |   |
| $31,001 to $36,000 |   |
| $36,001 to $39,000 |   |
| $39,001 to $47,000 |   |
| $47,001 to $55,000 |   |
| $55,001 to $59,000 |   |
| $59,001 to $63,000 |   |
| $63,001 to $71,000 |   |
| $71,001 to $78,000 |   |
| $78,001 to $83,000 |   |
| $83,001 to $94,000 |   |
| $94,001 to $107,000 |   |
| $107,001 to $110,000 |   |
| $110,001 to $126,000 |   |
| $126,001 to $142,000 |   |
| $142,001 o más |   |

37. ¿Cuántas adultos, incluyendo usted, viven en su casa?

________________________

38. ¿Cuántas niños viven en su casa?

________________________

39. ¿Cuándo nació su hijo(a) menor?

_______ _______ _______

Mes Día Año

¡Gracias por completar la encuesta!
SAGE Environmental Assessment

Instructions: SAGE team members should complete this assessment at the ECEC in collaboration with center directors. First, SAGE team members review this questionnaire thoroughly to determine what they are looking for at the ECEC. Then, SAGE team members should walk around the entire property, noting what you see throughout the ECEC. All questions refer to the entire space available as indicated in the question.

Outdoor Play Environment

1. The amount of our outdoor play space that is shaded by structures or trees is…
   - No Shade
   - Less than ⅓ is shaded
   - ⅓ to ½ is shaded
   - ½ to ¾ is shaded
   - More than ¾ is shaded

*Structures that provide shade include fabric canopies or umbrellas, hardtop canopies, gazebos, and arbors.

2. An open area for outdoor games, activities, and events is…
   - Not available
   - Large enough for some children to run around safely
   - Large enough for most children to run around safely
   - Large enough for all children to run around safely

*This refers to all children who regularly use the open area together, not necessarily all of the children in the program. For large centers, this response refers to a space large enough for at least 25 children to run around safely.

3. The outdoor play space for preschool children includes how many different areas for play…
   - 1–2 play areas
   - 3–5 play areas
   - 6–7 play areas
   - 8 play areas or more

* Each play area offers different play opportunities. An area might include a swing set, sandbox, climbing structure, pathway, garden, house or tent, small inflatable pool, rassel, or outdoor musical instruments like pots, pans and pipes for drumming. A play area does not need to be permanent; it can be created by bringing equipment outside.

4. Describe the program’s garden (before SAGE)…
   - There is no garden for herbs, fruits, or vegetables
   - Has a garden, but does not grow anything
   - It grows only herbs
   - It grows some fruits and/or vegetables for children to taste
   - It grows enough fruits and/or vegetables to provide children meals or snacks during 1 or more seasons

*A garden can be planted in the ground or in containers like window boxes or pots. A garden can include vines growing on fences or arbors, or fruit trees planted in the outdoor play space.

5. The path for wheeled toys is…
   - No path
   - Unpaved and any width
   - Paved and less than 5 feet wide
   - Paved and 5 feet wide or wider
6. Describe the shape of the path for wheeled toys...
   No path  Straight  Curved but not looped  Curved and looped
   □  □  □  □

* A curved and looped path allows children to ride around multiple loops, not just one large circle.

7. Describe how the path for wheeled toys connects to different parts of the outdoor play space: See list and mark all responses that apply below.
   □ No path
   □ Connects to building entrances
   □ Connects the building to play areas
   □ Connects different play areas to each other

8. Check all types of portable play equipment that are available and in good condition for children to use outdoors:

   **Fixed Play Equipment**
   □ Balancing surfaces (balance beams, boards, etc.)
   □ Basketball hoops
   □ Climbing Structures (jungle gyms, ladders, etc.)
   □ Merry-go-round
   □ pool
   □ sandbox
   □ see-saw
   □ slides
   □ swinging equipment
   □ tricycle track
   □ tunnels

   **Portable Play Equipment**
   □ ball play equipment
   □ Climbing Structures (ladders, jungle gyms, etc.)
   □ floor play equipment (tumbling mats, carpet squares, etc.)
   □ jumping play equipment (jump ropes, hula hoops)
   □ parachute
   □ push/pull toys (wagon, scooters, etc.)
   □ riding toys (tricycles, cars, etc.)
   □ rocking & twisting toys (rocking horse, sit-n-spin, etc.)
   □ sand/water toys (buckets, scoops, shovels, etc.)
   □ slides
   □ twirling play equipment (ribbons, scarves, batons etc.)

**Indoor Play Environment**

9. The program offers the following in the indoor play space: See list and mark all responses that apply below.
   □ None
10. The program’s collection of posters that promote physical activity includes:

<table>
<thead>
<tr>
<th>Few or no posters</th>
<th>Some posters with limited variety</th>
<th>A variety of posters</th>
<th>A large variety of posters with items, added or rotated seasonally</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

11. The program’s collection of books that promote physical activity includes:

<table>
<thead>
<tr>
<th>Few or no books</th>
<th>Some books with limited variety</th>
<th>A variety of books</th>
<th>A large variety of books with items, added or rotated seasonally</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

12. The program’s collection of other learning materials that promote physical activity includes:

<table>
<thead>
<tr>
<th>Few or no materials</th>
<th>Some materials with limited variety</th>
<th>A variety of materials</th>
<th>A large variety of materials with items, added or rotated seasonally</th>
</tr>
</thead>
<tbody>
<tr>
<td>☐</td>
<td>☐</td>
<td>☐</td>
<td>☐</td>
</tr>
</tbody>
</table>

13. Check all types of portable play equipment that are available and in good condition for children to use indoors:

<table>
<thead>
<tr>
<th>Fixed Play Equipment</th>
<th>Portable Play Equipment</th>
</tr>
</thead>
</table>
☐ Balancing surfaces (balance beams, boards, etc.)
☐ Basketball hoops
☐ Climbing Structures (jungle gyms, ladders, etc.)
☐ Merry-go-round
☐ pool
☐ sandbox
☐ see-saw
☐ slides
☐ swinging equipment
☐ tricycle track
☐ tunnels

☐ ball play equipment
☐ Climbing Structures (ladders, jungle gyms, etc.)
☐ floor play equipment (tumbling mats, carpet squares, etc.)
☐ jumping play equipment (jump ropes, hula hoops)
☐ parachute
☐ push/pull toys (wagon, scooters, etc.)
☐ riding toys (tricycles, cars, etc.)
☐ rocking & twisting toys (rocking horse, sit-n-spin, etc.)
☐ sand/water toys (buckets, scoops, shovels, etc.)
☐ slides
☐ twirling play equipment (ribbons, scarves, batons etc.)

Screen Time

14. Televisions are located:
   ☐ In every classroom  ☐ In some classrooms  ☐ Stored outside of classrooms but regularly available to children  ☐ No televisions; or, televisions stored outside of classrooms and not regularly available to children

15. Computers are located:
   ☐ In every classroom  ☐ In some classrooms  ☐ Stored outside of classrooms but regularly available to children  ☐ No computers; or, computers stored outside of classrooms and not regularly available to children

Nutrition

16. The program’s collection of posters that promote nutrition includes:
   ☐ Few or no posters  ☐ Some posters with limited variety  ☐ A variety of posters  ☐ A large variety of posters with items, added or rotated seasonally

17. The program’s collection of books that promote nutrition includes:
   ☐ Few or no books  ☐ Some books with  ☐ A variety of books  ☐ A large variety of
18. The program’s collection of other learning materials that promote nutrition includes:
- Few or no materials
- Some materials with limited variety
- A variety of materials
- A large variety of materials with items, added or rotated seasonally

19. Soda and other vending machines are located:
- In the entrance or front of building
- In public areas, but not entrances
- Out of sight of children and families
- There are no vending machines on site

20. Drinking water access for children is located:
- In the entrance, front of the building, or other public areas
- On the playground
- In the classrooms
- There is no drinking water access for children

Policy
21. The written policy on outdoor play and learning includes the following topics: Read list and mark all responses that apply.
- Amount of outdoor playtime provided each day
- Ensuring adequate total playtime on inclement weather days
- Shoes and clothes that allow children and teachers to play outdoors in all seasons
- Safe san exposure for children, teachers, and staff
- Not taking away outdoor playtime in order to manage challenging behaviors
- Professional development on outdoor play and learning
- Education for families on outdoor play and learning
- No written policy or policy does not include these topics

21a. How is this policy enforced? Mark all responses that apply.
- Not enforced
- Verbal communication or reporting within the center.
- Written communication or reporting within the center.
- Verbal communication or reporting to an agency outside the center.
- Written communication or reporting to an agency outside the center.

22. The written policy on screen time includes the following topics: Read list and mark all responses that apply.
22a. How is this policy enforced? Mark all responses that apply.

☐ Not enforced
☐ Verbal communication or reporting within the center.
☐ Written communication or reporting within the center.
☐ Verbal communication or reporting to an agency outside the center.
☐ Written communication or reporting to an agency outside the center.

23. The written policy on physical activity includes the following topics. Read list and mark all responses that apply:

☐ Amount of time provided each day for indoor and outdoor physical activity
☐ Limiting long periods of seated time for children
☐ Shoes and clothes that allow children and teachers to actively participate in physical activity
☐ Teacher practices that encourage physical activity
☐ Not taking away physical activity time or removing children from long periods of physically active playtime in order to manage challenging behaviors
☐ Planned and informal physical activity education
☐ Professional development on children’s physical activity
☐ Education for families on children’s physical activity
☐ No written policy or policy does not include these topics

23a. How is this policy enforced? Mark all responses that apply.

☐ Not enforced
☐ Verbal communication or reporting within the center.
☐ Written communication or reporting within the center.
☐ Verbal communication or reporting to an agency outside the center.
☐ Written communication or reporting to an agency outside the center.
24. The written policy on child nutrition includes the following topics: See list and mark response below.

- Foods provided to children
- Beverages provided to children
- Creating healthy mealtime environments
- Teacher practices to encourage healthy eating
- Not offering food to calm children or encourage appropriate behavior
- Professional development on child nutrition
- Education for families on child nutrition
- Guidelines for foods offered during holidays and celebrations
- Fundraising with non-food items
- No written policy or policy does not include these topics.

24a. How is this policy enforced? Mark all responses that apply.

- Not enforced
- Verbal communication or reporting within the center.
- Written communication or reporting within the center.
- Verbal communication or reporting to an agency outside the center.
- Written communication or reporting to an agency outside the center.
APPENDIX H

CHILD GROSS LOCOMOTOR SKILLS DATA COLLECTION FORM
Child Data Collection Form

Child ID: ____________ Date: ________________ Time: 1 2 3 4

Height

Weight

Waist Circumference

Measurement 1: ______ Measurement 1: ______ Measurement 1: ______

Measurement 2: ______ Measurement 2: ______ Measurement 2: ______


CHAMPS Motor Skills

Instructions: Demonstrate each motor skill to the child, one skill at a time. Provides two demonstrations on each skill, one facing the child the other facing away. Following the demonstrations ask the child two complete trials of each skill. Check off each of the criteria that child completes correctly during each individual trial. Do NOT provide feedback between trials.

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>Run</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Arms move in opposition to legs, elbows bent</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Brief period of suspension: both feet off the ground</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Narrow foot placement; lands on heel or toe; not flat footed</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Length of stride even; path of movement horizontal</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Nose supported leg flexed to approximately 90 degrees</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Eyes focused forward</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>Prep Jumpl</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Preparatory: flexion of both knees; arms behind body</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Arms extend forcefully; forward and upward to full extension above the head</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Take-off and landing on both feet simultaneously</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Take-off on both feet simultaneously; landing non-simultaneous</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Arms move downward during landing</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Balance maintained on landing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th>Slide (Shuffle)</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Body turned sideways, shoulders aligned with line on floor to initiate</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Steps sideways with lead foot; slides trail foot next to lead foot</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Minimum of four continuous step-slide cycles to right</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Minimum of four continuous step-slide cycles to left</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Arms used to assist leg action</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Body maintained in sideways position moving to right</td>
</tr>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>Body maintained in sideways position moving to left</td>
</tr>
<tr>
<td>T1</td>
<td>T2</td>
<td><strong>Gallop</strong></td>
</tr>
<tr>
<td>----</td>
<td>----</td>
<td>------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arms (elbows) flexed and at waist level at take-off</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Step forward with lead foot; step with trail foot to a position adjacent to or behind lead foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Heel-toe action of lead foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Assumes initial position facing forward</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Final position facing forward</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brief period of suspension; both feet off the floor</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintains rhythmic pattern: four consecutive gallops</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th><strong>Leap (Skip)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Take off on one foot; land on opposite foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brief period of suspension; both feet off the ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forward reach with arm opposite the lead foot</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>T1</th>
<th>T2</th>
<th><strong>Hop (one leg)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Preferred Foot (circle): Left / Right</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-support leg swings forward in pendular motion to assist force production</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Foot of non-support leg remains behind body</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Arms flexed; swing forward together to produce force</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Weight received (lands) on ball of foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Takes off and lands three consecutive times on preferred foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Takes off and lands three consecutive times on nonpreferred foot</td>
</tr>
</tbody>
</table>

Please rate the following testing environment characteristics on their level of interference:

<table>
<thead>
<tr>
<th></th>
<th>Defiantly Interfering</th>
<th>Not Interfering</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise level (e.g., noise-related disturbances from classrooms, hallways)</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>General distractions (e.g., traffic in the testing area during demonstrations, teachers watching and performing the skill)</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Temperature of the testing area</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td>Nature and adequacy of the space (e.g., inadequate floor space, inappropriate floor surface)</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX I

CHILD PACER DATA COLLECTION FORM
Set Up

- Set up cones 20 meters apart. Measure this out with the tape measure.
- Use multiple cones to draw a “line” that the children will stand behind on each end.
- Have one score-keeper for each 2-3 children.
- Have one person run with the children.

Instructions

“Hello Students! Today we are going to do something really fun! We are going to do some running, but it’s not going to be a race. We just want to see how long you can run. Don’t worry. Ms./Mr._________ will be running with you.

Now I want you guys to listen carefully because there are some rules! Rule number one, when you hear the beep you will start to run right next to Ms./Mr._________. When you get to the other end wait behind the line.

- Ask the students “what do you do at the sound of the beep?”
- Then when you hear the beep again, I want you to run back to the other side and wait patiently behind the line.”

[PLAY THE CD FOR THE STUDENTS TO LISTEN TO, NOTING THE TRIPLE BEEP.]

“Did everyone hear the triple beep? That means you will run a little faster but still right next to Ms./Mr._________.

- Ask the students, “What do you do when you hear the triple beep?”
- Ask the students, “What does the triple beep mean?”

“Okay now if you don’t reach the line by the time you hear the beep I want you to turn around and go run right back to the opposite line. Don’t worry. Ms./Mr._________ will be helping you.”

- Ask the students, “What do you do if you don’t reach the line by the beep?”

Scoring

- Scorers should stand in the middle of the area where the PACER is being conducted so that they can see when the student crosses the line.
- The scorer crosses off the lap number on the PACER score sheet as the child completes each lap. If one student fails to reach the line before the beep, the scorer places a mark such as a “X” next to the lap number. This counts as one “miss”.
- The second time the child fails to reach the line before the beep, the last completed lap is recorded. For example, fails to reach the line on lap 5, lap 1 is recorded on the score sheet.
- After the second “miss” the child can continue to participate, but the scorer no longer needs to keep track of completed laps.
### PACER Score Sheet

<table>
<thead>
<tr>
<th>Stage</th>
<th>Laps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>2</td>
<td>8 9 10 11 12 13 14 15</td>
</tr>
<tr>
<td>3</td>
<td>16 17 18 19 20 21 22 23</td>
</tr>
<tr>
<td>4</td>
<td>24 25 26 27 28 29 30 31 32</td>
</tr>
<tr>
<td>5</td>
<td>33 34 35 36 37 38 39 40 41</td>
</tr>
<tr>
<td>6</td>
<td>42 43 44 45 46 47 48 49 50 51</td>
</tr>
<tr>
<td>7</td>
<td>52 53 54 55 56 57 58 59 60 61</td>
</tr>
<tr>
<td>8</td>
<td>62 63 64 65 66 67 68 69 70 71 72</td>
</tr>
<tr>
<td>9</td>
<td>73 74 75 76 77 78 79 80 81 82 83</td>
</tr>
<tr>
<td>10</td>
<td>84 85 86 87 88 89 90 91 92 93 94</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Missed Lap Symbol</th>
<th>Child ID Number</th>
<th>Laps completed</th>
</tr>
</thead>
<tbody>
<tr>
<td>“○”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“×”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>“□”</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>