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

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39 **Abstract**

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

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

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

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

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

69

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

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85 **INTRODUCTION**

86 Several high-income countries including the United States, United Kingdom,
87 Australia, and Canada, have developed physical activity (PA) guidelines specific to preschool-
88 age children recommending that children this age engage in at least 120 to 180 minutes of
89 total PA (including light PA and moderate-to-vigorous PA) daily (Commonwealth of
90 Australia, Department of Health and Ageing, 2010; Department of Health, Physical Activity,
91 Health Improvement and Protection, 2011; NASPE, 2009; Okely, Salmon, Trost, & Hinkley,
92 2008; Tremblay et al., 2012).

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

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

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

110 Physical activity is a key component of energy balance consistent with healthy
111 patterns of physical growth and weight status; thus, promoting PA is essential to prevention of
112 childhood obesity (O'Dwyer et al., 2012; Pratt, Epping, & Dietz, 2009). Physically active
113 children have healthier cardiovascular profiles, leaner body frames, and higher peak bone
114 mass compared to physically inactive children (AAP, 2006; Goldfield, Harvey, Grattan, &
115 Adamo, 2012; Hodges, Smith, Tidwell, & Berry, 2013; O'Dwyer, Fairclough, Knowles, &
116 Stratton, 2012). In addition to regulating body weight and improving body composition, PA
117 improves psychological and social wellbeing (AAP, 2006; Beets et al., 2011; Hodges et al.,
118 2013; O'Dwyer et al., 2012).

119 Despite well-documented benefits of PA for children, activity levels of children across
120 the globe have declined over the past decades, and most preschool-age children are not
121 accruing the recommended levels of moderate-vigorous physical activity (MVPA) daily
122 (Montgomery et al., 2004; Pate et al., 2015). Moreover, an increasing number of studies
123 document excessive screen-viewing time including television, computers, smartphones, etc.
124 among preschool-age children (Asplund, Kair, Arain, Cervantes, Oreskovic, Zuckerman,
125 2015; Beets, Bornstein, Dowda, & Pate, 2011; Davison et al., 2011; Ekelund, Brage, &
126 Wareham, 2004; Garriguet, Carson, Colley, Janssen, Timmons & Tremblay, 2016; Lampard,
127 Jurkowski, Davison, 2013; Mendoza, Zimmerman, & Christakis, 2007; Pate et al., 2015; Vale,
128 Santos, Soares-Miranda, Silva, & Mota, 2010; Vandewater, Bickham, & Lee, 2006).

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

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

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

145 **METHODS**

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

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

166 [Figure 1 here]

167 **Theoretical Model for Examining Influences on Preschool Children’s Physical Activity**

168
169 The social-ecological model provided the conceptual framework for this review
170 (McLeroy, Bibeau, Steckler, & Glanz, 1988) and was used to organize influences on
171 preschool-age children’s PA by level: (a) intrapersonal (e.g., age, gender, material
172 **circumstances, ethnicity, etc.**); (b) interpersonal (e.g., social support, networks, etc.); (c)
173 environmental (e.g., access and proximity to parks, etc.); (d) organizational (e.g., child care,
174 federally funded nutrition programs such as WIC, etc.); and (e) policy (e.g., state policies and
175 regulations related to nutrition and PA in child care settings, etc.). This framework posits that
176 factors at each level interact and influence health behaviors (McLeroy et al., 1998). Table 1
177 shows a breakdown of the studies reviewed according to the social-ecological model.

178

[Figure 2 and Table 1 here]

179 **RESULTS**

180 **Individual/Intrapersonal Influences**

181 **Socioeconomic and demographic factors.** Parents' socioeconomic status (SES) and
182 educational level are associated with preschool children's early PA behaviors (Dawson-Hahn,
183 Fesinmeyer, & Mendoza, 2015; Salmon, Owen, Crawford, Bauman, & Sallis, 2003). Jones,
184 Hendricks, and Draper (2014) found that among children aged 4–5 years old attending
185 preschools, parents with low-income reported that their children spent 93% of time indoors
186 compared to 79% reported by parents with mid/high-income. Parental socioeconomic status is
187 also associated with preschool children's early sedentary behaviors. Levin, Martin & Riner
188 (2004) found excessive TV viewing habits among a sample of low-income 4-year old children
189 enrolled in Head Start in South Carolina.

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

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

200 **Ethnicity, acculturation, and place of birth.** Caucasian children have higher rates of
201 PA than African American or Hispanic children (Ariza, Chen, Binns, & Christoffel, 2004;
202 Fakhouri, Hughes, Brody, Kit, & Ogden, 2013; Kuepper-Nybelen et al., 2005; Kumanyika &
203 Grier, 2006).

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

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

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

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

232 **Interpersonal Influences**

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

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

250 **Parental beliefs and attitudes.** Parents' perceptions, beliefs, and attitudes toward PA
251 may influence their young children's PA behaviors (Dwyer, Higgs, Hardy, & Baur, 2008;
252 Hesketh et al., 2013; Hinkley, Salmon, Okely, Crawford, & Hesketh, 2011; Loprinzi & Trost,
253 2010; O'Connor, Chen, Baranowski, Thompson, & Baranowski, 2013; Zecevic, Tremblay,
254 Lovsin, & Michel, 2010). Parental belief that participating in PA is important is associated
255 with their children's participation in both organized and free-time PA (Sawyer et al., 2014).
256 Children whose parents hold positive attitudes toward PA (e.g., PA is important to overall
257 health) are more active compared to those whose parents do not hold these positive attitudes
258 (Sawyer et al., 2014). Similarly, Zecevic and colleagues (2010) determined that children of
259 parents who view PA as enjoyable engage in significantly more PA than children did whose
260 parents did not view PA positively.

261 **Parental concerns.** Parents of preschool-age children have reported that their
262 concerns about safety inhibit their children's PA (Dwyer et al., 2008; O'Connor, Chen, et al.,
263 2013; Soltero et al., 20016; Suen et al., 2015), including concerns related to neighborhood and
264 community safety (e.g., crime, traffic) (Dwyer et al., 2008; Soltero et al., 2016). In addition,
265 parental concerns about excess screen time are also associated with children's PA levels (He,
266 Irwin, Sangster Bouck, Tucker, & Pollett, 2005; De Decker et al., 2012).

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

269 style encompasses broader patterns of how parents respond and demand to their children
270 (Baumrind, 1971). Four parenting styles have been defined: 1) authoritarian (demand
271 obedience); 2) authoritative (use reasoning); 3) permissive (acquiesce to child's demands) and
272 4) uninvolved. Only one study included in this review examined the association between
273 parenting styles and preschool-age children's PA levels, and no association was found
274 between parenting styles and time spent in active play nor did parenting styles moderate the
275 relationship between parental support and child active play (Schary, Cardinal, Loprinzi,
276 2012).

277 **Parenting Practices.** Parenting practices describe context-specific behaviors such as
278 what a parent does to facilitate physical activity. A growing, but still limited literature exists
279 on studies that have examined the influence of parenting practices on young children's PA
280 behaviors (Hesketh et al., 2013; O'Connor, Chen, et al., 2013; Oliver, Schofield, & Schluter,
281 2010; Zecevic, Tremblay, Lovsin and Michel, 2010; Dowda et al., 2011; Hesketh et al., 2014).
282 Results of these studies show that some parental practices, such as encouraging PA, setting
283 rules, providing transportation, **paying fees and tuition**, parental modeling of PA, and
284 engaging in PA activities with children are associated with PA behaviors of preschool-age
285 children (Hesketh et al., 2014; O'Connor, Chen, et al., 2013; Vanderwater et al., 2005; Veitch,
286 Hume, Salmon, Crawford, & Ball, 2013).

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

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

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

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

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

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

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

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

338 parents' high restriction of screen time (Lampard et al., 2013). Downing, Hinkley and Hesketh
339 (2015) found that children whose parents limited television viewing spent significantly less
340 time in watching TV and in total screen time; however, overall sedentary behavior was
341 unaffected. Further studies need to be conducted on how family environment influences
342 sedentary behaviors among children.

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

351 Current research also indicates that many preschoolers' daily screen time exceeds
352 recommendations. Vandewater, Shim, and Caplovitz (2004) determined that preschool
353 children watched more television than primary school children (2.19 hours/day vs. 1.91
354 hours/day), with 61.7% of children in the preschool group watching television for at least
355 2 hours per day.

356 Other screen-viewing behaviors common among young children include activities
357 such as DVDs/VHS, video games, computers, smartphones, etc (Bagley, Salmon & Crawford,
358 2006), but to date, these other screen-viewing behaviors have not been extensively examined
359 among preschool-age children.

360 **Siblings and peer influences.** Sibling and peer PA and sedentary behaviors appear to
361 be important influences on preschool-aged children’s PA and sedentary behaviors.
362 Preschoolers observe and imitate the behaviors of those who are similar to them (Ward et al.,
363 2017). Therefore, siblings and peers may be role models for preschoolers' physical activity. A
364 study conducted in child care centers in Canada found that peers influenced preschoolers’
365 physical activity over time (Ward et al., 2017).

366 **Environmental (Community/Neighborhood) Influences**

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

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

383 children spent more time indoors and engaged in less PA, whereas children spent more time
384 outdoors and in parks and recreational facilities during warmer weather. Similarly, additional
385 qualitative studies with parents of young children in Canada and Australia showed that colder
386 weather posed challenges for parents in keeping their preschoolers physically active (He et al.,
387 2005; Pearson, Salmon, Crawford, Campbell, & Timperio, 2011).

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

394 **Time outdoors.** The more time preschool children spend outdoors, the higher their PA
395 levels (Boldemann et al., 2006; Burdette, Whitaker, & Daniels, 2004; Hinkley, Crawford,
396 Salmon, Okely, & Hesketh, 2008). Several studies included in this review suggest that parents
397 and caregivers can and should encourage outdoor play (Anderson et al., 2008; Ergler, Kearns,
398 & Witten, 2013; Tandon, Saelens, Zhou, Kerr, & Christakis, 2013; Veitch, Salmon, & Ball,
399 2010). Questions of safety and accessibility, however, can make it more difficult for some
400 parents and children to spend time outdoors. Minority and low-income parents, for example,
401 are more likely to live in communities with fewer parks, sports facilities, bike paths, and other
402 places for children to be active and safe (Lindsay et al., 2009).

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

406 efforts that promote preschool-age children's PA activity through active play, age-appropriate,
407 outdoor play spaces with access to play equipment should be developed and maintained in
408 communities (Anderson et al., 2008; Burdette & Whitaker, 2005; Ergler, Kearns, & Witten,
409 2013; Tandon, Saelens, Zhou, Kerr, & Christakis, 2013; Veitch, Salmon, & Ball, 2010). The
410 concept of neighborhood greenness has also been correlated with preschool-age children and
411 PA. Grigsby-Toussaint et al. (2011) determined that families with preschool-age children who
412 have access to recreational facilities with higher levels of green space are more physically
413 active than are preschoolers without access.

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

424 **Organizational Influences**

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

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

441 Results of studies included in this review suggest that day care centers and preschools
442 may be able to provide access to outdoor play spaces for young children (Burdette &
443 Whitaker, 2005; Grigsby-Toussaint et al., 2011), which could foster opportunities to be
444 physically active. A recent study conducted in the U.K. by Hesketh, Griffin & van Sluijs
445 (2015) found that preschool-aged children and particularly boys were less sedentary and more
446 active when in child care compared to at home. Despite opportunities for daycare/child care
447 centers and preschools to provide access to outdoor play spaces for young children some
448 studies have also documented children facing barriers to being physically active in these
449 settings. Using focus groups, Copeland, Kendeigh, Saelens, Kalkwarf, and Sherman (2012)
450 determined that preschool and daycare center teachers believe that PA is important for
451 developing children, but noted that children's inappropriate clothing (e.g., flip-flops or

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

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

462 Other important influences on levels of PA among preschool-age children in ECE
463 settings include adult support and availability of both outdoor space and play equipment.
464 Using direct observation at child care centers, Bower et al. (2008) determined that adult
465 support and availability of play equipment were associated with greater PA and lower
466 sedentary activity levels among preschoolers. Similarly, a study in the Netherlands focusing
467 on preschools and daycare centers found that locations with greater outdoor space and
468 equipment availability reported higher PA levels in the children (Gubbels, Van Kann, &
469 Jansen, 2012). Likewise a recent study by Schlechter, Rosenkranz, Fees & Dzewaltowski
470 (2017) found that providing more time outdoors and restructuring preschool activities from
471 whole group to small group could increase the amount of total physical activity that children
472 accumulate during preschool.

473 **Policy Influences**

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

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

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

499 guidelines recommend that preschool-age children engage in 90–120 minutes of age-
500 appropriate MVPA per 8-hour day in an ECE setting. If weather permits, preschool-age
501 children should be given two or three occasions of 60–90 minutes of outdoor play, and that
502 structured activities that promote bodily movement should be led by caregiver/teachers two or
503 more times per day (indoor or outdoor). Another recommendation is to have written policies
504 in ECE settings regarding children’s PA while at the ECE. The Institute of Medicine (IOM,
505 2011) has made policy and policy implementation recommendations for ECE settings, such as
506 the need to increase young children’s PA and reduce sedentary behavior, in order to guide
507 care providers and health professionals. The Society of Behavioral Medicine has
508 recommended that state and local policymakers use effective evidence-based models (e.g.,
509 Michelle Obama’s Let’s Move!, Childcare) to implement policies in ECE settings in order to
510 increase PA and reduce sedentary behavior (Buscemi et al., 2015). A recent study in the
511 United States suggested adoption of the Montessori school system as a strategy to promote PA
512 in preschools. Pate et al. (2015) determined that compared to students in traditional
513 preschools, children in Montessori preschools accumulated more light, MVPA, and total PA
514 after adjusting for BMI, sex, SES, and parental education (Pate et al., 2015). Different than
515 traditional school settings where children often sit at their desks for most of the time, children
516 in Montessori programs learn through action and self-discovery, choosing activities and
517 moving about freely during the course of the day (Pate et al., 2015).

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

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

528 **ECE policy change efforts.** ECE-level policies and efforts have been supportive
529 influences on preschool-age children's PA behaviors in the U.S. (Gubbels, Slining, et al.,
530 2012; Trost, Ward, & Senso, 2010), but states inconsistently regulate the implementation of
531 national policies on PA in ECE settings (Buscemi et al., 2015; Gubbels et al., 2012; Larson et
532 al., 2011; McPherson & Homer, 2011; Vanderloo et al., 2014), and many children do not meet
533 PA levels in childcare centers (Buscemi et al., 2015; Duffey et al., 2014; Vanderloo et al.,
534 2014). There have been attempts to develop and implement PA policies in ECEs. For
535 example, in 2007, New York City's ECE centers implemented new regulations put forth by
536 the New York City Department of Health and Mental Hygiene to reduce screen time, increase
537 PA, and provide healthier beverages (Nonas, Silver, Kettel Khan, & Leviton, 2004). However,
538 results of recent studies evaluating compliance with these recommendations found that
539 compliance was low for offered PA time (38.5%) and structured PA time (34.6%) (Lessard
540 et al., 2014; Nonas et al., 2004).

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

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

547 **DISCUSSION**

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

556 Findings from studies included in this review elucidated multi-level factors at various
557 levels in the social-ecological model that influence preschool-age children’s PA levels and
558 behaviors. At the individual level, factors associated with differing levels of PA include SES
559 and the child’s sex (Annesi, Smith, & Tennant, 2013; Bagley et al., 2006; Cespedes et al.,
560 2013; Chuang, Sharman, Skala, & Evans, 2013; Kumanyika & Grier, 2006; Montgomery et
561 al., 2004; O’Connor et al., 2014; Pate et al., 2004; Salmon et al., 2003; Sisson et al., 2009;
562 Suen et al., 2015; Vale et al., 2010; Van Cauwenberghe et al., 2012). At the individual level,
563 some factors suggest that the lack of PA may have to do with lack of access or insufficient
564 family resources to make PA a priority (e.g., SES, family structure), while other factors
565 suggest parental values come into play (child’s sex and cultural context).

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

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

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

590 At the organizational level, in the context of the ECE settings, teacher/caregiver
591 support of PA, play equipment, and outdoor space were important factors associated with PA
592 of children while at the EEC setting (Bower et al., 2008; Copeland et al., 2012; Dowda et al.,
593 2004; Gubbels, Kremer, et al., 2012; Reilly, 2010).

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

598 **CONCLUSIONS**

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

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

617 **How Might this Information Affect Nursing Practice?**

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

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

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

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