Journal of Pediatric Nursing (2013) **28**, 3–19

Promoting Physical Activity in Preschoolers to Prevent Obesity: A Review of the Literature[1]

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Key words:
Physical activity;
Preschoolers;
Obesity;
Overweight;
Prevention;
Childcare

This literature review summarizes clinical recommendations for adequate physical activity and reviews recently published studies that focus on identifying common factors associated with physical activity levels among preschoolers in the United States and Canada. Currently, there is inconsistency in both the definition of and recommendations for physical activity. In addition, there is relatively little research in this area. Common factors and contexts associated with physical activity levels in preschoolers in this review included (a) child characteristics; (b) interpersonal dynamics between preschoolers and their families, childcare providers, and health care providers; (c) childcare setting; and (d) neighborhood environment.

THE OBESITY EPIDEMIC in children is on the rise (Ogden, Carroll, Curtin, Lamb, & Flegal, 2010; Wang & Beydoun, 2007) and represents one of our most challenging public health issues (Lobstein, Baur, Uauy, & IASO International Obesity TaskForce, 2004). Worldwide, the prevalence of overweight (body mass index [BMI; kg/m^2] ≥85th percentile) and obesity (BMI ≥95th percentile) among preschoolers (age 2–5 years) increased from 4.2% in 1990 to 6.7% in 2010, with a projected increase to 9.1% by 2020 (de Onis, Blössner, & Borghi, 2010). Obesity in preschoolers is even more prevalent in the United States, with 21.2% of preschoolers being overweight and another 10.4% being obese (Ogden et al., 2010).

The increasing prevalence of obesity in young children is not without costs. Early childhood obesity is associated with both immediate and long-term health consequences that may persist into adolescence and adulthood (Nathan & Moran, 2008; Malina, 2001; Reilly, 2005; Singh, Mulder, Twisk, van Mechelen, & Chinapaw, 2008). Short-term consequences include social isolation, low self-esteem, depression (Daniels, 2006; Reilly, 2005), negative body image (Daniels, 2006), hypertension, hyperlipidemia (Daniels, 2006; Reilly, 2005), cardiovascular dysfunction, hyperinsulinemia/insulin resistance, asthma, Type 1 diabetes mellitus, and podiatric problems (Daniels, 2006; Reilly, 2005). Long-term consequences include persistence of obesity into adulthood with its attendant comorbidities, including cardiovascular disease, Type 2 diabetes mellitus, and premature mortality (Daniels, 2006; Reilly, 2005).

In a recent review, Hammond and Levine (2010) have estimated annual direct medical costs associated with obesity (diagnosis and treatment) of up to $147 billion for adults and $14.3 billion for children in the United States. Additional indirect costs related to lost productivity may be as high as $66 billion annually (Hammond & Levine, 2010). Between 2001 and 2005, hospital costs alone associated with childhood obesity rose from $125.9 to $237.6 million (Trasande, Liu, Fryer, & Weitzman, 2009).

The preschool years represent a time when many children establish nutritional and physical activity habits that persist into adulthood (Lanigan, Barber, & Singhal, 2010; Malina, 2001; Pellegrini & Smith, 1998). Therefore, it is essential

[1] This article was presented in October 2010 at the 2010 annual meeting on the Obesity Society in San Diego, CA.

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http://dx.doi.org/10.1016/j.pedn.2012.01.002

that interventions to prevent obesity are instituted during this critical period. Understanding factors that are associated with nutritional and physical activity habits among young children is vital to the development of comprehensive and effective interventions.

This review focuses on physical activity among preschoolers in their various contexts, including their homes, preschools/day cares, and neighborhoods. It is important to consider physical activity outside of homes and neighborhoods, as many preschoolers spend significant time in nonparental childcare (Maher, Li, Carter, & Johnson, 2008). In the United States, more than 11 million children younger than 5 years are enrolled in some type of childcare arrangement for an average of 36 hours every week (National Association of Child Care Resources and Referral Agencies, 2008).

Although it was once thought that preschoolers engaged in high levels of physical activity, several recent studies have shown that preschool children actually engage in fairly low levels of moderate to vigorous physical activity (MVPA; Alhassan, Sirard, & Robinson, 2007; Dowda et al., 2009; Trost, Fees, & Dzewaltowski, 2008). Among this age group, low levels of physical activity are associated with increasing body fat (Moore, Nguyen, Rothman, Cupples, & Ellison, 1995), whereas vigorous physical activity (VPA) is associated with lower odds of overweight (Metallinos-Katsaras, Freedson, Fulton, & Sherry, 2007).

The purpose of this article was to first summarize current clinical recommendations for adequate physical activity among children aged 2–5 years and then identify common factors that are associated with the promotion or hindrance of physical activity in this population. The social–ecological model, develop by Bronfenbrenner (1979), served as an organizational framework for this review. According to this theory, children exist within interactive systems, from children's own bodies, beliefs, and behaviors to familial, neighborhood, community, and cultural influences, all of which play a role in influencing the child's development (Bronfenbrenner, 1979). When evaluating various factors that are associated with preschoolers' physical activity levels, the social–ecological theory provides a comprehensive framework that enables the identification of potential facilitators and barriers within these different systems, which may then become intervention targets to increase the amount of physical activity in which preschoolers engage.

Methods

The first step in our review was to identify current recommendations from the National Association of Sports and Physical Education (NASPE), the American Academy of Pediatrics (AAP), and the American Heart Association (AHA). These recommendations were reviewed to determine both current definitions of physical activity and recommendations for adequate physical activity levels among preschool-age children to assess areas of convergence and divergence.

The second step of the review was to search for research related to physical activity in preschool children, with a particular focus on studies that identified factors associated with physical activity. The search engines Pubmed, CINAHL, PsychINFO, and SPORTSDiscus were used to identify published articles using the following key search terms: *physical activity*, *preschoolers*, *overweight*, *obese/obesity*, *prevention*, and *childcare*. An additional specific search of journals in which pediatric obesity-related research is often published, such as the *International Journal of Behavioral Nutrition and Physical Activity*, *Pediatrics*, *International Journal of Pediatric Obesity*, *American Family Physician*, and *Journal of the American Dietetic Association*, was performed to ensure that all available literature was collected and reviewed. Studies were retrieved and reviewed using the following inclusion criteria: (a) female and male preschoolers aged 2–5 years; (b) measurement of physical activity or perceived factors associated with physical activity; and (c) publication in English from June 2004 to December 2010. Exclusion criteria included the following: (a) children with a preexisting condition such as a developmental disorder, mental disability, cardiac disease, hypertension, diabetes mellitus, dyslipidemia, or mental illness, which may constrain participation in physical activity; (b) review articles; (c) data related to dietary patterns and recommendations, in order to focus on physical activity; and (d) studies performed outside of the United States and Canada, in order to decrease questions of generalizability because of cultural differences.

Seventy-four articles were obtained for review. All authors reviewed the abstracts collected and jointly discussed their relevance for this review. Sixty studies did not meet inclusion criteria, which left 14 articles for review (Table 1). The compiled reference list was evaluated by three outside independent reviewers with expertise in this field to ensure that all relevant literature was included. All authors

Table 1 Reasons Studies Did Not Meet Inclusion Criteria

	No. of Studies (*n*)
Systematic review	1
Articles published before June 2004	9
Age group not including 2–5 years old	24
Diet/Nutrition as outcome/intervention	9
Sedentary behavior rather than physical activity	7
Play undefined (may not be physical activity)	6
Subjects other than parents and preschoolers	4

independently reviewed the included articles and then discussed relationships among studies regarding factors associated with physical activity.

Results

Physical Activity Recommendations

Several associations including the AHA, the AAP, and the NASPE propose that children of all ages should participate in daily physical activity to promote health and well-being (AAP, 2010; AHA, 2010; NASPE, 2010). The AAP and the NASPE define physical activity as running, swimming, tumbling, throwing, catching, walking, and participating in interactive play through the use of games and various play equipment; the AAP specifically suggests that physical activity be of moderate intensity, whereas the NASPE makes no mention of intensity (AAP, 2010; Council on Sports Medicine and Fitness and Council on School Health, 2006; NASPE, 2010). The AHA, in contrast, does not define physical activity in terms of specific activities but rather in the intensity level of the behavior being performed.

According to the NASPE, preschoolers (age 3–5 years) should engage in at least 60 minutes of structured physical activity daily and at least 60 minutes and up to several hours of unstructured physical activity daily (NASPE, 2010). Preschoolers should avoid being sedentary for more than 60 minutes at a time except when sleeping and limit screen time to less than 2 hours per day (Council on Sports Medicine and Fitness and Council on School Health, 2006; NASPE, 2010). The AHA, on the other hand, recommends that children 2 years and older should participate in 30 minutes of moderate-intensity physical activity per day (AHA, 2010).

Thus, although there appears to be consensus among organizations regarding the need for daily physical activity, there are discrepancies in definitions of physical activity in addition to prescribed amount and intensity. One can see how this might contribute to differences in expectations, opportunities, and policies for physical activity among parents and other caregivers of preschoolers, if they attend to recommendations at all.

Factors Associated With Physical Activity Among Preschoolers

In light of a social–ecological framework, common factors and contexts identified in this literature review that were associated with physical activity levels in preschoolers included (a) child characteristics; (b) interpersonal dynamics between preschoolers and their families, childcare providers, and health care providers; (c) childcare setting; and (d) neighborhood environment (Table 2).

Child Characteristics

Four of the studies highlight parental perceptions of child characteristics that parents feel impact involvement in physical activity. Dwyer, Needham, Simpson, and Heeney (2008) identified intrapersonal characteristics reported by parents to hinder their preschoolers' physical activity levels, such as personality traits like shyness and anxiety. In addition, preference to participate in less active play, lack of interest or lack of ability to follow the rules of organized physical play activities, or a disability such as a speech problem were cited. Parents also reported that preschoolers who experienced feelings of fatigue after being at a childcare center all day were less likely to be active in the evening (Dwyer et al., 2008).

Inaccurate parental perceptions of their child's weight and health also may serve as a barrier to the promotion of sufficient physical activity. Rich et al. (2005) found that 50% of parental caregivers were not concerned about their child's weight and perceived their preschooler to be healthy although they exceeded the 95th percentile for height and weight. Twenty-one percent of those who were not concerned with their child's weight mentioned that other people, such as a health care professional, were concerned (Rich et al., 2005). Of all parents in this study, only 38% were concerned about their child's physical activity.

On the other hand, some parents perceived their preschooler's personality traits, physical activity preferences, and health to be intrapersonal facilitators of their physical activity levels. Parents of children who enjoyed physical activity felt that it was easy to facilitate regular physical activity (Irwin, He, Bouck, Tucker, & Pollett, 2005). Dwyer et al. (2008) reported that parents felt children who were healthy were more physically active. This contention was supported by Maher et al. (2008), finding that children who were perceived by their parents as more active than their age mate peers were significantly less likely to be obese.

Interpersonal Dynamics

Parents acknowledged their belief in the powerful influence of relationships between preschoolers and other people in their lives in regard to physical activity. Parents perceived that their own physical activity levels were associated with levels of physical activity among preschool children (Dwyer et al., 2008; Irwin et al., 2005). Parents reported believing that many parents supported a healthy lifestyle through positive role modeling by making time for personal physical activity a priority and by participating in active play with their children (Dwyer et al., 2008). Yet, children have different opportunities for physical play at home depending on their parents' willingness to participate. In a study by Rich et al. (2005), 12% of parents reported participating in only sedentary activities with their preschoolers. Several parents in Dwyer et al.'s study cited

Table 2 Factors Associated With Physical Activity Among Preschoolers

Authors	Year	Title	Associated Factor/Context	Study Design	Sample	Methodology	Instruments	Results
Alhassan et al.	2007	The effects of increasing outdoor playtime on physical activity in Latino preschool children	Childcare	Experimental	$N = 32$ Age: 3.5 ± 0.5 years (RECESS) and 3.8 ± 0.5 years (CON)	Participants randomized into an intervention (RECESS) or control group (CON). • RECESS (10 ♂,7 ♀) received two additional 30-minute periods of outdoor free playtime per day for 2 days. • CON (10 ♂, 5 ♀) followed their normal classroom schedule. Body weight, height, and BMI collected.	Actigraph Accelerometers	Mean BMI among CON and RECESS groups were similar, 17.0 ± 2.0 and 17.2 ± 1.9, respectively. Mean BMI = 85th percentile for age and gender. No statistically significant differences between groups in changes from baseline in average total daily activity (CON, 48.2 ± 114.5; RECESS, 58.2 ± 74.6) and during the school day (CON, 64.6 ± 181.9; RECESS 59.7 ± 79.1) counts per minute, or total daily (CON, 0.4 ± 1.3; RECESS 0.3 ± 0.8) and during the school day (CON, 0.6 ± 2.1; RECESS 0.5 ± 0.8) percent of time spent in MVPA.
Benjamin et al.	2008	Improving nutrition and physical activity in childcare: What parents recommend	Childcare	Mixed method	$N = 508$ parents of children 2–5 years old 90% mothers 35% <30 years old White, 75% Black, 14% Native American, 4% Hispanic, 2% 77% some college education/technical education 47% household income <$30,000	Parents rated the quality of PA their child received at their childcare center. Parents suggested ways to improve levels of PA by answering open-ended questions.		Parents rated the quality of PA at the childcare center as follows: • 36% excellent • 46% good • 12% average • 4% fair/poor Suggested improvements for increasing the quality of PA: • More structured and provider led activities (21%) • Increase outdoor playtime (11%) • Provide additional space and equipment (8%).
Brown et al.	2009	Social and environmental factors associated with preschoolers' non-sedentary physical activity	Childcare	Descriptive	$N = 539$ overall, of which 476 children were observed in indoor activity and 372 in outside activity.	Informal preschool observations using OSRAC-P.	OSRAC-P	• 87% of observations recorded inside. • 94% of activity was classified as sedentary. • Less than 10% of

					Ages 3–5 years Predominantly White and Black Commercial childcare centers Church-affiliated preschools Head start program Approximately equal proportion ♂ and ♀			observations were outside; 17% of the intervals were MVPA. • 2.6% of activity outside was teacher arranged; 16% of the intervals were MVPA. • When indoor teacher arranged PA and music was implemented, 4%–8% of the intervals were MVPA. • Game observation was 1.1%, but 11% of the intervals were MVPA. MVPA was: • 3.21 times more likely when children engaged with balls and objects. • 2.57 times more probable when playing in open spaces. • 1.31 times more likely when playing on fixed equipment. • 1.29 times more likely when using wheeled toys. Teachers rarely prompted children to increase or decrease their physical play.
Burdette et al.	2005	A National study of neighborhood safety, outdoor play, television viewing, and obesity in preschool children	Neighborhood	Observational/ Cross-sectional	Children $N = 3141$ Age = 39 ± 3 months ♂ = 53% Income below federal poverty level, 35% Mothers $N = 3,326$ Age at child's birth = 26 ± 6 years Non-Hispanic Black, 50% Non-Hispanic White, 25% Hispanic, 25% Married to child's	Mothers self-reported the mean daily time of outdoor play and TV viewing for their 3-year-old child either by in-home interviews or telephone surveys. Neighborhood Environment for Children Rating Scales in written form were completed by mothers. BMI was measured.	Neighborhood Environment for Children Rating Scales	Obesity prevalence did not differ in children from the least safe to the safest neighborhood safety tertile (18% vs.17% vs. 20%) or in weekday (160 vs. 151 vs. 156 minutes/day) or weekend (223 vs. 222 vs. 222 minutes/day) outdoor playtime. Children who lived in neighborhoods perceived by their mothers as the least safe watched more TV (201 vs. 182 vs. 185 minutes/day) and were more likely to

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Table 2 (*continued*)

Authors	Year	Title	Associated Factor/Context	Study Design	Sample	Methodology	Instruments	Results
					father, 26% <High school education, 64%			watch >2 hours/day (66% vs. 60% vs. 62%). Children in the least safe tertile for neighborhood safety watched approximately 20 minutes more TV per day than children in the other two tertiles of neighborhood safety.
Dowda et al.	2009	Policies and characteristics of the preschool environment and physical activity of young children	Childcare	Cross-sectional	*N* = 299 Age range, 3–5 years Age 3, 38.5% Age 4, 47.8% Age 5, 13.7% ♂ = 50% Black, 49% White, 42% Other race, 10% Parental education: 54% >high school education	Each preschool child wore an accelerometer for an average of 8.1 ± 1.5 hours/day, for 5.5 ± 2.1 days. Researcher completed the ECERS-R for each preschool to assess quality. Classrooms and playgrounds were assessed. Preschool directors were interviewed about PA policies. Preschools were divided into two groups based on whether the characteristic/policy was presumed to promote or not promote PA. Body weight, height, and BMI were collected.	ECERS-R OSRAC-P Actigraph Accelerometers	Higher quality scores (ECERS-R scores of >5), lower use of electronic media, more than one piece of portable playground equipment, less fixed playground equipment, and larger playground size were all associated with less sedentary minutes per hour and more MVPA in preschool children. Children had increased MVPA levels in preschools in which teachers had recent PA training. Children in the Top 5 PA-promoting preschools accumulated more than 60 minutes of MVPA per day, compared with the children in the other preschools, who accumulated less than 60 minutes of MVPA per day.
Dwyer et al.	2008	Parents report intrapersonal, interpersonal, and environmental barriers to supporting healthy eating & physical activity among their preschoolers	Child characteristics Interpersonal Neighborhood	Qualitative	*N* = 39 parents of children 2–5 years old ♀ = 34 Caucasian = 37 Chinese = 2	Five focus groups Self-administered questionnaire Audio-taped sessions.		Social–Ecological model used to present various themes including: • Intrapersonal • Personality traits • PA preferences • Health

								• Interpersonal (interactions with): • Parents • Childcare personnel • Health care providers • Physical environmental factors: • Neighborhood safety • Weather • Access to community play areas and equipment.
Hannon et al.	2008	Increasing preschoolers' physical activity intensities: An activity-friendly preschool playground intervention	Childcare	One group pretest/posttest design	*N* = 64 Age 3 = 23 (8 ♂, 15 ♀) Age 4 = 25 (13 ♂, 12 ♀) Age 5 = 16 (9 ♂, 17 ♀) Mostly Caucasian	Activity-friendly equipment was added to an outdoor preschool playground. Accelerometers measured intensities of 15-second epochs of PA for five preintervention and five postintervention days during outdoor play. Accelerometer data were used to compare preschoolers' PA levels before and after the introduction of new play equipment.	Actigraph GT1M Accelerometers OSRAC-P	Sedentary activity accounted for 49.3% of outdoor playtime. Light activity accounted for 32.3% of outdoor play. MVPA and VPA accounted for 13.7% and 4.5%, respectively. Sedentary activities decreased post-intervention by 16%. Light PA increased by 3.52%, MVPA increased by 7.76%, and VPA increased by 4.66%. Addition of new playground equipment significantly decreased sedentary behavior and significantly increased light, moderate, and vigorous PA in both male and female children.
Irwin et al.	2005	Preschooler's physical activity behaviours parents perspectives	Child characteristics Childcare interpersonal Neighborhood	Qualitative	*N* = 71 parents of children 2.5–5 years old Parental age = 21–63 years Caucasian, 95.5% Southeast Asian, 1.5% Black, 1.5% Other, 1.5% Diverse SES, education, and	Ten semistructured focus group interviews were to assess parent's perspectives of PA behaviors.		Parents felt it was important to encourage healthy behaviors early in life. Types and hours of daily PA among preschoolers varied. Most parents reported 3–4 hours of daily physical play by their preschooler. Parents had differing views on the value of structured vs. unstructured PA.

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Table 2 (*continued*)

Authors	Year	Title	Associated Factor/Context	Study Design	Sample	Methodology	Instruments	Results
					employment backgrounds			Parents felt that current PA guidelines were insufficient. Various barriers and facilitators of PA include: • Age • Seasonal weather • Day care • Siblings • Financial Costs • Time • Society • Safety Issues • Parenting • Child's activity preferences
Maher et al.	2008	Preschool child care participation and obesity at the start of kindergarten	Child characteristic Interpersonal	Cross-sectional	$N = 15,691$ children entering kindergarten in 1998; mean age 68.2 months Nationally representative	Used data from the Early Childhood Longitudinal Study–Kindergarten Cohort to assess relationships between obesity status and childcare.		No significant difference between obese and nonobese children in hours/week engaging in sport/exercise with family. Children perceived by parents as more active than peers were significantly less likely to be obese.
Pate et al.	2004	Physical activity among children attending preschools	Childcare	Descriptive	$N = 247$ Age range = 3–5 years ♀ = 132 (53%) Black, 65%	Accelerometers worn for an average of 4.6 ± 1.3 hours/day for an average of 6.9 ± 1.8 days. Height, weight, and BMI were measured, and parents of participating children provided demographic and education data.	Actigraph Uniaxial Accelerometer	Boys participate in higher levels of MVPA and VPA. Children 4–5 years old have more sedentary intervals and fewer light activity intervals compared to 3–year-olds. Black children participate in more VPA than White children. Age is not a significant predictor for MVPA or VPA. Parent's education level did not impact child's activity level. Gender, age, race, BMI, and parent education accounts for 4.3% of the variance in level of PA.

							Type of preschool the child attends improves the prediction of MVPA and VPA, accounting for 43.3% of the variance.
Rich et al.	2005	Perceptions of health status & play activities in parents of overweight Hispanic toddlers & preschoolers	Child characteristics Interpersonal Neighborhood	Qualitative	*N* = 76 parents with obese children served by WIC Child's age = 14 to 47 months ♀ = 35 (46%) Hispanic = 66 Black = 7 White= 3	In-depth personal interviews with open-ended questions addressing parental perceptions of the child's health status, long-term effects of obesity, and family play patterns were audio-taped and reviewed.	50% said they were not concerned with their child's weight. • Of these, 21% mentioned that other people were concerned. 50% concerned about their child's weight. • Of these, 17% were concerned because of advice or an intervention by a health care provider. No significant differences in weight concern between female and male children. 38% concerned about PA. 82% indicated their child had a safe place to play. • Of these, 48% indicated a safe area to play referred to indoor areas. 71% had a playground/park near their home. • 5% mentioned that the park/playground nearby was unsafe. 89% of families with boys reported access to a playground, where as only 70% of families with girls reported access. 69% of participants who reported having access to a playground reported more active play than those with no access.
Spence et al.	2008	Influence of neighborhood design and access to facilities on	Neighborhood	Cross-sectional	*N* = 501 Mean age = 4.95 ± 0.4 years	Parents completed demographic, PA, and dietary intake	A significantly larger proportion of boys (85%) than girls (77%) reportedly

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Table 2 (*continued*)

Authors	Year	Title	Associated Factor/Context	Study Design	Sample	Methodology	Instruments	Results
		overweight among preschool Children			♂ = 239, ♀ = 262 Diverse SES and demographic background	questionnaires Height/weight measured		engaged in ≥10.5 hours/week of PA, $\chi^2(1, 501) = 5.41$, $p = 0.02$. Increasing neighborhood intersection density (walkability) was associated with lower odds of overweight for girls, but not for boys. No significant associations found between bodyweight classification and number of recreational facilities. No significant differences between boys and girls in bodyweight classification.
Trost et al.	2008	Feasibility and efficacy of a "move and learn" physical activity curriculum in preschool children	Childcare	Experimental	Preschool classrooms randomized to intervention ($n = 20$) or control ($n = 22$) Intervention: Age: 4.1 ± 0.7 years ♂ = 55% Control: Age: 4.0 ± 0.7 years ♂ = 54.5%	After training, teachers chose PA components from existing curricula to include two activities lasting ≥10 minutes/2.5-hour session with several repetitions through the week. 10-week study PA monitored twice weekly	Actigraph accelerometer OSRAP	PA experiences: • 96% during circle/group time • 88% indoor • 74% ≥10 minutes For classroom time MVPA and VPA, intervention significantly > control for Weeks 5–8. Intervention significantly more likely to demonstrate MVPA during circle time, free-choice time outdoors, and free-choice time indoors than control.
Tucker et al.	2008	Physical activity behaviors during the preschool years	Childcare	Descriptive	$N = 140$ parents Mean age, 34.7 years ♀ = 83% Mean age of preschoolers, 3.42 ± 0.8 years Resided in double-parent home, 89%	Using Harro's Physical Activity Questionnaire parents identified the amount of time (minutes) their preschoolers spent in indoor and outdoor low-intensity and high-intensity activities on Tuesday, Thursday, and	Harro's Physical Activity Questionnaire Outdoor Playtime Checklist	Parents report children engaged in 40.9 ± 32.2 minutes of high-intensity indoor activity/day and averaged 31.7 ± 28.2 minutes of high-intensity outdoor activity/day. Children spend more time engaging in high-intensity indoor activity vs. outdoor

		Saturday of the week following questionnaire distribution. Parents also were asked to identify the amount of time their child spent in outdoor playtime on a "typical" weekday and "typical" weekend day. Day care leaders identified the amount of outdoor playtime provided by completing the Outdoor Playtime Checklist.	activity ($p < .001$). Children engage in more high-intensity PA on weekend days than on weekdays (54.3 ± 41.1 minutes vs. 29.2 ± 24.5 minutes, respectively; $p < .001$). Parents report an average of 108.3 ± 98 minutes of low-intensity indoor activity and 37.1 ± 28.2 minutes of low-intensity outdoor activity each day, which is significantly more than preschooler's high-intensity activity ($p < .001$). According to parental reports, 55% of preschoolers met the minimum requirement of 60 minutes of PA recommended in Active Start: PA Guidelines for Children Birth to Five Years. Day care providers indicated that children attending their facilities had approximately 2 hours of outdoor playtime, which afforded ample opportunity during the day to meet the minimum PA guidelines.

Note: WIC = Women, Infants, & Children Program; PA = physical activity; OSRAC-P = Observational System for Recording Physical Activity in Children–Preschool Version; SES = socioeconomic status; OSRAP = Observational System for Recording Physical Activity in Preschoolers.

being single parents, having busy schedules, and feeling fatigued at the end of the day as factors that led them to be less likely to engage in physical activity with their preschool child.

Active adult involvement was believed to be important in developing preschoolers' knowledge of healthy behaviors including physical activity (Dwyer et al., 2008; Irwin et al., 2005). In addition, parents believed that establishing physical activity patterns during the preschool years promoted a long-term healthy lifestyle (Irwin et al., 2005). Parents with multiple children felt that their preschooler had more opportunities to be active because they had siblings with whom they could play (Irwin et al., 2005). Maher et al. (2008) found no significant differences reported between parents of obese (n = 1,787) and those of nonobese (n = 13,904) preschoolers in participation in family-based exercise in a typical week.

In addition to parents and siblings, childcare personnel and health care providers were also perceived by parents as important in promoting physical activity among preschoolers. Parents who enrolled their preschooler in a licensed day care facility believed that their children will be given more opportunities for active play compared with children remaining in home day care settings (Irwin et al., 2005). Yet, some parents voiced frustration over childcare workers' decisions to limit children's physical activity opportunities because of safety concerns or cooler weather (Dwyer et al., 2008). For instance, some parents felt that their children should have more opportunities to climb ladders and play outside in the winter when dressed appropriately. According to parents, health care providers are another source of support of physical activity in the preschool-age child (Dwyer et al., 2008; Rich et al., 2005).

Although there are consistencies in results among several of these studies, findings from this review must still be interpreted with some caution because of differences among the studies' participants and the methods with which the studies were conducted. Rich et al. (2005) reported low participant response rates, and their participants were low-income, Hispanic parents, whereas most parents in the studies by Dwyer et al. (2008) and Irwin et al. (2005) were Caucasian and of diverse socioeconomic status. These differences along with relatively low sample sizes limit generalizability. Maher et al.'s (2008) study offered the strongest generalizability because of sample size and diversity, yet physical activity was not the main outcome variable in their study. Engagement in physical activity in their study was measured by two variables: one continuous variable based on parental self-report of the weekly frequency of the child's participation in family exercise and one dichotomous variable based on parental perceptions of their child's average activity compared with that of their age mates (Maher et al., 2008). As in all studies relying on self-report, social desirability may have influenced participant responses, and perceptions may not reflect actual behavior.

Childcare Setting

Childcare settings offer an important venue for many children to obtain a substantial amount of their daily physical activity. However, most preschool children in the childcare studies reviewed here did not meet the minimum requirements outlined by organizations such as NASPE (Alhassan et al., 2007; Dowda et al., 2009; Pate, Pfeiffer, Trost, Ziegler, & Dowda, 2004). In Pate et al.'s study, children on average tended to engage in only 7.7 minutes of MVPA (≥3 metabolic equivalents [METs]) per hour while attending preschool, which is approximately 1 hour of MVPA throughout an 8-hour preschool day. However, many children in Pate et al.'s study did not attend preschool for an entire 8-hour day, suggesting they may not meet physical activity recommendations.

Variations among preschools are highly correlated with activity levels of preschool children. Children were found to engage in less sedentary behavior and higher levels of moderate-vigorous activity when the preschool had more than one piece of portable playground equipment (Dowda et al., 2009; Hannon & Brown, 2008), less fixed playground equipment (Dowda et al., 2009), and larger playground size (Dowda et al., 2009; Hannon & Brown, 2008). Tucker and Irwin (2010) concluded that the childcare center accounts for at least half of the variation in the amount of physical activity a child receives during preschool hours (Tucker & Irwin, 2010). Pate et al. (2004) concluded that although demographic factors, such as gender, age, race, parental education, and BMI, were associated with a relatively small proportion of variance in levels of physical activity among preschoolers, characteristics of the preschool attended had a much greater influence on variations in levels of physical activity among preschoolers. Dowda et al. critically assessed the preschool environment using the Early Childhood Environment Rating Scale–Revised (ECERS-R; Harms, Clifford, & Cryer, 1998 as cited in Dowda et al., 2009), which allows for comprehensive rating of program quality using seven subscales: space and furnishings, personal care routines, language–reasoning, activities, interaction, program structure, and provisions for parents and staff members. Higher quality scores overall on these seven dimensions were associated with higher levels of moderate-vigorous activity levels, whereas preschools with lower quality scores participated in more sedentary activity. Brown et al. (2009) found that activities that engaged preschoolers with balls, objects, wheeled toys, playing on fixed equipment, or playing in open spaces all encouraged nonsedentary activity and moderately vigorous physical activity. This parallels findings that the addition of activity-friendly equipment to an outdoor preschool playground significantly decreased sedentary behavior and significantly increased light, moderate, and vigorous physical activity (Hannon & Brown, 2008). However, in at least one study, increased opportunities for free outdoor play did not lead to significant differences in physical activity during the school day (Alhassan et al.,

2007). Trost et al. (2008), in a randomized clinical trial of integrating a physical activity curriculum into traditional classroom activities, found that their intervention group (n = 20) had significantly greater MVPA (3–5.9 METs) and VPA (≥6 METs) in the classroom compared with the control group (n = 22) in the final 4 weeks of an 8-week intervention. When combining classroom and outdoor time in analysis, Trost et al. found significant differences between groups only in the last 2 weeks of the intervention.

Studies that used qualitative techniques demonstrated parental insight into and consensus with several of the same factors related to physical activity in the childcare setting noted above. In Irwin et al.'s (2005) study, a lack of sufficient space for physical activity in day care was cited by some parents as a barrier to adequate physical activity. In addition, although Benjamin, Haines, Ball, and Ward (2008) found that 82% of parents perceived the quality of their child's physical activity at the childcare center to be either excellent or good, increasing structured physical activity, increasing outdoor playtime, and providing additional space and a variety of play equipment were just a few modifiable factors suggested by parents that could be instituted to increase overall physical activity levels (Benjamin et al., 2008).

As with the studies involving interpersonal dynamics, results of these studies must be interpreted with some caution. Studies by Alhassan et al. (2007), Hannon and Brown (2008), Irwin et al. (2005), Trost et al. (2008), and Tucker and Irwin (2010) had relatively small samples. Hannon and Brown's study, although experimental, did not include a control group. It also consisted of a largely Caucasian sample from a university locale versus Alhassan et al.'s sample of Latino children. The studies by Benjamin et al. (2008) and Brown et al. (2009) had larger, more representative samples, aiding in generalizability, yet these studies (as the majority cited here) were largely descriptive so causality cannot be determined in regard to cited factors and physical activity levels. Although Trost et al.'s intervention showed promise in boosting physical activity, generalizability cannot be judged because no demographic information was provided.

Neighborhood Environment

For this review, neighborhood environment is defined as both the physical and social context by which the preschool child is surrounded in their neighborhood. Spence, Cutumisu, Edwards, and Evans (2008) found girls to be less likely to be overweight or obese if they lived in walkable neighborhoods with more intersections; this finding did not hold true for boys, although boys were reported to engage in significantly more structured and unstructured physical activity than girls (85% vs. 77%). Parents living in rural communities mentioned a desire to create more home-based activities because of the extra time and financial cost that it took to have their child participate in organized play activities outside of the home (Irwin et al., 2005). Neighborhood safety was also commonly cited when identifying factors that may limit preschoolers' outdoor playtime (Burdette & Whitaker, 2005; Dwyer et al., 2008; Irwin et al., 2005; Rich et al., 2005). Burdette and Whitaker examined the effects of maternal perceptions of neighborhood safety on obesity rates, time spent playing outdoors, and time spent watching television. If mothers perceived the neighborhood in which they lived to be unsafe, preschoolers watched significantly more television, but this maternal perception was not related to BMI, obesity risk, or decreased outdoor playtime (Burdette & Whitaker, 2005). Eighty-two percent of parental caregivers in one study indicated that their child had a safe place to play (Rich et al., 2005). However, for 48% of those caregivers, safe places were indoor areas.

Studies addressing the neighborhood environment were limited in number, and the results must be interpreted with some caution. Limitations of the studies by Dwyer et al. (2008), Irwin et al. (2005), and Rich et al. (2005) have been mentioned earlier. Burdette and Whitaker's (2005) study involved only 3-year-old children primarily from larger cities, oversampled unwed mothers, and did not measure other risk factors or dimensions of safety. Spence et al.'s (2008) study involved a larger, more representative sample, but physical activity was defined only in terms of a dichotomous, self-report variable involving number of hours spent in physical activity per week; no other criteria, such as intensity, were included, and the authors cite a lack of reliability or validity for this measurement.

Discussion

Childhood obesity is a major public health concern affecting children of all ages with an increased incidence seen in preschoolers over the last few decades (CDC, 2010; Ogden et al., 2010). Energy intake and energy expenditure through physical activity are key to the development of overweight and obesity in preschoolers. Many preschoolers continue to fall short in meeting daily physical activity requirements set forth by accredited associations. The purposes of this article were to summarize clinical recommendations for adequate physical activity in children 2–5 years old and to identify common factors associated with physical activity levels in this population. From this review, we have (a) identified discrepancies in physical activity recommendations and (b) identified factors from three broad areas (parental perception, the childcare setting, and the child's home/neighborhood environment) to consider when assessing and promoting increased physical activity among preschoolers.

Physical Activity Recommendations

Several associations including the AHA, AAP, and NASPE propose that children of all ages should participate

in daily physical activities to promote health and well-being (AAP, 2010; AHA, 2010; NASPE, 2010). However, our review of physical activity guidelines uncovered discrepancies in definitions and recommendations. Although physical activity guidelines are consistent among some associations, there is a lack of uniformity among others. For example, the AHA recommends that children 2 years and older should participate in 30 minutes of moderate-intensity physical activity per day (AHA, 2010), whereas NASPE recommends at least 60 minutes of structured physical activity daily and at least 60 minutes and up to several hours of unstructured physical activity daily (NASPE, 2010). In addition to differences in duration, the AHA and AAP suggest intensity levels, whereas NASPE does not. These discrepancies make it difficult for providers and parents alike to understand and implement the appropriate physical activity guidelines that are most effective in preventing overweight and obesity in this age group. We offer a synthesized recommendation for physical activity in preschoolers based on the recommendations from the AAP, AHA, and NASPE: Preschoolers should engage in at least 30–60 minutes of mild- to moderate-intensity structured physical activity daily and at least 60 minutes and up to several hours of unstructured physical activity daily. In addition, preschoolers should avoid being sedentary for more than 60 minutes at a time except when sleeping and limit screen time to less than 2 hours per day (Council on Sports Medicine and Fitness and Council on School Health, 2006; NASPE, 2010).

Factors in Preschoolers' Physical Activity

Our review of the literature suggests that there are several factors the clinicians should consider in assessing physical activity levels and planning ways to help families and preschoolers meet these recommendations. A primary challenge involves investigating and resolving disparities between parental perceptions and realities of preschooler physical activity. In one study, most parents believed that their preschooler was engaging in enough daily physical activity to prevent them from becoming overweight and/or obese despite the increasing trend of childhood obesity (Dwyer et al., 2008). In another study, 50% of parents were not concerned about their child's weight; however, 21% of those parents mentioned that others were concerned about their child's weight and overall health (Rich et al., 2005). Although many parents felt that preschoolers were continuously active throughout the day, studies have illustrated that many of the activities that preschoolers participated in were sedentary in nature and thus fell short of recommendations for daily physical activity (Alhassan et al., 2007; Irwin et al., 2005; Spurrier, Magarey, Golley, Curnow, & Sawyer, 2008). Thus, clinicians will need to motivate parents and other primary caregivers to critically evaluate the types and intensity of physical activity in which their children are involved in the home, neighborhood, and childcare settings.

It also appears worthwhile for clinicians to encourage caregivers and children to reflect on the child's personality traits and activity preferences (Dwyer et al., 2008; Irwin et al., 2005) when discussing and planning opportunities for physical activity in the home and childcare settings. Parents reported that preschoolers were more physically active when children enjoyed the activity and initiated their own play (Brown et al., 2009; Irwin et al., 2005). Thus, tailoring physical activity options to child preferences is likely to lead to greater success in meeting physical activity recommendations.

Despite Maher et al.'s (2008) findings of no significant difference in parental reports of obese and nonobese preschoolers' participation in family-based exercise in a typical week, other studies reviewed here suggest that clinicians should ask parents (or other primary caregivers) about their own physical activity levels and the extent to which they engage in physical activity with their preschoolers. Active adult involvement, increased creativity of parents during play, and role modeling especially by mothers were all perceived by parents to promote physical activity among preschoolers (Dwyer et al., 2008; Irwin et al., 2005). In addition, being single parents, having busy schedules, and feeling fatigued at the end of the day have all been cited as factors that led parents to be less likely to engage in physical activity with their preschool child (Dwyer et al., 2008). Asking about any siblings and their active play with their preschool-age sibling is another aspect of family assessment for the clinician to consider (Irwin et al., 2005).

Perceived safety and the role of weather conditions in opportunities for physical activity (Dwyer et al., 2008; Irwin et al., 2005) are areas for assessment and problem solving for the clinician and family. This appears to be true in both the home/neighborhood context and the childcare setting. From a proactive standpoint, parents could be encouraged to find out about open and safe places within their neighborhood/community by consulting with local parenting groups and/or local law enforcement. They should also be counseled to explore a childcare setting's activity and play policies prior to enrolling their child.

Whether physical activity is indoors or outdoors does not appear to be as important as once thought. Alhassan et al. (2007) concluded that when additional amounts of outdoor playtime were added to preschoolers' daily routine, there was no significant increase in physical activity levels. Tucker and Irwin (2010) found that parents' report of their children playing outdoors did not achieve higher levels of physical activity compared with those playing indoors. However, when considering the outdoor setting, the amount and variation in portable playground equipment in the childcare setting appeared to play a more influential role on preschooler's physical activity levels than the amount of outdoor playtime (Alhassan et al., 2007; Dowda et al., 2009; Hannon & Brown, 2008). Preschoolers engaged in higher levels of physical activity when the childcare environment had more than one piece of playground equipment, had less fixed playground

equipment such as balls and tricycles, and had an overall larger playground area (Brown et al., 2009; Dowda et al., 2009; Hannon & Brown, 2008). Increased creativity coupled with greater amounts of available equipment resulted in higher levels of physical activity for preschoolers (Dowda et al., 2009; Hannon & Brown, 2008). Thus, parents and other primary caregivers should be encouraged to ask about time, equipment, and space for physical activity in the childcare setting and likely consider these factors in their home and neighborhood contexts as well.

Limitations

Limitations of the studies reviewed here relate to design, measurement, and sampling. Qualitative studies were used to assess parental perceptions of factors associated with their child's physical activity levels. Although qualitative approaches are appropriate for this type of assessment, it must be noted that parental perception may not accurately reflect the reality of what children are actually doing. In addition, when using cross-sectional, descriptive, or observational designs to evaluate physical activity levels in preschoolers, physical activity patterns at one point in time may not represent typical daily levels of physical activity nor adequately capture variation among individuals. With only two randomized controlled trials (RCTs) and a one-group, pretest/posttest study, it is clear that a great deal of work in this area remains. This is underscored by the mixed results of two larger RCTs among African American and Latino low-income preschoolers, which were not included in this review because they consisted of both nutritional and physical activity interventions (Fitzgibbon et al., 2005, 2006).

Another overall limitation is the use of different measures of physical activity levels in preschoolers. Among the 14 studies included in the review, preschooler's physical activity levels were assessed and measured using different questionnaires, scales, checklists, inventories, personal interviews, and accelerometers. The lack of consistency among measures in these studies presents challenges in the interpretation of preschoolers' overall physical activity levels across studies. It is crucial that future studies focus on using the most reliable instruments for measuring physical activity levels in preschoolers and on using these tools consistently across studies to ensure accuracy and increase validity, reliability, and comparability of study results.

The sample characteristics of the various studies also pose limitations. Variations in sample sizes coupled with a relative lack of variation in ethnicity and parental respondent serve as limitations in comparing results among studies along with the potential for limiting generalizability. Most of the samples in the various studies were composed largely of Caucasians, with slightly more boys in the studies. However, as noted above, there is an increasing prevalence of overweight and obesity among minority children (CDC, 2010; Ogden et al., 2010). In addition, most study parents were mothers with low response rates overall. A greater future focus on minority groups and increased representation of fathers and other primary caregivers, such as grandparents, are suggested. Capturing greater sample variation should better ensure that results can be generalized to the larger population of preschoolers.

Lastly, there are few studies that focus on the amount of physical activity that preschoolers obtain in the home environment. Although the home environment is an extremely influential factor in preschooler's levels of physical activity, many studies fall short of examining this environment. Most studies in this review assessed physical activity in the home by subjective measurement of physical activity through parental perception and observation. Using accelerometers as an objective measurement of preschooler's level of physical activity in the home environment will provide further insight.

Conclusions

Overall, in spite of the immense amount of literature that examines the growing problem of childhood obesity across the life span, there is a relative lack of research that examines physical activity levels specifically in the preschool population. Although this age group was once thought to be extremely active, research suggests that overall, many activities in which preschoolers engage are actually sedentary in nature. This results in surprisingly low levels of physical activity and likely contributes to the increasing prevalence of obesity in these children. Studies of preschoolers' physical activity are a vital missing component within the literature because past studies have shown that children in the preschool years begin to develop lifestyle behaviors that are carried into late childhood, adolescence, and adulthood. Future research on this topic is needed to better understand exactly how much and what type of physical activity preschooler's engage in and what interventions can be instituted to increase their overall physical activity levels. Developing specific interventions that focus on preventing obesity in preschoolers will result in better overall psychological and physical health, will improve quality of life, and will be a key factor in decreasing steadily rising health care costs.

Clinical Pearls

- ➢ Multiple factors such as child characteristics, interpersonal dynamics, childcare setting, and neighborhood environment are associated with the type and amount of physical activity in which preschoolers engage throughout the day, so assess each of these.
- ➢ Obesity in preschoolers is a multifaceted health concern, and therefore, interventions to prevent obesity in this age group must be targeted at multiple levels to be effective.
- ➢ Provide preschoolers and their family members with age-appropriate physical activity recommendations to help fight the obesity epidemic.

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