2017

A review of early influences on physical activity and sedentary behaviors of preschool-age children in high-income countries

Ana Cristina Lindsay

Mary L. Greaney

University of Rhode Island, mgreaney@uri.edu

Sherrie F. Wallington

Tatiana Mesa

Carlos F. Salas

Follow this and additional works at: https://digitalcommons.uri.edu/kinesiology_facpubs

The University of Rhode Island Faculty have made this article openly available.
Please let us know how Open Access to this research benefits you.

This is a pre-publication author manuscript of the final, published article.

Terms of Use

This article is made available under the terms and conditions applicable towards Open Access Policy Articles, as set forth in our [Terms of Use](#).

Citation/Publisher Attribution

Lindsay AC, Greaney ML, Wallington SF, Mesa T, Salas CF. A review of early influences on physical activity and sedentary behaviors of preschool-age children in high-income countries. *J Spec Pediatr Nurs*.

2017;22:e12182. <https://doi.org/10.1111/jspn.12182>

Available at: <https://doi.org/10.1111/jspn.12182>

This Article is brought to you for free and open access by the Kinesiology at DigitalCommons@URI. It has been accepted for inclusion in Kinesiology Faculty Publications by an authorized administrator of DigitalCommons@URI. For more information, please contact digitalcommons-group@uri.edu.

A review of early influences on physical activity and sedentary behaviors of preschool-age children in high-income countries

Ana Cristina Lindsay^{1,2}; Mary L. Greaney³; Sherrie F. Wallington⁴; Tatiana Mesa¹; Carlos F. Salas¹

1. University of Massachusetts Boston, Exercise and Health Sciences Department, College of Nursing and Health Sciences, Boston, MA, USA
2. Harvard School of Public Health, Department of Nutrition, Boston, MA, USA
University of Rhode Island, Health Studies & Department of Kinesiology, Kingston, RI, USA
3. University of Rhode Island, Department of Kinesiology
4. Lombardi Comprehensive Cancer Center, Georgetown University Medical Center, Washington, DC, USA

Authors' email addresses:

Ana Cristina Lindsay: Ana.Lindsay@umb.edu
Mary L. Greaney: mgreaney@uri.edu
Sherrie F. Wallington: slw49@georgetown.edu
Tatiana Mesa: Tatiana.Mesa001@umb.edu
Carlos Salas: Carlos.Salas001@umb.edu

Address for Correspondence:

Ana Cristina Lindsay, DDS, MPH, DrPH
Associate Professor
Department of Exercise and Health Sciences
University of Massachusetts Boston
100 Morrissey Boulevard
Boston, MA 02125
Phone: 617-287-7579
Email: Ana.Lindsay@umb.edu

Abstract

Purpose: Promoting physical activity (PA) is a key component of preventing and controlling childhood obesity. Despite well-documented benefits of PA, globally, rates of physical activity among young children have declined over the past decades, and most children are not accruing sufficient physical activity daily. Helping children develop the foundation for PA habits early in life is critical for the promotion of health in childhood and prevention of chronic diseases later in life, and will ultimately promote longer and healthier lives for individuals and the general population. The purpose of this review is to provide a synthesis of current evidence on influences on PA and sedentary behaviors of preschool-age children in high-income countries.

Design and Methods: A systematic review of three databases was performed. Studies conducted in high-income countries and published from 2000 onwards that addressed influences on physical activity and sedentary behaviors of preschool-age children were identified and reviewed. Additionally, reference lists of identified articles and relevant published reviews were reviewed. Studies that met the following inclusion criteria were considered: (a) sample included preschoolers (age ≤ 5 years); (b) PA and/or sedentary behaviors or factors associated with PA and/or sedentary behaviors was assessed; (c) published in English; (d) used either quantitative or qualitative methods; and (e) conducted in a high-income country. Data were extracted from selected studies to identify influences on PA and sedentary behaviors of preschool-age children and organized using the social-ecological model according to multiple levels of influence.

Results: Results from included studies identify multiple factors that influence PA and sedentary behaviors of young children in high-income countries at the various levels of the

social-ecological model including intrapersonal, interpersonal, environmental, organizational, and policy.

Practice Implications: Given pediatric nurses' role as primary care providers, and their frequent and continued contact with parents and their children throughout childhood through well-child visits, immunization, and minor acute illnesses, they are well positioned to promote and support the development of early healthful PA habits of children starting in early childhood.

Keywords: physical activity, sedentary behaviors, preschool-age children, social-ecological model

INTRODUCTION

Several high-income countries including the United States, United Kingdom, Australia, and Canada, have developed physical activity (PA) guidelines specific to preschool-age children recommending that children this age engage in at least 120 to 180 minutes of total PA (including light PA and moderate-to-vigorous PA) daily (Commonwealth of Australia, Department of Health and Ageing, 2010; Department of Health, Physical Activity, Health Improvement and Protection, 2011; NASPE, 2009; Okely, Salmon, Trost, & Hinkley, 2008; Tremblay et al., 2012).

In the United States, the National Association for Sport and Physical Education (NASPE, 2009) has developed PA guidelines from infancy to the age of 5 years. These guidelines advocate increasing opportunities for preschoolers to engage in a minimum of 120 minutes of daily PA in the form of 60 minutes of structured activity and 60 minutes of unstructured or spontaneous active play. Similarly, the American Academy of Pediatrics recommends that clinicians encourage parents to increase physical activities and decrease time spent in sedentary activities (e.g., screen-time, time spent indoors, etc.) in a manner compatible with the developmental level of a child (AAP, 2006).

Furthermore, high-income countries including the United States, Canada and Australia have created stringent screen-viewing guidelines in response to the increasing rates of sedentary behaviors among preschool-aged children. For example, the American Academy of Pediatrics recommends that screen-viewing be limited to a maximum of two hours per day for children over two years of age (AAP, 2006). Both Canada (Tremblay et al., 2012) and Australia (Commonwealth of Australia, Department of Health and Ageing, 2010) have more stringent screen-viewing guidelines for young children, with both countries recommending

that screen-viewing for children 1-4 years of age in Canada and 2-5 years of age in Australia be limited to 1 hour per day.

Physical activity is a key component of energy balance consistent with healthy patterns of physical growth and weight status; thus, promoting PA is essential to prevention of childhood obesity (O'Dwyer et al., 2012; Pratt, Epping, & Dietz, 2009). Physically active children have healthier cardiovascular profiles, leaner body frames, and higher peak bone mass compared to physically inactive children (AAP, 2006; Goldfield, Harvey, Grattan, & Adamo, 2012; Hodges, Smith, Tidwell, & Berry, 2013; O'Dwyer, Fairclough, Knowles, & Stratton, 2012). In addition to regulating body weight and improving body composition, PA improves psychological and social wellbeing (AAP, 2006; Beets et al., 2011; Hodges et al., 2013; O'Dwyer et al., 2012).

Despite well-documented benefits of PA for children, activity levels of children across the globe have declined over the past decades, and most preschool-age children are not accruing the recommended levels of moderate-vigorous physical activity (MVPA) daily (Montgomery et al., 2004; Pate et al., 2015). Moreover, an increasing number of studies document excessive screen-viewing time including television, computers, smartphones, etc. among preschool-age children (Asplund, Kair, Arain, Cervantes, Oreskovic, Zuckerman, 2015; Beets, Bornstein, Dowda, & Pate, 2011; Davison et al., 2011; Ekelund, Brage, & Wareham, 2004; Garriguet, Carson, Colley, Janssen, Timmons & Tremblay, 2016; Lampard, Jurkowski, Davison, 2013; Mendoza, Zimmerman, & Christakis, 2007; Pate et al., 2015; Vale, Santos, Soares-Miranda, Silva, & Mota, 2010; Vandewater, Bickham, & Lee, 2006).

Physical activity and sedentary behaviors are complex and influenced by interacting multi-level factors that either facilitate or hinder PA and sedentary behaviors in young

children. The social-ecological model has been extensively used to help health professionals and researchers identify and understand how the various multi-level influences interact to form individual's PA opportunities and choices. Consistent evidence shows that addressing multiple levels of the social-ecological model is associated with greater change in behaviors including PA (Sallis, Cervero, Asher, Henderson, Kraft & Kerr, 2006). Moreover, the social-ecological model recognizes the context and interaction typical of preschool-aged children and provide an important framework for developing interventions that address the social and physical environments and public policy for improving PA and reducing sedentary behaviors of young children (Sallis, Cervero, Asher, Henderson, Kraft & Kerr, 2006).

Given the increasing prevalence of insufficient PA and increasing levels of sedentary behaviors among young children, this review sought to elucidate early influences on PA and sedentary behaviors of preschool-age children in high-income countries by using the social-ecological model to identify and organize facilitators and/or barriers to PA and sedentary behaviors of young children.

METHODS

We searched three electronic databases (PubMed, SPORTDiscus, and PsycINFO) to identify studies published from January 2000 onward that addressed influences on PA and sedentary behaviors among preschool-age children (age ≤ 5 years) in high-income countries. We used the criteria from the Organization for Economic Cooperation and Development (OECD) and The World Bank to define high-income countries, which defines high-income as a country with a gross national income per capita above US\$ 12,475 in 2015, calculated using the Atlas method (The World Bank, 2013). Additionally, we searched the references of identified studies and relevant published reviews. We used the combination of the following

key search terms: *physical activity, inactivity, lifestyle, sedentary behavior, screen, preschool, children, overweight, obese/obesity, prevention, and influences*. Studies that met the following inclusion criteria were reviewed: (a) sample included preschoolers (age ≤ 5 years); (b) measured PA and sedentary behaviors and/or factors associated with PA and sedentary behaviors; (c) published in English; (d) used either quantitative or qualitative methods; (e) **conducted in a high-income country**. Exclusion criteria included the following: (a) the study sample was children with preexisting conditions (e.g., cardiac disease, hypertension, diabetes mellitus, dyslipidemia, or mental illness) that could constrain PA; (b) review articles; and (c) articles published only in languages other than English. One author read all the abstracts of identified full-text papers meeting inclusion criteria. Identified papers were reviewed by two of the authors, who used the social-ecological model as a framework to organize identified factors influencing PA. Figure 1 shows the literature search strategy.

[Figure 1 here]

Theoretical Model for Examining Influences on Preschool Children's Physical Activity

The social-ecological model provided the conceptual framework for this review (McLeroy, Bibeau, Steckler, & Glanz, 1988) and was used to organize influences on preschool-age children's PA by level: (a) intrapersonal (**e.g., age, gender, material circumstances, ethnicity, etc.**); (b) interpersonal (e.g., social support, networks, etc.); (c) environmental (e.g., access and proximity to parks, etc.); (d) organizational (e.g., child care, federally funded nutrition programs such as WIC, etc.); and (e) policy (e.g., state policies and regulations related to nutrition and PA in child care settings, etc.). This framework posits that factors at each level interact and influence health behaviors (McLeroy et al., 1998). Table 1 shows a breakdown of the studies reviewed according to the social-ecological model.

[Figure 2 and Table 1 here]

RESULTS

Individual/Intrapersonal Influences

Socioeconomic and demographic factors. Parents' socioeconomic status (SES) and educational level are associated with preschool children's early PA behaviors (Dawson-Hahn, Fesinmeyer, & Mendoza, 2015; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Jones, Hendricks, and Draper (2014) found that among children aged 4–5 years old attending preschools, parents with low-income reported that their children spent 93% of time indoors compared to 79% reported by parents with mid/high-income. Parental socioeconomic status is also associated with preschool children's early sedentary behaviors. Levin, Martin & Riner (2004) found excessive TV viewing habits among a sample of low-income 4-year old children enrolled in Head Start in South Carolina.

Differences in PA by sex exist (Vale et al., 2010; Van Cauwenberghe et al., 2012), and across SES and demographic strata (Vale et al., 2010; Van Cauwenberghe, Jones, Hinkley, Crawford, & Okely, 2012), with boys being more active than girls (Finn, Johannsen, & Specker, 2002; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004).

Children's PA and sedentary behaviors may also vary according to family structure. Controlling for household SES and child age, Bagley, Salmon, and Crawford (2006) determined that boys without siblings spent more time watching TV compared to those who had siblings. They also found that girls from single-parent families spent significantly more time watching TV compared to girls from two-parent families, and girls with siblings were more physically active compared to those who were the only child.

Ethnicity, acculturation, and place of birth. Caucasian children have higher rates of

PA than African American or Hispanic children (Ariza, Chen, Binns, & Christoffel, 2004; Fakhouri, Hughes, Brody, Kit, & Ogden, 2013; Kuepper-Nybelen et al., 2005; Kumanyika & Grier, 2006).

A few studies have examined the associations between ethnicity and preschool children's PA (Dawson-Hahn, Fesinmeyer & Mendoza, 2015; Fitzgibbon et al., 2011; Fitzgibbon et al., 2006; O'Connor et al., 2014; Toselli, Zaccagni, Celenza, Albertini & Gualdi-Russo, 2015). Dawson-Hahn, Fesinmeyer & Mendoza (2015) found that the majority of Latino preschool-aged children attending Head Start programs exceeded US national and international guidelines of physical activity duration. A study conducted in Italy among parents of Italian and immigrant preschool-aged children found that physical activity was significantly higher in Italians than in immigrants (Toselli et al., 2015).

Limited research exists examining the association between acculturation levels and preschool-age children's PA, and the limited research shows mixed results (Soltero, Cerin, Lee & O'Connor, 2016; O'Connor et al., 2014; Gallagher, 2010). A recent study with 240 of preschool-aged children showed that Latino parents' acculturation levels moderated the relationship between perceptions of disorder and crime, which in turn, influenced parenting practices that discourage child physical activity due to safety concerns were associated with increased perceptions of traffic hazards, physical and social disorder and perceived stranger danger (Soltero, Cerin, Lee & O'Connor, 2016). Another study with also conducted with Latino parents of preschool-aged children showed that cultural variables only had a weak main effect on PA parenting practices, specifically on discouraging PA due to safety concerns (O'Connor et al., 2014). A qualitative study with Mexican-American mothers showed that

mothers' acculturation levels influenced their views of the type of physical activity children should engage in depended on the age and maturity of the child (Gallagher, 2010). Previous research highlights a need for further study of associations between acculturation and preschoolers' PA in Western cultures (O'Connor et al., 2014; Suen, Cerin, & Wua, 2015).

Cespedes, McDonald, Haines, Bottino, and Taveras (2013) examined obesity-related behaviors in urban, low-income, and non-U.S.- and U.S.-born racial/ethnic minority preschool-age children (34% Black, 52% Hispanic), and found that time spent in active play was lower among children whose parents were born outside the U.S. than among those whose parents were U.S.-born, after adjusting for parental education.

Interpersonal Influences

Parental physical activity. Parental PA and sedentary behaviors are important determinants of their preschool-aged children's PA and sedentary behaviors. Ruiz, Gesell, Buchowski, Lambert, and Barkin (2011) determined that Latino parents who are less physically active and more sedentary had children who were more sedentary and less active than Latino parents who were more physically active. A similar study found weak correlations between mild and moderate parental PA and their 3- and 4-year-old children's PA (Taylor et al., 2009). A study conducted in Canada by Carson, Stearns, and Janssen (2015) examined the associations between parental PA and screen time behaviors and their young children's behavior (61% aged 1–3, 35% aged 4–5) and found that parents in the lowest quartile of PA were 2.77 times more likely to have a child in the lowest quartile of PA compared with parents in the highest quartile. Relationships were stronger in two parent homes than in single-parent homes. Furthermore, parents in the second, third, and fourth screen time quartiles were significantly more likely to have a child in the highest quartile of screen time

compared with parents in quartile one. Similar, a recent study conducted in Australia found that maternal self-reported co-participation in sedentary behavior and provision of child opportunities for physical activity was associated with children's physical activity (Hnatiuk, Ridgers, salmon & Hesketh, 2016).

Parental beliefs and attitudes. Parents' perceptions, beliefs, and attitudes toward PA may influence their young children's PA behaviors (Dwyer, Higgs, Hardy, & Baur, 2008; Hesketh et al., 2013; Hinkley, Salmon, Okely, Crawford, & Hesketh, 2011; Loprinzi & Trost, 2010; O'Connor, Chen, Baranowski, Thompson, & Baranowski, 2013; Zecevic, Tremblay, Lovsin, & Michel, 2010). Parental belief that participating in PA is important is associated with their children's participation in both organized and free-time PA (Sawyer et al., 2014). Children whose parents hold positive attitudes toward PA (e.g., PA is important to overall health) are more active compared to those whose parents do not hold these positive attitudes (Sawyer et al., 2014). Similarly, Zecevic and colleagues (2010) determined that children of parents who view PA as enjoyable engage in significantly more PA than children did whose parents did not view PA positively.

Parental concerns. Parents of preschool-age children have reported that their concerns about safety inhibit their children's PA (Dwyer et al., 2008; O'Connor, Chen, et al., 2013; Soltero et al., 20016; Suen et al., 2015), including concerns related to neighborhood and community safety (e.g., crime, traffic) (Dwyer et al., 2008; Soltero et al., 2016). In addition, parental concerns about excess screen time are also associated with children's PA levels (He, Irwin, Sangster Bouck, Tucker, & Pollett, 2005; De Decker et al., 2012).

Parenting styles. Parenting styles are psychological constructs that represent broad and standard strategies that parents use in child rearing (Baumrind, 1971). Overall parenting

style encompasses broader patterns of how parents respond and demand to their children (Baumrind, 1971). Four parenting styles have been defined: 1) authoritarian (demand obedience); 2) authoritative (use reasoning); 3) permissive (acquiesce to child's demands) and 4) uninvolved. Only one study included in this review examined the association between parenting styles and preschool-age children's PA levels, and no association was found between parenting styles and time spent in active play nor did parenting styles moderate the relationship between parental support and child active play (Schary, Cardinal, Loprinzi, 2012).

Parenting Practices. Parenting practices describe context-specific behaviors such as what a parent does to facilitate physical activity. A growing, but still limited literature exists on studies that have examined the influence of parenting practices on young children's PA behaviors (Hesketh et al., 2013; O'Connor, Chen, et al., 2013; Oliver, Schofield, & Schluter, 2010; Zecevic, Tremblay, Lovsin and Michel, 2010; Dowda et al., 2011; Hesketh et al., 2014). Results of these studies show that some parental practices, such as encouraging PA, setting rules, providing transportation, **paying fees and tuition**, parental modeling of PA, and engaging in PA activities with children are associated with PA behaviors of preschool-age children (Hesketh et al., 2014; O'Connor, Chen, et al., 2013; Vanderwater et al., 2005; Veitch, Hume, Salmon, Crawford, & Ball, 2013).

An important parenting practice is parental support for physical activity. Available research shows that children are more likely to be active if parents are supportive of them being physically active in a number ways, but especially by providing encouragement, participating in PA together, taking children to places where they can be physically active, and enrolling them in organized activities such as sports classes (Davison et al., 2011;

Zecevic, Tremblay, Lovsin and Michel, 2010). Nevertheless, only limited research has examined the relationship between parental support of PA and preschool-age children's PA levels (Dowda et al., 2011; Gubbles et al., 2011; Hinkley, Salmon, Okely, Crawford, 2013; O'Connor et al., 2013; Scharby et al., 2012; Vanderwater et al., 2005; Zecevic et al., 2010). O'Connor et al. (2013) examined parental encouragement and discouragement of PA among Latino children aged 3-5 and determined that parental practices promoting PA, including enrolling children in sports, participating in the child's activities, and modeling of PA, and supporting children's PA behavior. Grigsby-Toussaint, Chi, and Fiese (2011) found that while certain environmental factors, such as a built environment with high levels of green space are important for PA, most increases in preschoolers' PA is due to parental support for PA. A study with preschool-age boys determined that boys who received greater parental support for PA were significantly more likely to engage in 1 hour or more of daily PA than those who did not receive such support (Zecevic et al., 2010). A study by Østbye and colleagues (2013) found that parental attitudes in support of PA were significantly associated with MVPA among preschool-age children. Suen and colleagues (2015) examined parental practices among Hong Kong preschoolers and determined that providing conditional, instrumental, and motivational support to parents motivated them to encourage children to be physically active. On the other hand, parental emphasis on academic achievement, lack of time and resources, promotion of sedentary behaviors, and safety concerns discouraged PA (Suen et al., 2015).

Parental involvement is another influential parental practice as it relates to PA. A study conducted in New Zealand by Oliver et al. (2010) found a positive association between PA of parents and their preschool-aged children, which suggests the potential importance of parental involvement in preschool-based PA intervention such as parents and children

participating together in activities sponsored by the intervention (e.g., Family Fun Nights) and parents direct involvement in intervention activities beyond the intervention environment (e.g. “try this at home”).

Parental and/or family influences on television-viewing and other screen-viewing.

Most studies focusing on parental and family influences on screen-viewing time of young children have focused on TV (Bagley, Salmon & Crawford, 2006; Barr, Danziger, Hilliard, Andolina, Ruskis, 2010; Certain & Kahn, 2002; Dalzell, Msall, High, 2000; Dawson-Hahn et al., 2015; Downing, Hinkley, Hesketh, 2015; Dennison BA, Erb TA, Jenkins PL., 2002; Jackson, Djafarian, Stewart, & Speakman, 2009; Thompson, Polk, Cheah, Vandewater, Johnson, Chrismer, Tschann, 2015; Vandewater, Rideout, Wartella, Huang, Lee, Shim, 2007).

A study by Jackson et al. (2009) of preschool-age children (2–6 years) found that children who watched more TV were significantly less physically active than children who watched less TV. Similarly, a recent cross-sectional study by Dawson-Hahn et al. (2015) conducted among preschool-age children in found that watching TV was inversely associated with PA. Parental attitudes, screen time, and having a television in the bedroom were positive predictors of children’s excess screen time and inadequate PA.

Parental education and self-efficacy for PA were negative predictors of screen time (Carson & Janssen, 2012). A study by Lampard et al (2013) found low-income preschool-age children (2-5 years) were more likely to meet the American Academy of Pediatrics screen time recommendation (no more than 1 hour per day) if their parent reported high restriction of child screen time. Moreover, in multivariate analysis, less parent screen time, fewer parent life pressures, and greater social support were associated with

parents' high restriction of screen time (Lampard et al., 2013). Downing, Hinkley and Hesketh (2015) found that children whose parents limited television viewing spent significantly less time in watching TV and in total screen time; however, overall sedentary behavior was unaffected. Further studies need to be conducted on how family environment influences sedentary behaviors among children.

Studies suggest that the TV viewing habits of parents and other family members in the household (e.g., older siblings) likely contribute to the time preschoolers spend watching TV (Downing, Hinkley, Hesketh, 2015; Djafarian, Stewart, & Speakman, 2009; Thompson, Polk, Cheah, Vandewater, Johnson, Chrismer, Tschann, 2015). The more time that parents spend watching TV the more time their preschool-aged children spend watching TV (Vandewater, Rideout, Wartella, Huang, Lee, Shim, 2007). A similar pattern is found between older siblings' time spent viewing TV and preschool children's time spent viewing (Vandewater, Rideout, Wartella, Huang, Lee, Shim, 2007).

Current research also indicates that many preschoolers' daily screen time exceeds recommendations. Vandewater, Shim, and Caplovitz (2004) determined that preschool children watched more television than primary school children (2.19 hours/day vs. 1.91 hours/day), with 61.7% of children in the preschool group watching television for at least 2 hours per day.

Other screen-viewing behaviors common among young children include activities such as DVDs/VHS, video games, computers, smartphones, etc (Bagley, Salmon & Crawford, 2006), but to date, these other screen-viewing behaviors have not been extensively examined among preschool-age children.

Siblings and peer influences. Sibling and peer PA and sedentary behaviors appear to be important influences on preschool-aged children's PA and sedentary behaviors. Preschoolers observe and imitate the behaviors of those who are similar to them (Ward et al., 2017). Therefore, siblings and peers may be role models for preschoolers' physical activity. A study conducted in child care centers in Canada found that peers influenced preschoolers' physical activity over time (Ward et al., 2017).

Environmental (Community/Neighborhood) Influences

Promoting physical activities in neighborhood environments where children spend significant amounts of time can contribute to increased PA levels (Goldfield et al., 2012). Several studies show that being outdoors is the strongest correlate of PA among preschool children and that activity levels correlate with the number of play spaces near their homes and the amount of time spent in those spaces (Hart, Herriot, Bishop, & Truby, 2003; Lindsay, Sussner, Greaney, & Peterson, 2009; McKenzie et al., 2008; Roemmich et al., 2006; Salmon et al., 2013). Researching the relationships between built environments and PA is challenging, and designing and implementing supportive environments, corrective programs and policies is complex because environmental factors may vary across children of different demographics (e.g., age, gender, race/ethnicity, SES) and cultural backgrounds (Vandewater et al., 2006).

Weather and season. Natural environments can present barriers to PA. McKee, Murtagh, Boreham, Nevill, and Murphy (2012) examined the influence of season on objectively assessed PA in preschool children in Minnesota and found that children take approximately 2,000 (20%) fewer steps per day in winter than in Spring. A qualitative study by Lindsay et al. (2009) determined that Latina mothers viewed weather as an important factor influencing their preschool children's PA habits in Massachusetts; during cold weather,

children spent more time indoors and engaged in less PA, whereas children spent more time outdoors and in parks and recreational facilities during warmer weather. Similarly, additional qualitative studies with parents of young children in Canada and Australia showed that colder weather posed challenges for parents in keeping their preschoolers physically active (He et al., 2005; Pearson, Salmon, Crawford, Campbell, & Timperio, 2011).

Weather is also an important influence on children's screen time. A qualitative study conducted in six European countries by De Decker and colleagues (2012) found that weather condition was one of the most important factors influencing children's screen time. Researchers suggest that parents should be provided with guidance on alternatives for screen activities and information on how to set rules for screen time to assist them in decreasing their preschool children's screen time.

Time outdoors. The more time preschool children spend outdoors, the higher their PA levels (Boldemann et al., 2006; Burdette, Whitaker, & Daniels, 2004; Hinkley, Crawford, Salmon, Okely, & Hesketh, 2008). Several studies included in this review suggest that parents and caregivers can and should encourage outdoor play (Anderson et al., 2008; Ergler, Kearns, & Witten, 2013; Tandon, Saelens, Zhou, Kerr, & Christakis, 2013; Veitch, Salmon, & Ball, 2010). Questions of safety and accessibility, however, can make it more difficult for some parents and children to spend time outdoors. Minority and low-income parents, for example, are more likely to live in communities with fewer parks, sports facilities, bike paths, and other places for children to be active and safe (Lindsay et al., 2009).

Availability and access to PA programs, parks, and recreational facilities.

Availability and access to PA programs, parks, and recreational facilities are important influences on preschool children's PA. Results from studies reviewed suggest that to support

efforts that promote preschool-age children's PA activity through active play, age-appropriate, outdoor play spaces with access to play equipment should be developed and maintained in communities (Anderson et al., 2008; Burdette & Whitaker, 2005; Ergler, Kearns, & Witten, 2013; Tandon, Saelens, Zhou, Kerr, & Christakis, 2013; Veitch, Salmon, & Ball, 2010). The concept of neighborhood greenness has also been correlated with preschool-age children and PA. Grigsby-Toussaint et al. (2011) determined that families with preschool-age children who have access to recreational facilities with higher levels of green space are more physically active than are preschoolers without access.

Neighborhood safety. As discussed earlier, a number of studies have demonstrated that perceived lack of neighborhood safety is a potential barrier to preschool children's PA (Burdette & Whitaker, 2005; Goldfield et al., 2012; Lindsay et al., 2009; Salmon et al., 2003). For example, a cross-sectional survey of 2,445 mothers of 2-3 year old children found that perceived neighborhood safety was a barrier to PA (Burdette, Wadden, & Whitaker, 2006). Likewise, a qualitative study conducted with Latina mothers in Massachusetts found that mothers reported neighborhood safety as a barrier to PA engagement and to their preschool-age children's active play (Lindsay et al., 2009). On the other hand, research indicates that providing a safe play area and attendants to supervise children increases PA and decreases screen time of young children attending schools near the play areas (Burdette et al., 2006).

Organizational Influences

Early care and education (ECE) settings. Currently, there are several types of early care and education arrangements in the United States. Broadly, they can be broken down into four types: **nurseries/preschools**, center-based child care/daycare, family child care homes, and home-based care from nannies/babysitters. Center-based child care is generally provided

in a public building and children are usually grouped by age in classrooms with at least one trained teacher. Most states regulate center-based childcare. Nursery schools and pre-schools are educational establishments or learning spaces offering early childhood education to children between the ages of 3 and 5 years. Like center-based child care, most states regulate nurseries and pre-schools. Family child care is home-based, and providers care for children other than their own in the providers' own home. Family child care may be licensed or unlicensed, and despite the growing interest in this type of setting, further exploration of PA and sedentary in family child care settings is needed because available studies show that PA levels have been low among preschool-age children attending licensed family child care homes (Lindsay et al., 2016; Vanderloo, Martyniuk, & Tucker, 2015). Home-based care provided by a nanny or a babysitter often involve child care hired on a scheduled full- or part-time basis with care often provided in the child's home.

Results of studies included in this review suggest that day care centers and preschools may be able to provide access to outdoor play spaces for young children (Burdette & Whitaker, 2005; Grigsby-Toussaint et al., 2011), which could foster opportunities to be physically active. A recent study conducted in the U.K. by Hesketh, Griffin & van Sluijs (2015) found that preschool-aged children and particularly boys were less sedentary and more active when in child care compared to at home. Despite opportunities for daycare/child care centers and preschools to provide access to outdoor play spaces for young children some studies have also documented children facing barriers to being physically active in these settings. Using focus groups, Copeland, Kendeigh, Saelens, Kalkwarf, and Sherman (2012) determined that preschool and daycare center teachers believe that PA is important for developing children, but noted that children's inappropriate clothing (e.g., flip-flops or

sandals, dress/expensive clothes, no hat/gloves or coat during the winter) were barriers to children's PA at the daycare centers (Copeland et al., 2012). Furthermore, results showed that clothing choices were a source of conflict between parents and child-care providers (Copeland et al., 2012). In addition, a recent cross-sectional study conducted in Australia by Hinkley, Salmon, Crawford, Okely & Hesketh (2016) found that preschool-age children significantly less active during the hours they spent in organized child care than outside care hours.

Quality of **early education and care** also appears to influence children's PA levels when in these settings. Dowda, Pate, Trost, Almeida, and Sirard (2004) found that children spent more time in sedentary activities at low-quality preschools than did children in high-quality preschools.

Other important influences on levels of PA among preschool-age children in ECE settings include adult support and availability of both outdoor space and play equipment. Using direct observation at child care centers, Bower et al. (2008) determined that adult support and availability of play equipment were associated with greater PA and lower sedentary activity levels among preschoolers. Similarly, a study in the Netherlands focusing on preschools and daycare centers found that locations with greater outdoor space and equipment availability reported higher PA levels in the children (Gubbels, Van Kann, & Jansen, 2012). Likewise a recent study by Schlechter, Rosenkranz, Fees & Dzewaltowski (2017) found that providing more time outdoors and restructuring preschool activities from whole group to small group could increase the amount of total physical activity that children accumulate during preschool.

Policy Influences

Need for PA policies in early care and education settings. There has been a growing interest in understanding how policies in ECE settings influence PA behavior and obesity

prevention efforts in young children in the U.S. (Larson, Ward, Neelon, & Story, 2011). Some studies investigating the role of child care environments in influencing PA levels of preschoolers noted these settings as important venues to promote and support PA among young children, given families' increased reliance on these sites (Gubbels, Van Kann, & Jansen, et al., 2012; Vanderloo et al., 2014). National trends in the U.S show that about 77% of children age 3–5 years spend an average of 30 hours weekly in an ECE setting (Buscemi, Kanwischer, Becker, Ward, & Fitzgibbon, 2015; McPherson & Homer, 2011). A study by Duffey, Slining, and Benjamin Neelon (2014) investigating ECE policies found that no state in the US had regulations for staff joining children in PA, taking away PA opportunities as a punishment for poor classroom behavior (e.g., taking away recess), or providing training/education on PA for childcare providers. Study results suggested that there is room for improvement in childcare regulations related to PA for young children and that updated regulations are needed (Duffey et al., 2014).

National support for PA policies. Some of the leading national health organizations have come to consensus on strategies to support obesity prevention efforts through promotion of PA, reduced screen time, and healthy eating in ECE settings (AAP, American Public Health Association, [National Association of Pediatric Nurse Practitioners \(NAPNAP\)](#), and National Resource Center for Health and Safety in Child Care and Early Education, 2012). With support from the Health Resources and Services Administration, organizations such as the American Academy of Pediatrics, [NAPNAP](#), Maternal Child Health Bureau, American Public Health Association, and the National Resource Center for Health and Safety in Child Care and Early Education have outlined national child care regulations that include PA guidelines for children from birth to 6 years of age (AAP et al., 2012) attending ECE setting. These

guidelines recommend that preschool-age children engage in 90–120 minutes of age-appropriate MVPA per 8-hour day in an ECE setting. If weather permits, preschool-age children should be given two or three occasions of 60–90 minutes of outdoor play, and that structured activities that promote bodily movement should be led by caregiver/teachers two or more times per day (indoor or outdoor). Another recommendation is to have written policies in ECE settings regarding children’s PA while at the ECE. The Institute of Medicine (IOM, 2011) has made policy and policy implementation recommendations for ECE settings, such as the need to increase young children’s PA and reduce sedentary behavior, in order to guide care providers and health professionals. The Society of Behavioral Medicine has recommended that state and local policymakers use effective evidence-based models (e.g., Michelle Obama’s Let’s Move!, Childcare) to implement policies in ECE settings in order to increase PA and reduce sedentary behavior (Buscemi et al., 2015). A recent study in the United States suggested adoption of the Montessori school system as a strategy to promote PA in preschools. Pate et al. (2015) determined that compared to students in traditional preschools, children in Montessori preschools accumulated more light, MVPA, and total PA after adjusting for BMI, sex, SES, and parental education (Pate et al., 2015). Different than traditional school settings where children often sit at their desks for most of the time, children in Montessori programs learn through action and self-discovery, choosing activities and moving about freely during the course of the day (Pate et al., 2015).

In addition, it has been proposed that community policies concerning joint-use agreements related to PA (e.g., school gyms), neighborhood design, and urban planning may increase PA opportunities for preschool-age children (McPherson & Homer, 2011).

Research suggests that state regulations, outlined in the National Resource Center for Health and Safety in Child Care and Early Education (2011), lack specificity about PA frequency in ECE settings (Battista et al., 2014; Benjamin, Cradock, Walker, Slining, & Gillman, 2008; Cradock, O'Donnell, Benjamin, Walker, & Slining, 2010). This is an area of growing research interest, and additional information is critical to providing directions on ways in which state regulations can help promote early physical activity among young children.

ECE policy change efforts. ECE-level policies and efforts have been supportive influences on preschool-age children's PA behaviors in the U.S. (Gubbels, Slining, et al., 2012; Trost, Ward, & Senso, 2010), but states inconsistently regulate the implementation of national policies on PA in ECE settings (Buscemi et al., 2015; Gubbels et al., 2012; Larson et al., 2011; McPherson & Homer, 2011; Vanderloo et al., 2014), and many children do not meet PA levels in childcare centers (Buscemi et al., 2015; Duffey et al., 2014; Vanderloo et al., 2014). There have been attempts to develop and implement PA policies in ECEs. For example, in 2007, New York City's ECE centers implemented new regulations put forth by the New York City Department of Health and Mental Hygiene to reduce screen time, increase PA, and provide healthier beverages (Nonas, Silver, Kettel Khan, & Leviton, 2004). However, results of recent studies evaluating compliance with these recommendations found that compliance was low for offered PA time (38.5%) and structured PA time (34.6%) (Lessard et al., 2014; Nonas et al., 2004).

Barriers to PA policy changes in ECE settings. Some of the barriers to promoting PA in ECE settings that influence adoption of PA regulations are inadequate outdoor/play space, sedentary staff, staff not interested in PA and lack of appropriate equipment (Buscemi

et al., 2015; Nonas et al., 2004). Research gaps in preschool-age children's PA measurements and PA program policy-assessment tools are areas to further explore in ECE sites (Kaciroti, Staples-Watson, & Lumeng, 2012).

DISCUSSION

Using the social-ecological model as a framework, we appraised the current literature to look at the context of and influences on PA for preschool-age children. Our review provides significant evidence for several levels of action to improve the current state of PA for this diverse population. Overall, the two important themes are the importance of increasing access and achieving adult buy-in, including that of parents and child care providers. While policies have focused primarily on the quantity of suggested PA, these twin themes, access to and adult support of PA, could inform future policies and potentially have a positive impact on this important issue.

Findings from studies included in this review elucidated multi-level factors at various levels in the social-ecological model that influence preschool-age children's PA levels and behaviors. At the individual level, factors associated with differing levels of PA include SES and the child's sex (Annesi, Smith, & Tennant, 2013; Bagley et al., 2006; Cespedes et al., 2013; Chuang, Sharman, Skala, & Evans, 2013; Kumanyika & Grier, 2006; Montgomery et al., 2004; O'Connor et al., 2014; Pate et al., 2004; Salmon et al., 2003; Sisson et al., 2009; Suen et al., 2015; Vale et al., 2010; Van Cauwenberghe et al., 2012). At the individual level, some factors suggest that the lack of PA may have to do with lack of access or insufficient family resources to make PA a priority (e.g., SES, family structure), while other factors suggest parental values come into play (child's sex and cultural context).

At the interpersonal level, the presence of siblings, single- versus two-parent family structure, and the parents' culture, parents' PA habits, attitudes toward PA, concerns about the outside environment and their encouragement of PA—are important **factors influencing their children's PA** (Carson et al., 2014; Davison & Birch, 2002; De Decker et al., 2012; Oliver et al., 2010; Østbye et al., 2013; Pfeiffer, Dowda, McIver, & Pate, 2009; Rodriguez-Oliveros et al., 2011). Family time spent watching TV is also an important interpersonal level factor impacting the PA level of young children (Dawson-Hahn et al., 2015; Jackson et al., 2009). In addition, studies suggest that parents can be important mediators of children's sedentary behaviors and should promote other enjoyable alternatives to increase children's level of PA (Salmon et al., 2005). At the interpersonal level, family factors that suggest a need for access include concerns about neighborhood safety and traffic, whereas parents' PA habits and perceptions suggest a need for intervention that address communication, education and provision of guidance for parents regarding the importance of these factors in influencing their children's PA.

At the environmental level, outdoor space—greenness of the environment, weather and season, access to parks and PA programing, and safety and traffic—was the primary factor (Boldemann et al., 2006; Burdette et al., 2004; Ergler et al., 2013; Grigsby-Toussaint et al., 2011; McKee et al., 2012; McKenzie et al., 2008; Salmon et al., 2013; Tandon et al., 2013; Veitch et al., 2010). At the environmental level, identified factors reflect a need for access to safe and age-appropriate places for young children to be active (safety and traffic, weather and seasons). The fact that “greenness” of the outdoor resources has an impact on PA suggests that making the outdoor space desirable as well as useable is important. At the institutional

level, not all EEC facilities have equal resources, and, access is an issue (e.g., availability of indoor and outdoor space for PA, access to age-appropriate equipment, etc.).

At the organizational level, in the context of the ECE settings, teacher/caregiver support of PA, play equipment, and outdoor space were important factors associated with PA of children while at the EEC setting (Bower et al., 2008; Copeland et al., 2012; Dowda et al., 2004; Gubbels, Kremer, et al., 2012; Reilly, 2010).

At the policy level, there is much room for **improvement**. While the National Association for Sport and Physical Education, AAP, and IOM have clear PA guidelines for preschool-age children (AAP et al., 2012; IOM, 2011; NASPE, 2009), compliance is low (Lessard et al., 2014; Nonas et al., 2004).

CONCLUSIONS

PA is a key component of overall physical, social, and mental health (AAP, 2006; Goldfield et al., 2012; Hodges et al., 2013; O'Dwyer et al., 2012). Helping children set the foundation for healthful PA habits early in life is a key component for achieving longer and healthier lives for individuals and the general population. Promoting PA in early childhood requires attention to the child and also caregivers—the home, early care and education (e.g., child care centers, family child care homes, etc.), and community settings in which care and development of children take place. Despite an increasing number of studies focusing on the PA of young children, much remains to be learned about the many factors—such as parenting practices and styles, sociocultural factors, and environmental factors (including childcare settings)—that influence the development and maintenance of PA and sedentary behaviors among preschool-age children and, consequently, the development of obesity in childhood (Lindsay, Sussner, Kim, & Gortmaker, 2006; Lindsay et al., 2009).

Since children's PA habits are initiated very early in life, early PA promotion programs and intervention may not only have immediate health benefits, but may also help reduce chronic disease risks when learned, healthful PA habits and preferences are carried into adulthood (Davison, Edmunds, et al., 2011; Lindsay et al., 2006; Tremblay et al., 2011). This literature provides a comprehensive synthesis of factors related to PA of young children at multiple levels of influence that could be targeted in interventions.

How Might this Information Affect Nursing Practice?

This review provides a comprehensive synthesis of factors related to PA levels and behaviors of young children that could assist pediatric nurses in their daily health promotion and disease prevention efforts with families of young children and in the development of childhood obesity prevention interventions.

With reducing and preventing childhood obesity remaining a public health priority, nurses will continue to be engaged in childhood obesity prevention efforts through practice, research, and education. PA assessment should be integrated as part of well-child visit assessments in pediatric nursing primary care tasks of screening, communication and anticipatory counseling. Integrating such assessment into electronic medical records would help pediatric nurses routinely monitor children's PA behaviors as part of children's overall health status assessment, creating opportunities to communicate to parents the importance of early PA habits as part of their child's overall health. Given pediatric nurses' roles as primary care providers and their frequent and continued contact with parents and children throughout the early childhood years through well-child visits, immunization schedule, and minor acute illnesses, they are well positioned to work with parents to promote and support the development of healthful early physical activity behaviors of young children. **Pediatric nurses**

can play an important role in facilitating communication, education and provision of guidance for parents regarding the importance of PA as well as factors influencing their children's PA levels and behaviors. Nurses may be able to facilitate children's access to PA opportunities is by providing parents with information and anticipatory guidance about various types of physical activities which are developmentally appropriate for young children, as well as list of local places free-of-cost or low-cost where young children and their families can be active.

REFERENCES

- American Academy of Pediatrics (AAP). (2006). Active healthy living: Prevention of childhood obesity through increased physical activity. *Pediatrics*, 117, 1834-1842.
- American Academy of Pediatrics (AAP), American Public Health Association, and National Resource Center for Health and Safety in Child Care and Early Education. (2012). *Preventing childhood obesity in early care and education programs: Selected standards from caring for our children* (2nd ed.). Retrieved from [http://nrckids.org/default/](http://nrckids.org/default/assets/File/PreventingChildhoodObesity2nd.pdf)
[assets/File/PreventingChildhoodObesity2nd.pdf](http://nrckids.org/default/assets/File/PreventingChildhoodObesity2nd.pdf)
- Anand S, Krosnick JA. Demographic predictors of media use among infants, toddlers, and preschoolers. *Am Behav Sci*. 2005;48(5):539–561. doi: 10.1177/0002764204271512.
- Annesi, J. J., Smith A. E., & Tennant, G. A. (2013). Effects of the Start for Life treatment on physical activity in primarily African American preschool children of ages 3-5 years. *Psychology, Health, and Medicine*, 18(3), 300-309.
doi:10.1080/13548506.2012.712704

668 Ariza, A. J., Chen E. H., Binns H. J., Christoffel K. K. (2004) Risk factors for overweight in
669 five- to six-year-old Hispanic-American children: a pilot study. *J Urban*
670 *Health.*;81(1):150-61.

671 Asplund KM, Kair LR, Arain YH, Cervantes M, Oreskovic NM, Zuckerman KE. (2015).
672 Early Childhood Screen Time and Parental Attitudes
673 Toward Child Television Viewing in a Low-Income Latino Population Attending the
674 Special Supplemental Nutrition Program for Women, Infants, and Children.
675 *Child Obes.*,11(5):590-9. doi: 10.1089/chi.2015.0001. Epub 2015 Sep 21.

676 Bagley, S., Salmon, J., & Crawford, D. (2006). Family structure and children's television
677 viewing and physical activity. *Medicine & Science in Sports & Exercise*, 38(5), 910-
678 918.

679 Ball SC, Gillman MW, Mayhew M, Namenek Brouwer RJ, Benjamin Neelon SE. (2015)
680 Physical activity-related and weather-related practices of child care centers from
681 2 states. *J Phys Act Health.*, 12(2):238-44. doi: 10.1123/jpah.2013-0266. Epub 2014
682 Apr 17.

683 Barr R, Danziger C, Hilliard M, Andolina C, Ruskis J. (2010). Amount, content and context
684 of infant media exposure: a parental questionnaire and diary analysis. *Int J Early Years*
685 *Educ.* 18(2):107–122. doi: 10.1080/09669760.2010.494431.

686 Battista, R. A., Oakley, H., Weddell, M. S., Mudd, L. M., Greene, J. B., & West, S. T. (2014).
687 Improving the physical activity and nutrition environment through self-assessment
688 (NAP SACC) in rural area child care centers in North Carolina. *Preventive Medicine*,
689 67(Suppl 1), S10-16. doi:10.1016/j.ypmed.2014.01.022.

- Baumrind D. (1971). Current patterns of parental authority. *Developmental Psychology Monograph*, Part 2, 4 (1): 1–103.
- Beets, M. W., Bornstein, D., Dowda, M., & Pate, R. R. (2011). Compliance with national guidelines for physical activity in U.S. preschoolers: Measurement and interpretation. *Pediatrics*, 127(4), 658-664. doi:10.1542/peds.2010-2021
- Bélanger M, Humbert L, Vatanparast H, Ward S, Muhajarine N, Chow AF, Engler-Stringer R, Donovan D, Carrier N, Leis A. (2016). A multilevel intervention to increase physical activity and improve healthy eating and physical literacy among young children (ages 3-5) attending early childcare centres: the Healthy Start-Départ Santé cluster randomised controlled trial study protocol. *BMC Public Health*. 12;16:313. doi: 10.1186/s12889-016-2973-5.
- Benjamin, S. E., Cradock, A., Walker, E. M., Slining, M., & Gillman, M. W. (2008). Obesity prevention in child care: A review of U.S. state regulations. *BMC Public Health*, 30(8), 188. doi:10.1186/1471-2458-8-188.
- Bentley GF, Turner KM, Jago R. (2016) Mothers' views of their preschool child's screen-viewing behaviour: a qualitative study. *BMC Public Health*, 16:718. doi: 10.1186/s12889-016-3440-z.
- Boldemann, C., Blennow, M., Dal, H., Mårtensson, F., Raustorp, A., Yuen, K., & Wester, U. (2006). Impact of preschool environment upon children's physical activity and sun exposure. *Preventive Medicine*, 42, 301-308.
- Bower, J. K., Hales, D. P., Tate, D. F., Rubin, D. A., Benjamin, S. E., & Ward, D. S. (2008). The child care environment and children's physical activity. *American Journal of Preventive Medicine*, 34(1), 23-29.

713 Burdette, H. L., Wadden, T. A., & Whitaker, R. C. (2006). Neighborhood safety, collective
 714 efficacy, and obesity in women with young children. *Obesity, 14*(3), 518-525.

715 Burdette, H. L., & Whitaker, R. C. (2005). Resurrecting free play in young children: Looking
 716 beyond fitness and fatness to attention, affiliation, and affect. *Archives of Pediatric
 717 and Adolescent Medicine, 159*(1), 46-50.

718 Burdette, H. L., Whitaker, R. C., & Daniels, S. R. (2004). Parental report of outdoor playtime
 719 as a measure of physical activity in preschool-aged children. *Archives of Pediatric and
 720 Adolescent Medicine, 158*(4), 353-357.

721 Buscemi, J., Kanwisher, K., Becker, A. B., Ward, D. S., & Fitzgibbon, M. L. (2015). Society
 722 of Behavioral Medicine position statement: Early care and education (ECE) policies
 723 can impact obesity prevention among preschool-aged children. *Translational
 724 Behavioral Medicine, 5*(1), 122-125.

725 Carlson SA, Fulton JE, Lee SM, Foley JT, Heitzler C, Huhman M. (2010). Influence of limit-
 726 setting and participation in physical activity on youth screen time. *Pediatrics.*,
 727 126(1):e89-96. doi: 10.1542/peds.2009-3374.
 728

729 Carson, V., & Janssen, I. (2012). Associations between factors with the home setting and
 730 screen time among children aged 0-5 years: A cross-sectional study. *BMC Public
 731 Health, 12*, 539. doi:10.1186/1471-2458-12-539.

732 Carson, V., Stearns, J., & Janssen, I. (2015). The Relationship Between Parental Physical
 733 Activity and Screen Time Behaviors and the Behaviors of their Young Children.
 734 *Pediatr Exerc Sci.*, 27(3):390-5. doi: 10.1123/pes.2014-0214.

735 Cerin E, Baranowski T, Barnett A, Butte N, Hughes S, Lee RE, Mendoza JA, Thompson D,
 736 O'Connor TM. (2016). Places where prechoolers are (in) active: an observational

study on Latino preschoolers and their parents using objective measures. *Int J Behav Nutr Phys Act.* 29;13:29. doi: 10.1186/s12966-016-0355-0.

Certain LK, Kahn RS. (2002). Prevalence, correlates, and trajectory of television viewing among infants and toddlers. *Pediatrics.* 109(4):634–642. doi: 10.1542/peds.109.4.634

Cespedes, E. M., McDonald, J., Haines, J., Bottino, C. J., & Taveras, E. M. (2013). Obesity-related behaviors of U.S. and non-U.S. born parents and children in low-income households. *Journal of Developmental and Behavioral Pediatrics*, 34(8), 541-548.

Chen, T. A., O'Connor, T. M., Hughes, S. O., Frankel, L., Baranowski, J., Mendoza, J. A., Thompson, D., & Baranowski, T. (2013). TV parenting practices: Is the same scale appropriate for parents of children of different ages? *International Journal for Behavioral Nutrition and Physical Activity*, 10(41). doi:10.1186/1479-5868-10-41.

Cheng S, Maeda T, Yoichi S, Yamagata Z, Tomiwa K. (2010). Early television exposure and children's behavioral and social outcomes at age 30 months. *J Epidemiol.* 20(Suppl 2):S482–S489.

Chuang R. J., Sharman S., Skala, K., & Evans, A. (2013). Ethnic differences in the home environment and physical activity behaviors among low-income, minority preschoolers in Texas. *American Journal of Health Promotion*, 27(4), 270-278. doi:10.4278/ajhp.110427-QUAN-171

Commonwealth of Australia, Department of Health and Ageing. (2010). *Move and play every day: National physical activity recommendations for children 0 to 5 years*. Retrieved from <http://www.health.gov.au/internet/main/publishing.nsf/content>

759 /9D831D9E6713F92ACA257BF0001F5218/\$File/0-5yrACTIVE_Brochure
 760 _FA%20SCREEN.pdf

761 Copeland, K. A., Kendeigh, C. A., Saelens, B. E., Kalkwarf, H. J., & Sherman, S. N. (2012).
 762 Physical activity in child-care centers: Do teachers hold the key to the playground?
 763 *Health Education Research*, 27(1), 81-100.

764 Copeland KA, Sherman SN, Khoury JC, Foster KE, Saelens BE, Kalkwarf HJ. (2011). Wide
 765 variability in physical activity environments and weather-related outdoor play policies
 766 in childcare centers within a single county of Ohio. *Arch Pediatr Adolesc*
 767 *Med.*, 165(5):435-42. doi: 10.1001/archpediatrics.2010.267. Epub 2011 Jan 3.

768 Copeland KA, Khoury JC, Kalkwarf HJ. (2016). Child Care Center Characteristics Associated
 769 With Preschoolers' Physical Activity. *Am J Prev Med.*, 50(4):470-9. doi:
 770 10.1016/j.amepre.2015.08.028.

771 Cradock, A. L., O'Donnell, E. M., Benjamin, S. E., Walker, E., & Slining, M. (2010). A
 772 review of state regulations to promote physical activity and safety on playgrounds
 773 in child care centers and family child care homes. *Journal of Physical Activity and*
 774 *Health*, 7(Suppl 1), S108-119.

775 Davison, K. K., & Birch, L. L. (2002). Obesogenic families: Parents' physical activity and
 776 dietary intake patterns predict girls' risk of overweight. *International Journal of*
 777 *Obesity*, 26, 1186-1193.

778 Davison, K. K., Edmunds, L. S., Wyker, B. A., Young, L. M., Sarfoh, V. S., & Sekhobo, J. P.
 779 (2011). Feasibility of increasing childhood outdoor play and decreasing television
 780 viewing through a family-based intervention in WIC, New York State, 2007-2008.
 781 *Prevention of Chronic Disease*, 8, A54.

Dawson-Hahn, E. E., Fesinmeyer, M. D., & Mendoza, J. A. (2015). Correlates of physical activity in Latino preschool children attending Head Start. *Pediatric Exercise Science*, 27(3), 372-379. doi:10.1123/pes.2014-0144.

Dalzell VP, Msall ME, High PC. (2000). Parental attitudes of television and videocassette viewing of children aged birth to 36 months. *J Dev Behav Pediatr.* 21(5):390.

De Decker, E., De Craemer, M., De Bourdeaudhuij, I., Wijndaele, K., Duvinage, K., Koletzko, B., ... Cardon, G. (2012). Influencing factors of screen time in preschool children: An exploration of parents' perceptions through focus groups in six European countries. *Obesity Review*, (Suppl 1), 75-84. doi:10.1111/j.1467-789X.2011.00961.x.

Dennison BA, Erb TA, Jenkins PL. (2002). Television viewing and television in bedroom associated with overweight risk among low-income preschool children. *Pediatrics.* 109(6):1028-35.

Department of Health, Physical Activity, Health Improvement and Protection. (2011). *Start active, stay active: A report on physical activity for health from the four home countries' Chief Medical Officers*. London, England: Author.

Dowda, M., Pate, R., Trost, S., Almeida, M., & Sirard, J. (2004). Influences of preschool policies and practices on children's physical activity. *Journal of Community Health*, 29, 183-196.

Dowda, M., Pfeiffer K. A., Brown W. H., Mitchell J. A., Byun W., Pate R. R. (2011) Parental and environmental correlates of physical activity of children attending preschool. *Arch Pediatr Adolesc Med.* 165(10):939-44. doi: 10.1001/archpediatrics.2011.84. Epub 2011 Jun 6.

804 Downing KL, Hinkley T, Hesketh KD. (2015). Associations of Parental Rules and
805 Socioeconomic Position With Preschool Children's Sedentary
806 Behaviour and Screen Time. *J Phys Act Health.*, 12(4):515-21. doi:
807 10.1123/jpah.2013-0427.

808 Duffey, K. J., Slining, M. M., & Benjamin Neelon, S. E. (2014). States lack physical
809 activity policies in child care that are consistent with national recommendations.
810 *Childhood Obesity*, 10(6), 491-500. doi:10.1089/chi.2014.0096

811 Dwyer, G. M., Higgs, J., Hardy, L. L., & Baur, L. A. (2008). What do parents and preschool
812 staff tell us about young children's physical activity: A qualitative study. *International*
813 *Journal of Behavioral Nutrition and Physical Activity*, 5, 66. doi:10.1186/1479-5868-
814 5-66

815 Dwyer, J., Needham, L., Simpson, J. R., & Heeney, E. S. (2008). Parents report intrapersonal,
816 interpersonal, and environmental barriers to supporting healthy eating and physical
817 activity among their preschoolers. *Applied Physiology, Nutrition, and Metabolism*,
818 33(2), 338-46. doi:10.1139/H07-195.

819 Edwards MJ, Jago R, Sebire SJ, Kesten JM, Pool L, Thompson JL. The influence of friends
820 and siblings on the physical activity and screen viewing behaviours of children aged 5-
821 6 years: a qualitative analysis of parent interviews. *BMJ Open.*, 5(5):e006593. doi:
822 10.1136/bmjopen-2014-006593.

823 Ekelund, U., Brage, S., & Wareham, N. J. (2004). Physical activity in young children. *Lancet*,
824 363(9415), 1163-1164.

825 Ergler, C. R., Kearns, R. A., & Witten, K. (2013). Seasonal and locational variations in
826 children's play: Implications for wellbeing. *Social Science Medicine*, 91, 178-185.

827 Fakhouri, T. H., Hughes, J. P., Brody, D. J., Kit, B. K., & Ogden, C. L. (2013). Physical
828 activity and screen-time viewing among elementary school-aged children in the United
829 States from 2009 to 2010. *JAMA Pediatrics*, 167(3), 223-229.

830 Finch M, Wolfenden L, Falkiner M, Edenden D, Pond N, Hardy LL, Milat AJ, Wiggers J.
831 (2012). Impact of a population based intervention to increase the adoption of
832 multiple physical activity practices in centre based childcare services: a quasi
833 experimental, effectiveness study. *Int J Behav Nutr Phys Act.* 29;9:101. doi:
834 10.1186/1479-5868-9-101.

835 Finn, K., Johannsen, N., & Specker, B. (2002). Factors associated with physical activity in
836 preschool children. *Journal of Pediatrics*, 140(1), 81-85.

837 Fitzgibbon, M.L., Stolley, M.R., Schiffer, L.A., Braunschweig, C.L., Gomez, S.L., Van Horn
838 L., Dyer, A.R. (2011). Hip-Hop to Health Jr. Obesity Prevention Effectiveness Trial:
839 post-intervention results. *Obesity (Silver Spring)*.;19(5):994-1003. doi:
840 10.1038/oby.2010.314.

841 Fitzgibbon, M.L., Stolley, M.R., Schiffer, L.A., Van Horn L., Christoffel K.K., Dyer, A.R.
842 (2006). Hip-Hop to Health Jr. for Latino Preschool Children. *Obesity* 14 (9): 1617-
843 1625.

844 Gallagher MR. (2010). Maternal perspectives on lifestyle habits that put children of Mexican
845 descent at risk for obesity. *J Spec Pediatr Nurs.*;15(1):16-25. doi: 10.1111/j.1744-
846 6155.2009.00213.x.

847 Garriguet D, Carson V, Colley RC, Janssen I, Timmons BW, Tremblay MS. (2016). Physical
848 activity and sedentary behavior of Canadian children aged 3 to 5. *Health Rep.* 21;
849 27(9):14-23.

850 Goldfield, G. S., Harvey, A., Grattan, K., & Adamo, K. B. (2012). Physical activity promotion
851 in the preschool years: A critical period to intervene. *International Journal of*
852 *Environmental Research and Public Health*, 9(4), 1326-1342.

853 Grigsby-Toussaint, D. S., Chi, S. H., & Fiese, B. H. (2011). Where they live, how they play:
854 Neighborhood greenness and outdoor physical activity among preschoolers.
855 *International Journal of Health Geography*, 10, 66.

856 Gubbels, J. S., Kremer, S. P., Van Kann, D. H., Stafleu, A., Candel, M. J., Dagnelie, P. C., ...
857 de Vries, N. K. (2012). Interaction between physical environment, social environment,
858 and child characteristics in determining physical activity at child care. *Health*
859 *Psychology*, 30(1), 84-90.

860 Gubbels, J. S., Van Kann, D. H., & Jansen, M. W. (2012). Play equipment, physical
861 activity opportunities, and children's activity levels at child care. *Journal of*
862 *Environmental and Public Health*, 2012. doi:10.1155/2012/326520

863 Gubbels J. S., Kremers S. P. J., Stafleu A., de Vries SI, Goldbohm RA, Dagnelie PC, de Vries
864 NK, van Buuren S, Thijs C. (2011). Association between parenting practices and
865 children's dietary intake, activity behavior and development of body mass index: the
866 KOALA birth cohort study. *International Journal of Behavioral Nutrition and*
867 *Physical Activity*. 8, article 18 doi: 10.1186/1479-5868-8-18.

868 Hnatiuk JA, Ridgers ND, Salmon J, Hesketh KD. (2016). Maternal correlates of young
869 children's physical activity across periods of the day. *J Sci Med Sport*. 14. pii: S1440-
870 2440(16)30119-0. doi: 10.1016/j.jsams.2016.06.014.

871 Hart, K. H., Herriot, A., Bishop, J. A., & Truby, H. (2003). Promoting healthy diet and
872 exercise patterns amongst primary school children: A qualitative investigation of
873 parental perspectives. *Journal of Human Nutrition and Dietetics*, 16, 89-96.

874 He, M., Irwin, J. D., Sangster Bouck, L. M., Tucker, P., & Pollett, G. L. (2005). Screen-
875 viewing behaviors among preschoolers: Parents' perceptions. *American Journal of*
876 *Preventive Medicine*, 29, 120-125. doi:10.1016/j.amprepe.2005.04.004

877 Hesketh KR, Griffin SJ, van Sluijs EM. (2015). UK Preschool-aged children's physical
878 activity levels in childcare and at home: a cross-sectional exploration. *Int J Behav Nutr*
879 *Phys Act.*, 26, 12:123. doi: 10.1186/s12966-015-0286-1.

880 Hesketh, K. R., Goodfellow, L., Ekelund, U., McMinn, A. M., Godfrey, K. M., Inskip, H. M.,
881 ... van Sluijs, E. M. F. (2014). Activity levels in mothers and their preschool children.
882 *Pediatrics*, 133(4), 973-980.

883 Hesketh, K. R., McMinn, A. M., Griffin, S. J., Harvey, N. C., Godfrey, K. M., Inskip, H. M.,
884 ... van Sluijs, E. M. (2013). Maternal awareness of young children's physical activity:
885 Levels and cross-sectional correlates of overestimation. *BMC Public Health*, 13, 924.

886 Hinkley, T., Crawford, D., Salmon, J., Okely, A. D., & Hesketh, K. (2008). Preschool
887 children and physical activity: A review of correlates. *American Journal of Preventive*
888 *Medicine*, 34(5), 435-441.

889 Hinkley, T., Salmon, J., Okely, A. D., Crawford, D., & Hesketh, K. (2011). Influences on
890 preschool children's physical activity: Exploration through focus groups. *Family and*
891 *Community Health*, 34(1), 39-50.

892 Hinkley T., Salmon J., Okely A. D., Crawford D. (2013). The correlates of preschoolers'
893 compliance with screen recommendations exist across multiple domains. *Preventive*
894 *Medicine*. 57(3):212–219. doi: 10.1016/j.ypmed.2013.05.020.

895 Hinkley T, Salmon J, Crawford D, Okely AD, Hesketh KD. (2016). Preschool and childcare
896 center characteristics associated with children's physical activity during care hours: an
897 observational study. *Int J Behav Nutr Phys Act*. 11;13(1):117.

898 Hodges, E. A., Smith, C., Tidwell, S., & Berry, D. (2013). Promoting physical activity in
899 preschoolers to prevent obesity: A review of the literature. *Journal of Pediatric*
900 *Nursing*, 28(1), 3-19.

901 Horodyski MA, Stommel M, Brophy-Herb HE, Weatherspoon L. (2010). Mealtime
902 television viewing and dietary quality in low-income African American and Caucasian
903 mother-toddler dyads. *Matern Child Health J*. 14(4):548–556. doi: 10.1007/s10995-
904 009-0501-2.

905 Institute of Medicine (IOM). (2011). *Early childhood obesity prevention policies*.
906 Washington, DC: The National Academies Press.

907 Jackson, D. M., Djafarian, K., Stewart, J., & Speakman, J. R. (2009). Increased television
908 viewing is associated with elevated body fatness but not with lower total energy
909 expenditure in children. *American Journal of Clinical Nutrition*, 89(4), 1031-1036.
910 doi:10.3945/ajcn.2008.26746

911 Jones, S., Hendricks, S., & Draper, C. E. (2014). Assessment of physical activity and
912 sedentary behavior at preschools in Cape Town, South Africa. *Childhood Obesity*,
913 10(6), 501-510. doi:10.1089/chi.2014.0097

914 Kaciroti, N., Staples-Watson, J., & Lumeng, J. C. (2012). Enhancing self-regulation as a
 915 strategy for obesity prevention in Head Start preschoolers: The growing healthy study.
 916 *BMC Public Health*, 30(12), 1040.

917 Kelly, L. A., Reilly, J. J., Fisher, A., Montgomery, C., Williamson, A., McColl, J. H., ...
 918 Grant, S. (2006). Effect of socioeconomic status on objectively measured physical
 919 activity. *Archives of Disease in Childhood*, 91(1), 35-38.
 920 doi:10.1136/adc.2005.080275.

921 Kourlaba G, Kondaki K, Liarigkovinos T, Manios Y. (2009). Factors associated with
 922 television viewing time in toddlers and preschoolers in Greece: the GENESIS study. *J*
 923 *Public Health (Oxf)* 31(2):222–230. doi: 10.1093/pubmed/fdp011.

924 Kuepper-Nybelen, J., Lamerz, A., Bruning, N., Hebebrand, J., Herpertz-Dahlmann, B., &
 925 Brenner, H. (2005). Major differences in prevalence of overweight according to
 926 nationality in preschool children living in Germany: Determinants and public health
 927 implications. *Archives of Disease in Childhood*, 90, 359-363.

928 Kumanyika, S., & Grier, S. (2006). Targeting interventions for ethnic minority and low-
 929 income populations. *Future Child*, 16(1), 187-207.

930 Lampard AM, Jurkowski JM, Davison KK. (2013). The family context of low-income parents
 931 who restrict child screen time. *Child Obes.*, 9(5):386-92. doi: 10.1089/chi.2013.0043.

932 Lapierre MA, Piotrowski JT, Linebarger DL. (2012). Background television in the homes of
 933 US children. *Pediatrics*. 2012;130(5):839–846. doi: 10.1542/peds.2011-2581.

934 LaRowe TL, Tomayko EJ, Meinen AM, Hoiting J, Saxler C, Cullen B; Wisconsin Early
 935 Childhood Obesity Prevention Initiative (WECOPI). (2016) Active Early: one-
 936 year policy intervention to increase physical activity among early care and education

937 programs in Wisconsin. *BMC Public Health*, 16:607. doi: 10.1186/s12889-016-3198-
 938 3.

939 Larson, N., Ward, D. S., Neelon, S. B., & Story, M. (2011). What role can child-care settings
 940 play in obesity prevention? A review of the evidence and call for research efforts.
 941 *Journal of the American Dietetic Association*, 111(9), 1343-1362.

942 Lessard, L., Lesesne, C., Kakietek, J., Breck, A., Jernigan, J., Dunn, L., ... Khan, L. K.
 943 (2014). Measurement of compliance with New York City's regulations on beverages,
 944 physical activity, and screen time in early child care centers. *Prevention of Chronic
 945 Disease*, 16(11), E183. doi:10.5888/pcd11.130433.

946 Levin S, Martin MW, Riner WF. (2004). TV viewing habits and body mass index among
 947 South Carolina Head Start children. *Ethn Dis.* ;14(3):336-9.

948 Lindsay AC, Greaney ML, Wallington SF, Sands FD, Wright JA, Salkeld J. (2017).
 949 Latino parents' perceptions of the eating and physical activity experiences of their pre-
 950 school children at home and at family child-care homes: a qualitative study. *Public
 951 Health Nutr.*;20(2):346-356. doi: 10.1017/S136898001600207X.

952 Lindsay, A. C., Sussner, K. M., Greaney, M. L., & Peterson, K. E. (2009). Influence of social
 953 context on eating, physical activity, and sedentary behaviors of Latina mothers and
 954 their preschool-age children. *Health Education and Behavior*, 36, 81-96.

955 Lindsay, A. C., Sussner, K. M., Kim, J., & Gortmaker, S. L. (2006). The role of parents in
 956 preventing childhood obesity. *Future Child*, 16(1), 169-186.

957 Linebarger DL, Walker D. (2005) Infants' and toddlers' television viewing and language
 958 outcomes. *Am Behav Sci.* 48(5):624-645. doi: 10.1177/0002764204271505.

959 Loprinzi, P. D., & Trost, S. G. (2010). Parental influences on physical activity behavior in
 960 preschool children. *Preventive Medicine*, 50(3), 129-133.

961 Lumeng JC, Rahnema S, Appugliese D, Kaciroti N, Bradley RH. (2006). Television exposure
 962 and overweight risk in preschoolers. *Arch Pediatr Adolesc Med*. 160(4):417–422. doi:
 963 10.1001/archpedi.160.4.417.

964 Manios Y, Kondaki K, Kourlaba G, Grammatikaki E, Birbilis M, Ioannou E. (2009).
 965 Television viewing and food habits in toddlers and preschoolers in Greece: the
 966 GENESIS study. *Eur J Pediatr*. 168(7):801–808. doi: 10.1007/s00431-008-0838-3.

967 Masur EF, Flynn V. (2008). Infant and mother-infant play and the presence of the television. *J*
 968 *Appl Dev Psychol*. 29(1):76–83. doi: 10.1016/j.appdev.2007.10.001.

969 McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1988). An ecological perspective on
 970 health promotion programs. *Health Education Quarterly*, 15(4), 351-377.

971 McKee, D. P., Murtagh, E. M., Boreham, C. A., Nevill, A. M., & Murphy, M. H. (2012).
 972 Seasonal and annual variation in young children's physical activity. *Medicine &*
 973 *Science in Sports & Exercise*, 44(7), 1318-1324.
 974 doi:10.1249/MSS.0b013e3182464db5

975 McKenzie, T. L., Baquero, B., Crespo, N. C., Arredondo, E. M., Campbell, N. R., & Elder,
 976 J. P. (2008). Environmental correlates of physical activity in Mexican American
 977 children at home. *Journal of Physical Activity and Health*, 5(4), 579-591.

978 McLeroy, K. R., Bibeau, D., Steckler, A., & Glanz, K. (1998). An ecological perspective on
 979 health promotion programs. *Health Education Quarterly*, 15(4), 351-377.

980 McLearn KT, Minkovitz CS, Strobino DM, Marks E, Hou W. (2006). The timing of maternal
 981 depressive symptoms and mothers' parenting practices with young children:

982 implications for pediatric practice. *Pediatrics*. 118(1):e174–e182. doi:
 983 10.1542/peds.2005-1551.

984 McPherson, M. E., & Homer, C. J. (2011). Policies to support obesity prevention for children:
 985 A focus on of early childhood policies. *Pediatric Clinics of North America*, 58(6),
 986 1521-1541.

987 Mendelsohn AL, Dreyer BP, Brockmeyer CA, Berkule-Silberman SB, Huberman HS,
 988 Tomopoulos S. (2011). Randomized controlled trial of primary care pediatric
 989 parenting programs: effect on reduced media exposure on infants, mediated through
 990 enhanced parent–child interaction. *Arch Pediatr Adolesc Med*. 165(1):42–48. doi:
 991 10.1001/archpediatrics.2010.266.

992 Mendoza, J. A., Zimmerman, F. J., & Christakis, D. A. (2007). Television viewing, computer
 993 use, obesity, and adiposity in US preschool children. *International Journal of*
 994 *Behavioral Nutrition and Physical Activity*, 4, 44.

995 Montgomery, C., Reilly, J., Jackson, D., Kelly, L. A., Slater, C., Paton, J. Y., & Grant, S.
 996 (2004). Relation between physical activity and energy expenditure in a representative
 997 sample of young children. *American Journal of Clinical Nutrition*, 80(3), 591-596.

998 National Association for Sport and Physical Education (NASPE). (2009). *Active start: A*
 999 *statement of physical activity guidelines for children from birth to age 5* (2nd ed.).
 1000 Sewickley, PA: American Alliance for Health, Physical Education, Recreation, and
 1001 Dance.

1002 National Resource Center for Health and Safety in Child Care and Early Education (NRC),
 1003 University of Colorado Denver. (2011). *Achieving a state of healthy weight: A*

1004 *national assessment of obesity prevention terminology in Child Care Regulations*
1005 2010. Aurora, CO: Author.

1006 Nonas, C., Silver, L. D., Kettel Khan, L., & Leviton, L. (2004). Rationale for New York
1007 City's regulations on nutrition, physical activity, and screen time in early child care
1008 centers. *Prevention of Chronic Disease, 11*, E182. doi:10.5888/pcd11.130435

1009 O'Connor, T. M., Cerin, E., Hughes, S. O., Robles, J., Thompson, D., Baranowski, T., ...
1010 Shewchuk, R. M. (2013). What Hispanic parents do to encourage and discourage 3-4
1011 year old children to be active: A qualitative study using nominal group technique.
1012 *International Journal of Behavioral Nutrition and Physical Activity, 10*, 93.
1013 doi:10.1186/1479-5868-10-93

1014 O'Connor, T. M., Cerin, E., Lee, R. E., Parker, N., Chen, T. A., Hughes, S. O., ...
1015 Baranowski, T. (2014). Environmental and cultural correlates of physical activity
1016 parenting practices among Latino parents with preschool-aged children: Niños activos.
1017 *BMC Public Health, 14*, 707. doi:10.1186/1471-2458-14-707

1018 O'Connor, T. M., Chen, T. A., Baranowski, J., Thompson, D., & Baranowski, T. (2013).
1019 Physical activity and screen-media-related parenting practices have different
1020 associations with children's objectively measured physical activity. *Childhood Obesity*,
1021 9(5), 446-453.

1022 O'Dwyer, M. V., Fairclough, S. J., Knowles, Z., & Stratton, G. (2012). Effect of a family
1023 focused active play intervention on sedentary time and physical activity in preschool
1024 children. *International Journal of Behavioral Nutrition and Physical Activity, 9*(1), 1-
1025 13.

1026 Okely, A. D., Salmon, J., Trost, S. G., & Hinkley, T. (2008). *Discussion paper for the*
 1027 *development of physical activity recommendations for children under five years.*
 1028 Canberra, Australia: Commonwealth Department of Health and Ageing.

1029 Oliver, M., Schofield, G. M., & Schluter, P. J. (2010). Parent influences on preschoolers'
 1030 objectively assessed physical activity. *Journal of Science and Medicine in Sport,*
 1031 *13*(4), 403-409.

1032 Østbye, T., Malhotra, R., Stroe, M., Lovelady, C., Brouwer, R., Zucker, N., Fuemmeler, B.
 1033 (2013). The effect of the home environment on physical activity and dietary intake
 1034 in preschool children. *International Journal of Obesity* (London), *37*(10), 1314-21.
 1035 doi:10.1038/ijo.2013.76

1036 Pate, R. R., O'Neill, J. R., Brown, W. H., Pfeiffer, K. A., Dowda, M., & Addy, C. L. (2015).
 1037 Prevalence of Compliance with a New Physical Activity Guideline for Preschool-Age
 1038 Children. *Childhood Obesity*, *11*(4), 415-420. doi:10.1089/chi.2014.0143

1039 Pate, R. R., Pfeiffer, K. A., Trost, S. G., Ziegler, P., & Dowda, M. (2004). Physical activity
 1040 among children attending preschools. *Pediatrics*, *114*, 1258-1263.

1041 Pearson, N., Salmon, J., Crawford, D., Campbell, K., & Timperio, A. (2011). Are parental
 1042 concerns for child TV viewing associated with child TV viewing and the home
 1043 sedentary environment? *International Journal of Behavioral Nutrition and Physical*
 1044 *Activity*, *8*, 102. doi:10.1186/1479-5868-8-102

1045 Pfeiffer, K. A., Dowda, M., McIver, K. L., & Pate, R. R. (2009). Factors related to objectively
 1046 measured physical activity in preschool children. *Pediatric Exercise Science*, *21*(2),
 1047 196-208.

- 1048 Pratt, M., Epping, J. N., & Dietz, W. H. (2009). Putting physical activity into public health: A
1049 historical perspective from the CDC. *Preventive Medicine*, 49(4), 301-302.
- 1050 Prochaska, JO.; DiClemente, CC. The transtheoretical approach. In: Norcross, JC; Goldfried,
1051 MR. (eds.) *Handbook of psychotherapy integration*. 2nd ed. New York: Oxford
1052 University Press; 2005. p.147–171.
- 1053 Rodríguez-Oliveros, G., Haines, J., Ortega-Altamirano, D., Power, E., Taveras, E. M.,
1054 González-Unzaga, M. A., & Reyes-Morales, H. (2011). Obesity determinants in
1055 Mexican preschool children: Parental perceptions and practices related to feeding and
1056 physical activity. *Archives of Medical Research*, 42(6), 532-539.
- 1057 Roemmich, J. N., Epstein, L. H., Raja, S., Yin, L., Robinson, J., & Winiewicz, D. (2006).
1058 Association of access to parks and recreational facilities with the physical activity of
1059 young children. *Preventive Medicine*, 43(6), 437-441.
- 1060 Rosenstock, I. (1974). *Historical Origins of the Health Belief Model*. *Health Education*
1061 *Monographs*. Vol. 2 No. 4.
- 1062 Ruiz, R., Gesell, S. B., Buchowski, M. S., Lambert, W., & Barkin, S. L. (2011). The
1063 relationship between Hispanic parents and their preschool-aged children's physical
1064 activity. *Pediatrics*, 127(5), 888-895.
- 1065 Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. (2006).
1066 An ecological approach to creating active living communities. *Annu Rev Public*
1067 *Health.*, 27:297-322.
- 1068 Salmon, J., Ball, K., Crawford, D., Booth, M., Telford, A., Hume, C., ... Worsley, A. (2005).
1069 Reducing sedentary behaviour and increasing physical activity among 10-year-old

1070 children: Overview and process evaluation of the “switch-play” intervention. *Health*
1071 *Promotion International*, 20(1), 7-17.

1072 Salmon, J., Owen, N., Crawford, D., Bauman, A., & Sallis, J. F. (2003). Physical activity and
1073 sedentary behavior: A population-based study of barriers, enjoyment, and preference.
1074 *Health Psychology*, 22(2), 178-188.

1075 Salmon, J., Veitch, J., Abbott, G., ChinAPaw, M., Brug, J. J., teVelde, S. J., ... Ball, K.
1076 (2013). Are associations between the perceived home and neighbourhood environment
1077 and children’s physical activity and sedentary behaviour moderated by urban/rural
1078 location? *Health Place*, 24, 44-53. doi:10.1016/j.healthplace.2013.07.010

1079 Sawyer, A., Smith, L., Schrepft, S., van Jaarsveld, C. H., Wardle, J., & Fisher, A. (2014).
1080 Primary caregiver knowledge of paediatric physical activity recommendations in the
1081 United Kingdom and its association with caregiver behaviour: An observational study.
1082 *BMC Public Health*, 14, 795. doi:10.1186/1471-2458-14-795.

1083 Schary D. P., Cardinal B. J., Loprinzi P. D. (2012). Parental support exceeds parenting style
1084 for promoting active play in preschool children. *Early Child Development and*
1085 *Care*. 182(8):1057–1069. doi: 10.1080/03004430.2012.685622.

1086 Schlechter CR, Rosenkranz RR, Fees BS, Dzewaltowski DA. Preschool Daily Patterns
1087 of Physical Activity Driven by Location and Social Context. *J Sch Health*. 2017
1088 Mar;87(3):194-199. doi: 10.1111/josh.12486.

1089 Sigmundová D, Sigmund E, Badura P, Vokáčová J, Trhlíková L, Bucksch J. (2016).
1090 Weekday-weekend patterns of physical activity and screen time in parents and their
1091 preschoolers. *BMC Public Health*, 16:898. doi: 10.1186/s12889-016-3586-8.

1092 Sisson, S. B., Church, T. S., Martin, C. K., Tudor-Locke, C., Smith, S. R., Bouchard, C., ...
 1093 Katzmarzyk, P. T. (2009). Profiles of sedentary behavior in children and adolescents:
 1094 The U.S. National Health and Nutrition Examination Survey, 2001-2006. *International*
 1095 *Journal of Pediatric Obesity*, 4(4), 353-359.

1096 Schmidt ME, Rich M, Rifas-Shiman SL, Oken E, Taveras EM. (2009). Television viewing in
 1097 infancy and child cognition at 3 years of age in a US cohort. *Pediatrics*. 123(3):e370–
 1098 e375. doi: 10.1542/peds.2008-3221.

1099 Smith BJ, Grunseit A, Hardy LL, King L, Wolfenden L, Milat A. (2010). Parental influences
 1100 on child physical activity and screen viewing time: a population based study. *BMC*
 1101 *Public Health*,10:593. doi: 10.1186/1471-2458-10-593.

1102 Stephens RL, Xu Y, Lesesne CA, Dunn L, Kakietek J, Jernigan J, Khan LK. (2014).
 1103 Relationship between child care centers' compliance with physical activity regulations
 1104 and children's physical activity, New York City, 2010. *Prev Chronic Dis.*, 11:E179.
 1105 doi: 10.5888/pcd11.130432.

1106 Soltero EG, Cerin E, Lee RE, O'Connor TM. (2016). Associations Between Objective and
 1107 Self-Report Measures of Traffic and Crime Safety in Latino Parents of Preschool
 1108 Children. *J Immigr Minor Health*. 1-12. doi:10.1007/s10903-016-0498-8. Sep 28.
 1109 [Epub ahead of print]

1110 Tandon PS, Walters KM, Igoe BM, Payne EC, Johnson DB. (2016). Physical
 1111 Activity Practices, Policies and Environments in Washington State Child
 1112 Care Settings: Results of a Statewide Survey. *Matern Child Health J.*, 2016 Jul 22.
 1113 [Epub ahead of print]

1114 Tandon, P. S., Saelens, B. E., Zhou, C., Kerr, J., & Christakis, D. A. (2013). Indoor versus
 1115 outdoor time in preschoolers at child care. *American Journal of Preventive Medicine*,
 1116 44(1), 85-88.

1117 Taylor, R. W., Murdoch, L., Carter, P., Gerrard, D. F., Williams, S. M., & Taylor, B. J.
 1118 (2009). Longitudinal study of physical activity and inactivity in preschoolers: The
 1119 FLAME study. *Medicine & Science in Sports & Exercise*, 41(1), 96-102.

1120 The World Bank. Data High income: OECD. 2013.

1121 Thompson AL, Adair LS, Bentley ME. (2013). Maternal characteristics and perception of
 1122 temperament associated with infant TV exposure. *Pediatrics*. 131(2):e390–e397. doi:
 1123 10.1542/peds.2012-1224.

1124 Thompson DA, Christakis DA. (2007). The association of maternal mental distress with
 1125 television viewing in children under 3 years old. *Ambulatory Pediatr*. 7(1):32–37. doi:
 1126 10.1016/j.ambp.2006.09.007.

1127 Thompson D.A., Polk S, Cheah C.S., Vandewater E.A., Johnson S.L., Chrismer M.C.,
 1128 Tschann J.M. (2015). Maternal Beliefs and Parenting Practices Regarding
 1129 Their Preschool Child's Television Viewing: An Exploration in a Sample of Low-
 1130 Income Mexican-Origin Mothers. *Clin Pediatr (Phila)*. 54(9):862-70. doi:
 1131 10.1177/0009922815574074. Epub 2015 Feb 26.

1132 Thompson DA, Christakis DA. (2005). The association between television viewing and
 1133 irregular sleep schedules among children less than 3 years of
 1134 age. *Pediatrics*. 116(4):851–856. doi: 10.1542/peds.2004-2788.

1135 Thompson DA, Sibinga EM, Jennings JM, Bair-Merritt MH, Christakis DA. (2010).
 1136 Television viewing by young Hispanic children: evidence of heterogeneity. *Arch*
 1137 *Pediatr Adolesc Med.* 164(2):174–179. doi: 10.1001/archpediatrics.2009.257.

1138 Tomopoulos S, Dreyer BP, Valdez P. et al. (2007). Media content and externalizing behaviors
 1139 in Latino toddlers. *Ambulatory Pediatr.* 7(3):232–238. doi:
 1140 10.1016/j.ambp.2007.02.004.

1141 Tonge KL, Jones RA, Hagenbuchner M, Nguyen TV, Okely AD. (2017). Educator
 1142 engagement and interaction and children's physical activity in early childhood
 1143 education and care settings: an observational study protocol. *BMJ Open.*
 1144 7;7(2):e014423. doi: 10.1136/bmjopen-2016-014423.

1145 Toselli S, Zaccagni L, Celenza F, Albertini A, Gualdi-Russo E. (2015). Risk factors of
 1146 overweight and obesity among preschool children with different ethnic background.
 1147 *Endocrine.* 2015 Aug;49(3):717-25. doi: 10.1007/s12020-014-0479-4.

1148 Tremblay, M. S., Leblanc, A. G., Carson, V., Choquette, L., Connor Gorber, S., Dillman, C.,
 1149 ... Timmons, B. W. (2012). Canadian physical activity guidelines for the early years
 1150 (aged 0 to 4 years). *Applied Physiology, Nutrition, and Metabolism*, 37(2), 370-391.

1151 Tremblay, M. S., LeBlanc, A. G., Kho, M. E., Saunders, T. J., Larouche, R., Colley, R. C., ...
 1152 Gorber, S. C. (2011). Systematic review of sedentary behaviour and health indicators
 1153 in school-aged children and youth. *International Journal of Behavioral Nutrition and*
 1154 *Physical Activity*, 8, 98. doi:10.1186/1479-5868-8-98

1155 Trost, S. G., Ward, D. S., & Senso, M. (2010). Effects of child care policy and environment
 1156 on physical activity. *Medicine & Science in Sports & Exercise*, 42(2), 520-525.
 1157 doi:10.1249/MSS.0b013e3181cea3ef .

1158 Tucker P, Vanderloo LM, Burke SM, Irwin JD, Johnson AM. (2015). Prevalence and
 1159 influences of preschoolers' sedentary behaviors in early learning centers: a cross-
 1160 sectional study. *BMC Pediatr.*, 15:128. doi: 10.1186/s12887-015-0441-5.

1161 Vale, S., Santos, R., Soares-Miranda, L., Silva, P., & Mota, J. (2010). Compliance with
 1162 physical activity guidelines in preschool children. *Journal of Sports Science*,
 1163 28(6), 603-608.

1164 Van Cauwenberghe, E., Jones, R. A., Hinkley, T., Crawford, D., & Okely, A. D. (2012).
 1165 Patterns of physical activity and sedentary behavior in preschool children.
 1166 *International Journal of Behavioral Nutrition and Physical Activity*, 27(9), 138.

1167 Vanderloo LM, Tucker P. (2015). Weekly trends in preschoolers' physical activity and
 1168 sedentary time in childcare. *Int J Environ Res Public Health*, 12(3):2454-64. doi:
 1169 10.3390/ijerph120302454.

1170 Vanderloo LM, Tucker P, Johnson AM, Burke SM, Irwin JD. (2015) Environmental
 1171 Influences on Preschoolers' Physical Activity Levels in Various Early-Learning
 1172 Facilities. *Res Q Exerc Sport.*, 86(4):360-70. doi: 10.1080/02701367.2015.1053105.
 1173 Epub 2015 Aug 19.

1174 Vanderloo, L. M., Martynuik, O. J. M., & Tucker, P. (2015). Physical and sedentary activity
 1175 levels among preschoolers in home-based child care: A systematic review. *Journal of*
 1176 *Physical Activity and Health*, 12(6), 879-889. doi:10.1123/jpah.2013-0483

1177 Vanderloo, L. M., Tucker, P., Johnson, A. A., Van Zandvoort, M. M., Burke, S. M., & Irwin,
 1178 J. D. (2014). The influence of center-based child care on preschoolers' physical
 1179 activity levels: A cross-sectional study. *International Journal of Environmental*
 1180 *Research and Public Health*, 11(2), 1794-1802.

1181 Vandewater, E. A., Bickham, D. S., & Lee, J. H. (2006). Time well spent? Relating television
1182 use to children's free-time activities. *Pediatrics*, 117(2), 181-191.

1183 Vandewater, E. A., Shim, M. S., & Caplovitz, A. G. (2004). Linking obesity and activity level
1184 with children's television and video game use. *Journal of Adolescents*, 27(1), 71-85.

1185 Vandewater E. A., Park S.-E., Huang X., Wartella E. A. (2005). "No—you can't watch that":
1186 parental rules and young children's media use. *American Behavioral*
1187 *Scientist*. 48(5):608–623. doi: 10.1177/0002764204271497.

1188 Vandewater EA, Rideout VJ, Wartella EA, Huang X, Lee JH, Shim MS. (2007). Digital
1189 childhood: electronic media and technology use among infants, toddlers, and
1190 preschoolers. *Pediatrics*. 119(5):e1006–e1015. doi: 10.1542/peds.2006-1804.

1191 Vandewater EA, Bickham DS, Lee JH, Cummings HM, Wartella EA, Rideout VJ. (2005).
1192 When the television is always on - Heavy television exposure and young children's
1193 development. *Am Behav Sci*. 48(5):562–577. doi: 10.1177/0002764204271496.

1194 Veitch, J., Hume, C., Salmon, J., Crawford, D., & Ball, K. (2013). What helps children be
1195 more active and less sedentary? Perceptions of mothers living in disadvantaged
1196 neighbourhoods. *Child Care Health Development*, 39(1), 94-102.

1197 Veitch, J., Salmon, J., & Ball, K. (2010). Individual, social and physical environmental
1198 correlates of children active free-play: A cross-sectional study. *International Journal*
1199 *of Behavioral Nutrition and Physical Activity*, 2, 7-11.

1200 Ward S, Bélanger M, Donovan D, Boudreau J, Vatanparast H, Muhajarine N, Leis
1201 A, Humbert ML, Carrier N. (2017). "Monkey see, monkey do": Peers' behaviors
1202 predict preschoolers' physical activity and dietary intake in childcare centers. *Prev*
1203 *Med*. 10;97:33-39. doi: 10.1016/j.ypmed.2017.01.001.

1204 Zecevic, C. A., Tremblay, L., Lovsin, T., & Michel, L. (2010). Parental influence on young
1205 children's physical activity. *International Journal of Pediatrics*, 2010, 468-526.
1206 doi:10.1155/2010/468526.

1207 Zimmerman FJ, Christakis DA. (2005). Children's television viewing and cognitive
1208 outcomes: a longitudinal analysis of national data. *Arch Pediatr Adolesc*
1209 *Med.* 159(7):619–625. doi: 10.1001/archpedi.159.7.619.

1210 Zimmerman FJ, Christakis DA, Meltzoff AN. (2007). Television and DVD/video viewing in
1211 children younger than 2 years. *Arch Pediatr Adolesc Med.* 161(5):473–479. doi:
1212 10.1001/archpedi.161.5.473.

1213

1214

1215

1216

1217

1218