ASSESSING THE STRATEGIES FOR INCREASING MODERATE TO VIGOROUS PHYSICAL ACTIVITY IN CHILDREN BIRTH TO 5 YEARS OF AGE IN THE PREVENTION OF OBESITY: SYSTEMATIC REVIEW OF THE LITERATURE

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ABSTRACT

Purpose: A systematic review of the literature was conducted to identify the most current research studies describing the impact of increasing physical activity in children ages birth to five years for the prevention of childhood overweight/obesity.

Background: From 1980 to 2001 researchers found an increased prevalence of being overweight from 6.3% to 10.0% and increased at-risk-for-overweight from 11.1% to 14.4% in children including infants less than 6 months of age. Studies have shown children who were ever overweight during the ages 24, 36, or 54 months were more than five times as likely to be overweight at age 12 years compared to those not overweight at all three referenced ages. The recently released 2008 Physical Activity Guidelines for Americans only targets people greater than 6 years of age. Currently, the 2002 National Association for Sport and Physical Education guidelines is currently the only source that specifies the types of physical activity for infants, toddlers and preschoolers. The research behind the NASPE guidelines extend from 1985 to 2000, nonetheless they were a utilized as a reference for recommended physical activity levels in young children in this systematic review of the literature.

Methods: The literature review began on July 2009 and concluded in January 2010 with searches in PubMed, CINAHL and PsycHe. The search criteria included: publication date January 2000 through December 2009, English language, and children (from infancy through 5 years of age). The Medical Subject Headings Terms (MeSH) included health promotion, well-being, active living, physical activity, exercise, and childhood in order to expand the number of qualitative and quantitative research projects conducted in the target population. The exclusion criteria were: any disability, Prader Willi syndrome and diabetes. The challenges of this

literature review included insufficient research on physical activity in the selected age group and use of different methodology across studies.

Conclusion: Of the 37 journal articles included in this review, only one study stated definitively that physical activity predicts future body fat. Only six articles (16%) identified physical activity as a successful weight loss intervention when combined with nutrition education, counseling and long term trials involving entire families. However, studies involving older children and adolescents indicate correlations between the built environment, reduced physical activity and childhood obesity. The factors most influential in young children's physical activity levels were: gender, age, social-economic status, race, ethnicity, parental or caregiver's weight status, infant prematurity, maternal education and mental health and extended family health beliefs. Caregiver/teacher training on developmentally appropriate physical activity practices influences children's motor skill development confidence, which impacts activity levels. There were seven distinct observational instruments/physical activity assessment tools validated for use in the target population to assist researchers in developing evidence-based strategies. These tools should facilitate further studies essential for policy makers supporting consistent physical activity and screen time regulations for young children and reliable quality child care indicators. Although the Healthy People 2020 goals have yet to be established, there should be sufficient support for addressing the lack of physical activity guidelines for children birth through five years of age to reduce the rates of childhood obesity.

INTRODUCTION

Background

Community based and primary care practitioners are searching for evidence-to-practice based strategies to address one of the world's major public health issues—overweight, obesity and its co-morbidities. Although social ecological frameworks are shedding light on the multiple intervention levels required to promote healthy lifestyle behaviors, researchers and expert committees are finally looking to early childhood as an effective target population to aim prevention. Caregivers (relationship) and environments (community and society) are part of the framework and their influence is one consistently agreed upon in research findings. The guardianship of very young children in family child care homes and in child care settings is hindered by social-economic status; inconsistent national and state child care policies; inappropriate developmental practices and built environments limiting physical activity. These concerns when combined with the growing number of children in child care settings at younger ages, with the insufficient research and data collection in children birth to 5 years of age threaten the limited resources of the U.S. public health system. Childhood obesity will decrease the quality of life of millions of children, will overburden health care costs related to associated co-morbidities, and negatively impacts children's social-emotional development .

The Overweight/Obesity Epidemic

The rates of overweight and obesity in children continues to alarm many public health practitioners, health care providers and researchers. In infants less than six months through five years of age the prevalence of being overweight increased from 6.3% to 10.0% from 1980 to 2001 and being at-risk-for-overweight increased from 11.1% to 14.4% (3). A body mass index (BMI) over the 95th percentile for children is considered obese and between the 85th and 95th

percentile is overweight in children over two years of age based on the 2000 Centers for Disease Control's (CDC) gender-specific growth charts. In children less than two years o f age the 2000 CDC clinical growth charts are utilized to assess growth patterns using the same percentile ranges based on weight to length/height parameters (4).

Data collection for children birth through five years of age is beginning to progress, especially for minorities. The CDC Pediatric Nutrition Surveillance System (PedNSS) compiles state and local level overweight/obesity data for low-income, infants, toddlers and preschool children participating in federally funded health and nutrition programs (5). This includes 85% of the reported data originating from the Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) and 15% from non-WIC programs, i.e., the Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) Program and Title V Maternal and Child Health Program. Results of the 2007 PedNSS, indicate prevalence of obesity among preschool children aged 2–5 years was 14.9%, up from 12.2% in 1998. The highest obesity rates were reported among American Indian or Alaskan Native (19.5%) and Hispanic (18.2%) children; the lowest rates were among white (12.4%), black (11.9%), and Asian or Pacific Islander (10.8%) children.

No contributor to the PedNSS met the Healthy People 2010 obesity objective aimed at reducing the percentage of overweight children and adolescents ages 6-19 years to five percent. There was no weight or physical activity related HP 2010 goal specific for infants, toddlers and preschool children under six years of age (5,6). Studies have shown children who were ever overweight equal to or greater than one time at ages 24, 36, or 54 months during this period were more than five times as likely to be overweight at age 12 years compared to those below the 85th percentile for BMI at all three referenced preschool ages (7). In spite of these findings, only recently have we begun to look at child care settings as a place for primary prevention

approaches (2). The geographic patterns for overweight/obesity in low-income, preschool-aged children from 2006-2008 varied significantly by county and within a state. Overall, obesity prevalence is highest in western and southern California, southern Texas, the central and north eastern seaboard, and some Appalachian states. Nearly all counties on the West Coast have prevalence above 15%, whereas many of the counties in the Rocky Mountains have rates below 10% (5). The majority of the referenced regions/states do not have regulations specifying the amount or length of time required to meet the indoor or outdoor recommended physical activity guidelines for young children in center or home based child care settings.

Pediatric Data

The 2007 PedNSS data represent records from 42% Hispanic children; 32% non-Hispanic white; 20% non-Hispanic black; 3% Asian or Pacific Islander; 1% American Indian or Alaska Native; and 2% from children of all other or unspecified races and ethnicities. From 1998 through 2007, the proportion of records submitted to PedNSS for Hispanic children increased from approximately 27% to 41%, respectively. During the same period, the proportion of records for non-Hispanic and black children declined. Most PedNSS records (62%) were from children aged 1–5 years; 38% were from infants aged less than 1 year. The current data may not be an adequate representation of the total population since it is reflective of children receiving social services in WIC and non-WIC programs (5). The weight status, high risk low socio-economic status of these populations is further challenged by their inability to access quality child care.

Child Care Participation Rates

The number of children in child care settings continues to increase at all income levels. The percentage of kindergartners enrolled in full-day programs increased from 28% in 1977 to 65% in 2003. In the year 2000, half the children under 1 year of age and two-thirds of children less than 3 years of age were in child care and the number continues to rise (8). The statistics are somewhat skewed as the Census Bureau's analysis on which they are based, indicate that minorities and young children were missed at higher rates than other people in the 2000 Census. However these figures still identify opportunities to evaluate policies and interventions in these settings. The number of children ages 3-, 4- and 5 years who are cared for in center-based programs (e.g., child care centers, Head Start programs, publicly funded prekindergarten and private child care) has further increased to an estimated 7.5 million—roughly one-third of the child population (9). These figures do not include care by family members or residential child care, or children less than 3 years of age, only early childhood education programs. Center-based programs also referred to as "nursery school" and "preschool" include any and all entities providing educational experiences for children during the years preceding kindergarten. The data reported for 2003 show differences by race and ethnicity are worth noting. Non-Hispanic black kindergartners were much more likely to be enrolled in full-day programs at 80% compared to 68% American Indian; 64% non-Hispanic white; 57% Hispanic; and 59% Asian or Pacific Islander. There are regional differences as well, with kindergartners in the South more than twice as likely than those in the West to be enrolled in full-day kindergarten (85% versus 41%, respectively, in 2003). Kindergartners in the Northeast and Midwest fell in the middle at 63% and 59%, in that order for the same time period. Additional differences were reported based on income: kindergartners in families with low incomes were more likely than wealthier families to

be enrolled in full-day programs. For example, in 2003, 71% of kindergartners with household incomes between $15,000 and $29,000 were enrolled in full-day programs, compared to 58% with household incomes of $75,000 or greater. Lastly the hours in care by children five years of age also differed by school type: 72% of kindergartners in private school were enrolled in full-day programs, compared with 63% in public school (10).

Child Development

Extensive research has shown that social economic indicators affect a child's cognitive development. A recent report indicated 13,241,000 (19%) of children 0-17 years of age are living in poverty and given the most recent recession that number threatens to rise (10). Blacks, American Indian and Hispanic children have the highest child poverty rates at 34%, 31% and 28% respectively. The Hispanic child population percentage increased from 9% to 19% between 1980 and 2004, and is expected to continue rising to 24% by 2020. The minority adult population caring for these children also has one of the highest rates of diabetes, cardiovascular disease, hypertension, cancer and obesity rates in the nation. Compounding the challenge, children in low income working families are those most often exposed to experiences in lower quality child care (10). Early childhood education programs and child care settings are effective public venues where children can eat healthy and meet their requirements for physical activity to prevent further increases in obesity (2).

Physical Activity in Young Children

In 2008 the United States (U.S.) Department of Health and Human Services marked the first ever release of Physical Activity Guidelines for Americans (11). The guidelines are based on the 2007 Physical Activity Guidelines Committee Report which "conducted an extensive review of the scientific data relating physical activity to health published since the release of the

1996 Surgeon General's Report on Physical Activity and Health" (12). However, the guidelines do not include children less than 6 years of age. The Community Evidence-Based Strategies for Obesity Prevention released in 2009 by the CDC did not address physical activity in early childhood development programs, including family, private or subsidized child care, or prekindergarten (13). In 2002 the National Association for Sport and Physical Education (NASPE) released guidelines for all age groups categorized by infants (birth to 12 months old), toddlers (12 to 36 months old), and preschoolers (ages 3 to 5 years) and based on research studies of motor development, movement, and exercise physiology specialists (14). The NASPE guidelines recommend 120 minutes per day of total physical activity (60 minutes of structured and 60 minutes unstructured activities). Details are provided describing the kind of physical activity, as well as the environment, and individuals responsible for facilitating these activities in each age group. This information has not translated into consistent physical activity requirements in national child care licensing regulations and/or early childhood development settings.

Factors Influencing Physical Activity

Child care settings offer an important venue to focus on obesity and overweight prevention strategies. Recent studies have indicated the need for caregivers to monitor young children at early ages to begin identifying motor skill performance as a factor influencing their future physical activity levels (15). Studies underscore several causes to low activity levels, including lack of teacher enthusiasm (16). Nonetheless a healthy balance of sedentary behavior with optimum levels of moderate to vigorous physical activity (MVPA) is required for normal healthy development. Children require a specific measure of sedentary time to facilitate their cognitive capacities (e.g., learning to read or problem-solve), fine motor skills (e.g., writing) and social emotional development. Researchers also believe clear distinctions need to be made for

describing “physical inactivity” versus sedentary behavior; both have lower levels of energy expenditure, however these terms do not adequately reflect the behaviors associated with bouts of inactivity leading to overweight and/or obesity, i.e., eating while watching a TV, video, and playing computer games. Having valid assessment tools for this population would provide more insight into what children are actually doing while they are sedentary or inactive (17).

Child Care Licensing Regulations

The lack of consistent child care regulations across the U.S. limiting the amount of screen time, a term used to describe time children should spend watching television or computer screens, or mandating appropriate indoor and outdoor activities for young children in child care is a concern. A recent study examining maternal education, income status, home environments and TV screen time on weight status, revealed exposure to TV even as background noise, is a higher predictor of overweight status regardless of whether children are engaged in other activities (18). Researchers indicate child care licensing regulations should support early childhood educators becoming informed about children’s physical activity requirements because many settings are not encouraging appropriate levels. A recent observational study revealed that children 3-5 years of age are not very active spending as much as 89% of their day in sedentary activity, 8% in light activity, and as little as 3% to 5% in MVPA (16). The study recommends the need to work with caregivers and parents to monitor motor skill development which appears to be a strong predictor of physical activity levels.

Facilitating Physical Activity

Adults require a greater understanding on the elements which facilitate physical activity in young children. Teachers, caregivers and parents need guidance on how to help foster confidence levels in children’s gross and fine motor capabilities to facilitate physical activity in

children (15). A child's self-esteem and weight may further inhibit physical activity levels, negatively affecting their future weight status which as reported increases the likelihood of adolescent and adult onset obesity and its co-morbidities (19,20). There are also social and environmental factors influencing physical activity levels in young children that may negatively impact the amount of time spent in MVPA outdoors versus indoors (15). Adult initiated structured activities outdoors limits the amount of time children are active compared to intentional structured indoor activities which significantly contributes to a child's MVPA. Additionally, parents/guardians also influence their child's physical activity by the type of indoor and outdoor play rules, family recreation activities, and by prompting a child to be more active (21). Early childhood development programs and child care settings are poised to be an effective public health partner in advocating for increasing MVPA and reducing TV screen time in young children to meet the requirements of two hours for children over two years of age and zero for younger children. Although limited, current research supports the need for policy makers to implement licensing regulation that favor environmental practices promoting healthy lifestyles in early childhood development centers/schools and child care settings.

Two studies have been conducted to date reviewing U.S. state regulations for child care. The evidenced revealed that most states had few regulations related to the prevention of childhood obesity (2,22). These were the first comprehensive review of nutrition and physical activity regulations in the U.S. related to childhood obesity for child care facilities, emphasizing the need for additional research on this topic. The focus on classifying and categorizing state level policy related to physical education and nutrition services has been in school settings (children ages 6 to 18 years), but researchers have not extended their review to include state regulations governing child-care facilities.

Assessment Tools

A randomized controlled study was conducted in North Carolina using the Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC). In this study a sample of child care health consultants and centers utilized the NAP SACC in an effort to create a single set of comprehensive guidelines for physical activity for child care centers. The NAP SACC tool mainly addresses the inter-personal and organizational levels of the social ecological model aimed at "child care policy, practice and environmental influences on nutrition and physical activity behaviors in young children" (23). These best-practice guidelines may need additional modification by a panel of experts and/or committee review. Reducing childhood obesity will require effective prevention strategies that focus on environments and policies promoting physical activity, as well as healthy lifestyles for families, child care centers, and communities. In addition to fine-tuning a valid child care self-assessment tool, it may also be important to make a distinction between the terms related to a child's healthy development: motor skills, physical activity, exercise and physical fitness.

The aforementioned terms are sometimes used interchangeably, yet they have distinct meanings. The following definitions have been identified by the President's Council of Physical Fitness and Sports (24):

- "*Motor skills are non-fitness abilities that improve with practice (learning) and relate to one's ability to perform specific sports and other motor tasks."*
- *"Physical activity is a bodily movement that is produced by the contraction of skeletal muscle and that substantially increases energy expenditure."* Physical activity can be categorized by type, purpose, frequency, duration, and intensity. "*Forms of physical*

activity such as exercise, sports, and dance (among others) are considered as sub-categories of physical activity." In young children, physical activity is observed for the most part during play an integral part of children's social-emotional and cognitive development.

- *"Exercise is leisure time physical activity conducted with the intention of developing physical fitness."* It is considered a subset of physical activity which is planned, structured, repetitive, and conducted to with the goal of achieving physical fitness.
- Physical fitness is the outcome of participating in physical activity, including exercise which leads to *"improved body composition, muscle strength, endurance and/or flexibility, and cardio-respiratory fitness."*

Developmental screening assessment tools, i.e., Early Learning Accomplishment Profile (E-LAP), used in early childhood programs and clinical examination of preschool age children in primary care settings are performed with the intention of identifying healthy growth and development (23). A caregiver's comprehension of normal healthy development is essential in implementing and modifying environments to promote the right balance of activities for healthy growth in infants, toddlers and preschool children in child care settings.

SYSTEMATIC REVIEW OF THE LITERATURE

Rationale

The purpose for conducting this systematic review of the literature was to identify existing evidence-based strategies in the prevention of overweight infants, toddlers and preschool children. The articles were reviewed in the context of the benefits of play in increasing moderate to vigorous physical activity in children age five or younger. The process included formulating a series of questions to guide the review of the literature, gathering and classifying the research studies, critically appraising each article, and summarizing the evidence. The following research questions were posed as a framework to conduct the review of the articles:

1. Is physical activity an effective means of preventing and treating childhood obesity?
2. What impact does incorporating physical activity in early childhood development programs have on cognitive development?
3. What assessment tools are available to assess young children's physical activity levels in child care settings?
4. What influences physical activity levels in early childhood?

Methods

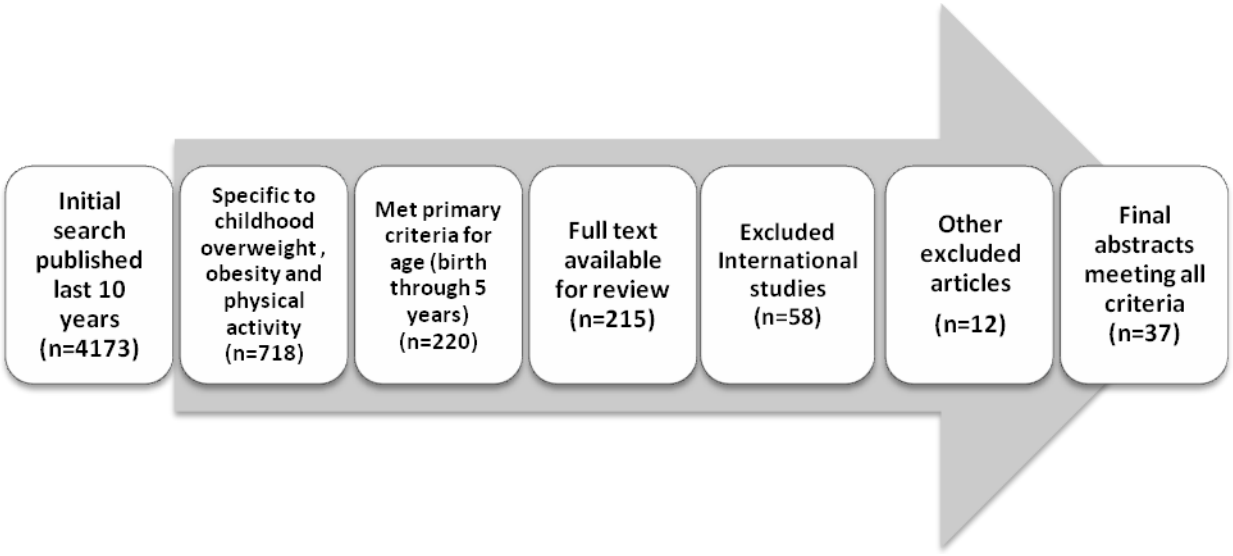
The literature review began on July 2009 and concluded in January 2010 with searches in PubMed and CINAHL. The search criteria included: publication date January 2000 through December 2009, English language, and children (infants through 5 years of age). The Medical Subject Headings Terms (MeSH) were modified to include health promotion, well-being, active living, physical activity, exercise, and childhood in order to expand the number of qualitative and quantitative research projects conducted in this population. Additional key words included: obesity, obese, overweight, weight loss, BMI, family intervention and multi-component weight

management programs. The exclusion criteria were: any disability, Prader Willi syndrome and diabetes (Figure 1). The term "motor skills" was not included, since it is associated with developmental concerns not childhood overweight.

Findings

The initial database search in PubMed began July 2009 and concluded in January 2010 yielded 4135 studies and CINAHL 7. Of those, 127 were available and only 37 met all of the aforementioned criteria (Figure 1). The most rigorous scientific method preferred is randomized clinical trials (RCT) over other sampling methods. Searches conducted in PsycHE yielded no results matching the review search criteria.

Figure 1 – Results of Systematic Literature Review



A total of 37 articles were identified and used for this review. Five (14%) of the selected articles were systematic reviews and meta-analyses, but were included because of the large sample size and that the age range of the target population included children from birth to 5 years

of age (22, 25-28). Due to the small number of studies limited to this age group, 11 articles (30%) were reviewed that also included children over five years of age (25-35). All of the studies discussed their limitations which were mostly related to sampling methods, sample size, short interventions, short follow-ups, insufficient data, etc.

Many studies on the target population (birth to five years) included adults, since caregivers, teachers and parents have a significant influence on children's development and support for physical activity. Of those reviewed, 18 studies (49%) focused on adults to identify the challenges of increasing MVPA in the homes, WIC clinics and child care settings (2,15,16, 22,-23, 25-29, 32, 35-44). Adults participated in focus groups, interviews, surveys, nutrition education and weight management interventions; provided demographic data; and monitored mechanical devices, such as accelerometers worn by children.

According to Issel there are three salient characteristics of an ideal design: (1) a control group comparable to the experimental group, (2) baseline and intervention measurements of outcome variables, and (3) minimal bias affecting generalizations to other populations or the ability to determine interventions effectiveness (45). Ranking studies using these criteria may be challenging due to the limited number of well controlled trials that meet all these elements. Randomized controlled trials exemplify the gold standard for research design, which typically meet most of these criteria. The articles included in this review were categorized according to the type of study design described by the authors and were grouped following four major categories (Tables 1-4). Several studies did not match the stringent definition for types of design. Nonetheless, these categories helped classify a wide range of studies, and identify the strength of the conclusion which is highly related to the strength of the study design. Table 1 lists the quantitative, longitudinal, and randomized controlled trials, Table 2 summarizes qualitative and

observational studies, Table 3 contains qualitative studies with focus groups and interviews and Table 4 presents systematic reviews or meta-analyses. The tables summarize the sample sizes, age for the target sample, study timeline, demographics/location, physical activity measures, diet/weight status, environmental assessments and brief results.

A total of 10 articles listed on Table 1 were identified as quantitative (27%), quasi-experimental (n= 3), longitudinal (n= 3) or randomized control trials (n=4). Most of the articles under this category concentrated more on the influences of MVPA, such as demographics, parents and included more assessments of diet and weight status in children. These articles reaffirm what previous research has shown in other age groups regarding the influences of parents on physical activity and the amount of screen time. There were only two longitudinal studies included in the systematic review listed in Table 1. One of these includes second and third generation cohorts from the Framingham Children's Study conducted by Moore et al. This study began in 1987, however the article is dated 2003. The other longitudinal study by Lumeng et al associated behavioral problems with screen time in excess of two hours and for children 36 months of age higher risk of overweight simply by being in a room with a television on in excess of two hours (18, 35). One specific article made reference to the effect that prematurity has on levels of physical activity (49).

Table 2 summarizes a total of 17 articles considered qualitative and observational studies. One of the articles was a review of child care and family child care regulations, 14 were observational with four also considered cross-sectional. Except for the review article, all were conducted in southern states. Nine of the articles on Table 2 assessed the validity of observational instruments in identifying the contextual data for evaluating MVPA in young children. Different methods were used to assess children's physical activity levels. Eight studies

validated the use of two instruments, an Observational System for Recording Physical Activity in Preschoolers (OSRAC preschool and home version) and the second Nutrition and Physical Activity Self-Assessment for Child Care (NAP SACC) (16, 23,37,43,48,51-53). Six studies used mechanical devices, i.e., accelerometer or pedometer to evaluate MVPA (15,32,39,43,47,49). In two studies the revised Early Childhood Environment Rating Scale (ECERS-R) and the Environmental and the Policy Assessment and Observation Instrument (EPAO) were the tools utilized to evaluate environmental barriers to children's physical activity levels (23, 49). These assessment and observational tools were validated for use in the target population and should aid future research in developing evidence-based strategies. Only one study actually measured the activity level of a three-month old baby. The researcher concluded that caregiver's handling of an infant is an important element along when measuring infant's physical activity levels (39). The majority of the studies in Table 2 were conducted in faith-based, Head Start (federally funded) and private child care centers.

Six qualitative studies conducted using focus groups or interviews are listed on Table 3. These studies highlight parent's perceived barriers to physical activity, identifying their children as overweight, lack of control and to getting adequate nutrition information in primary care settings. Except for one study conducted in the mid-west (Colorado), the remaining five were conducted in the northeast (32,36,40,42,44,55).

A total of three systematic reviews and a meta-analysis are summarized on Table 4. The reviews included studies that extended as far back as 1960 to 2005. Two of the articles indicated the inclusion of international studies (27,28). The most salient points from the meta-analyses was that trials lasting over six months reported lower sedentary levels, lower BMIs and notable differences between self reporting vs. other reporting methods (26,28). Lastly, an external

validity review reported evaluation difficulties due to inconsistent and insufficient information on intervention and control participants, outcome measures, as well as trial adaptations (27).

In general there were other notable data omissions in the articles. Not all of the studies reported mean ages of the target population. The youngest age included in a study was three months old with an average range from one to 19 years of age; with 5 (14%) studies reporting estimated mean ages between 8 to 11 (see Tables 1-4). Four studies (11%) used the term "preschool" without specifying the age of the target population; typically that term is defined as children between the ages of three and six (22,40,42,51). Eight studies reported the predominant group was of Hispanics or Latino origin, eight African Americans, five White and 22 (59%) did not include demographic information. Four specifically chose WIC participants who may be low income or have poor nutritional status; three studies indicated their target group was of low social economic status (SES), however 90% of the children who attend Head Start programs are below the federal poverty level and 9 studies were conducted in Head Start centers. Low income and minorities were well represented in this systematic review.

Another issue worth noting is that MVPA levels outdoors is affected by the seasons whether at home or in child care settings. There were 16 (43%) studies that did not indicate what time of year their observations and/or interventions were conducted (29,32,37,39,40-43,47-50). Knowing the time of year when an assessment or observation is implemented is important background data required to evaluate interventions.

Weight status was not part of the data collection in 16 (43%) of the studies (16,22, 23,28,36-40,42,51-53,62). Dietary recalls and/or food frequency was obtained in only 6 (16%) of the interventions and one of these was self-reported. Calorie restriction is not a recommended weight management strategy for very young children. The most proactive approach is increasing

physical activity and reducing screen time. On the other hand, food choices in young children should include a wide variety of nutrient rich foods, in age appropriate quantities, and with limited amounts of the so-called empty calories such as those rich in sugars and fat. Weight measurements will help identify if the children were are at risk for overweight or obesity. Dietary recalls or food frequencies are important in evaluating the evidence behind the selected strategies in the prevention of overweight and obesity in young children.

Only two studies utilized geographic information systems, an objective measure assessing built environments facilitation of physical activity (25, 34). Last of all, 17 studies (46%) were conducted in private, faith-based child care and Head Start, a federally funded child development program (2,15,16,23,38,40,43,46-54,56). Nine (24%) studies surveyed home and community environments to assess physical activity and screen time. Family child care (FCC) which represents a significant number of children was not represented in any of the studies. This alternative day care option is used by many families; they participate in child nutrition programs and are licensed when they serve more than 5 children. Future interventions need to engage FCCs to identify their unique challenges in reducing screen time and promoting physical activity.

Table 1 – Summary of quantitative studies, quasi-experimental and randomized controlled trials assessing benefits of play in increasing moderate to vigorous physical activity (MVPA) in children (birth to 5 years), 2010.

Authors	Type of Study	Sample Size	Age Range (Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Alhassan et al, 2007	Randomized controlled pilot	32	(3.6±0.5)	Dec 2005-Feb 2006	Latino, low income; Redwood City, CA	Accelerometer	Avg BMI @ 85th percentile age & gender	NA	Merely ↑ preschool children's outdoor free play time did not ↑MVPA;
Anderson et al, 2008	Cross-sectional	2964	4 –11	NHANES 2001-2004	U.S.	Surveys	16.9% BMI ≥95th percentile	Screen time	37% ↓ play levels; 65% ↑ screen time & 26% had both; Mexican-American ↑ risk low active play; non-Hispanic black ↑ risk high screen time; ↑ income associated with low active play, not high screen time.
Butte et al, 2006	Quantitative genetic analysis; Viva La Familia Study	1030 children 319 families	4-19 (10.9±.02)	Nov 2000 – Aug 2004	Hispanics Houston, TX	Accelerometer	24-h Diet Recall BMI 51% >95th percentile; 41% >99th percentile	NA	Strong genetic & environmental factors contributing to ↑ prevalence of obesity in Hispanic children.
Finn et al, 2002	Randomized clinical trial	214 children in Child Care	3-5 (3.9±.06)	NI	SD	Accelerometer	Avg BMI 16	NA	CC center quality strongest predictor of MVPA; Father's ↓ BMI associated with ↑ PA; Premature infants (2-9 weeks) ↓ active.
Fitzgibbon et al, 2006	Group randomized (controlled ?)trial	331 Latino children	3-5 (4.2)	Fall 2001 and Winter 2003	Chicago, IL	NA	Avg BMI 17 24-h dietary recall	Screen time	No significant group differences in BMI, dietary intake & PA at f/u between groups.

Authors	Type of Study	Sample Size	Age Range (Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Kaphingst et at, 2009	Quantitative content analysis	51 states	3-5	2006	NA	*State Child Care Regulations			State CC regulations vary widely regarding meals, physical activity & screen time.
Klohe-Lehman et al, 2007	Convenience sample; one-group, pre-test/post-test study	91 mothers 87 children	1-3 (2.1)	NI	African American Hispanic White Austin, TX	Pedometers (mothers) TBAQ+	<1 yo @69th percentile for WT/HT; 2-3 yo Avg BMI @ 62nd percentile for WT/HT; 24-h dietary recalls	NA	PA levels of both mother & child ↑overall but not in mother-child pairs; Boys >active than girls;1 year-olds & overweight at risk children ↑ PA.
Lumeng et al, 2006	Cross-sectional longitudinal analysis, random sampling	1016 children	3-4.5	Families recruited in 1991	10 U.S. cities: AK, CA, KS, NC, MA, VA, WA, WI, Pittsburgh & Philadelphia, PA;	NA	5.5% BMI >95th percentile	Screen time; HOME Scale	At age 36 mos being in a room awake with a TV on for >2 hrs associated with ↑ risk of overweight; children watching >2 hrs screen time had ↑behavior problems; Mothers with >depressive symptoms & less stimulating home environments↑ risk of overweight; At 54 mos. maternal education most powerful predictor of overweight risk.
Moore et al, 2003	Longitudinal data analysis Framingham Children's Study	103 children & their parents	4-11 (4)	1987 to 1995	MS	Accelerometer	Skinfold Avg BMI @16.2 3-day diet records	Screen time	Preschool children PA levels predict total body fat in early adolescent boys & girls.
Roemmich et al, 2006	Cross-sectional analysis longitudinal study	59	4-7 (6)	Summer 2003 – Winter 2004	Erie County, NY	Accelerometer	Avg BMI @19	GIS Screen time	Neighborhoods with parks & >housing units impact PA levels in young children.

Abbreviations: NI: Not Indicated
NA: Not Applicable
*Reviewed this data in the context of state child care regulations
BMI: Body Mass Index
TBAQ: Toddler Behavior Assessment Questionnaire
HOME: Home Observation for Measurement of the Environment
GIS: Geographic Information System

Table 2 – Summary of qualitative and observational studies assessing benefits of play in increasing moderate to vigorous physical activity (MVPA) in children (birth to 5 years), 2010.

Authors	Type of Study	Sample Size	Age Range(Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Benjamin et al, 2008	Review	50 US States & DC	Preschool	Jan – Aug 2007	U.S.	NA	NA	Screen time	Few regulations related to obesity in CC centers & FCC homes.
Brown et al, 2006	Observational	3 children	3-5	Spring & Fall 2006	SC	OSRAC-P*	NA	OSRAC-P*	OSRAC-p allows for improved uniformed assessment of social & nonsocial factors related to children's PA levels in CC, home & community environments.
Brown et al, 2009	Quasi-experimental, observational	5 children 6 teachers	4	Summer & Fall 2006; Fall 2007	Columbia, SC	OSRAP*	NA	OSRAP*	Preschool children not meeting daily MVPA goals in CC settings; Need bouts of 5 min intentional activity prompts to ↑MVPA.
Brown et al, 2009	Observational, cross-sectional	476 children	3-5	2005-2007	SC	OSRAC-P*	NA	OSRAC-P*	87% of observations recorded indoors; 94% of observations were sedentary only 1% coded as MVPA; adult initiated PA & music were observed <1%; when it did occur resulted in > MVPA; Most common outdoor activities spent in MVPA were 23% open space; 13% fixed

Authors	Type of Study	Sample Size	Age Range(Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
									equipment; 26% ball & object use; 10% socio-dramatic props & 14% wheel toys.
Butte et al, 2006	Cross-sectional assessment	897 children	4-19 (10.8±3.8)	Nov 2000 – Aug 2004	Hispanics Houston, TX	Accelerometer	Overweight Avg BMI @30; Non-overweight Avg BMI @19.7	Survey	87% of 4 to 8 yr olds had 60 min MVPA daily; Types & levels of PA ↓ with age & by gender: ↑boys ↓ girls & ↓ with higher BMI; ↑screen time associated with ↑BMI.
Dowda et al, 2009	Cross-sectional observational Interviews	299 children	3-5 (4)	NI	SC	Accelerometer	Avg BMI @16.6	ECERS-R^	Preschool children spent > time in MVPA in centers with ↑ ECERS score; MVPA ↑ in CC centers with less fixed & > portable equipment.
Drummond et al, 2009	Pilot Intervention	1876 children	Preschool	2005-2008	Yuma County, AZ	NAP SACC**	NA	NAPSACC**	Training and use of NAPSACC ↑ nutrition & PA best practices in CC centers.
McCormick et al, 2008	Observation, two-group; retrospective, matched-control	48 children	3.6-14/ (10.1±2.6)	June 2007 to December 2007	Galveston, TX	NA	Avg BMI @25	NA	Community based weight management program including nutrition education, PA, & gift card incentives, have positive impact on ↓ weight status.
McIver et al, 2009	Observation	13 families with children	3-6/ (4.5±0.9)	NI	White, African-American and Asian/Pacific Islander SC	OSRAC-P OSRAC-H	NA	OSRAC-P OSRAC-H	Children spent 25% of indoor time in sedentary activity; Children spent > time in MVPA in open spaces outdoors with wheeled toys, balls & gross motor toys.

Authors	Type of Study	Sample Size	Age Range(Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
McWilliams et al, 2009	Observation, convenience sample	96 CC centers	3-5	Fall 2005	NC	NAP SACC*	NA	EPAO	NAP SACC is supported by existing guidelines, research evidence & expert review favoring opportunities to be active, i.e., portable play equipment, varied fixed equipment, ↓ sedentary opportunities; MVPA ↑ with environments & policies promoting PA along with staff training on integrating PA in preschool settings.
Pate et al, 2008	Observational study; stratified random selection	438 children	3-5 (4.2±0.7)	NI	Columbia, SC Black & White	OSRAC-P	Avg BMI @16.5	OSRAC-P	Children in child care engaged in MVPA <3% of time during observations & were sedentary 80% of the time; Boys >likely than girls to be active; 3-year old boys >than 4-5 year old boys; child care environments impact PA levels.
Pate et al, 2004	Observational study	247 children	3-5 (4)	NI	Columbia, SC Black & White	Accelerometer	BMI	NI	Child care environments stronger predictor than personal demographics on PA levels; Black children had ↑levels of VPA, boys >MVPA than girls.
Topp et al, 2009	Observational study, single group, pre-test/post-test	33 children and their parents	5-10 (8±1.82)	NI	African American KY	Fitness testing	Avg BMI @21 Hip-to-waist ratios Skinfolds; FF Interview	NA	The pilot study improved cardiovascular fitness levels & improved muscle mass & dietary habits.
Trost et al, 2003	Cross-sectional study	245 children and their	3-5 (4)	NI	60% African American Columbia, SC	OSRAP Accelerometer	Overweight BMI @ 23; Non-overweight	Survey	Overweight boys ↓PA than non-overweight boys; weight status not associated with girls PA levels;

Authors	Type of Study	Sample Size	Age Range(Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
		parents					BMI@ 17.8		Overweight children 3-6 times> likely to have at least one obese parent/ caregiver; parental influences of PA was not a strong indicator of child's weight status.
Williams et al, 2009	Pilot observational Study	270 children and 32 teachers	3-5(4.6)	Spring 2003	74% Hispanic NM	Teacher surveys	NA	NA	The motor skill curriculum increased PA to 47 minutes/week; Teachers reported activities DAP, children enjoyed activities & motor skills appeared to improve;
Williams et al, 2008	Observational study	198 children	3-4 (4.2±.05)	Aug 2004 to Jan 2006	54% African-American SC	Accelerometer CHAMPS CMSP	Avg BMI @16.2	NA	Children spent 55% of day (7 hrs) in sedentary behaviors & 12% of day (90 min) in MVPA; Children with ↑motor skills spent > time in MVPA.
Worobey et al, 2009	Observational study	1 baby & mother	3 mo old baby & mother	NI	NI	*Motionlogger*	NA	NA	PA measure for infants under 6 months of age need to include monitoring of caregiver's handling of the infant and also measure their activity levels.

Abbreviations - OSRAP: Observational System for Recording Physical Activity in Preschoolers; OSRAC-P: Observational System for Recording Physical Activity in Children-Preschool Version; OSRAC-H: Observational System for Recording Physical Activity in Children-Home Version
NAP SACC: Nutrition and Physical Activity Self-Assessment for Child Care
ECERS-R: Early Childhood Environment Rating Scale-Revised
EPAO: Environmental and Policy Assessment and Observation instrument

Table 3 – Summary of qualitative studies with focus groups and interviews assessing benefits of play in increasing moderate to vigorous physical activity (MVPA) in children (birth to 5 years), 2010.

Authors	Type of Study	Sample Size	Age Range (Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Bellows et al, 2008	Formative research (interviews & focus groups)	62 teachers 45 parents	Preschool Parents & Teachers	NI	Low income, CO Head Start parents	Semi-structured telephone interview & focus groups	NA	Semi-structured telephone interview & focus groups	Identified PA practices, beliefs, barriers and desired materials for teachers & parents.
Benjamin et al, 2008	Qualitative, descriptive	91 CC; 508 surveys	2-5 (3.7±0.82)	Summer 2006	NC	Survey	NA	Survey	↑ structured PA; ↑ outdoor play time; need more space & equipment.
Lindsay et al, 2009	Qualitative research, Focus groups & Interviews	51 Latina mothers	2-4	Sept 2005 to Feb 2006	Latino Boston, MA	Focus Groups & Interviews			Social class & culture should be part of ecologic framework when designing program interventions for young immigrant families; WIC & CC are positive public health promotion venues.
McGarvey et al, 2006	Qualitative study, focus groups	25 parents	NI (all participant were recruited from WIC and Head Start which serves preschool children)	NI	Low SES African-American, White, Hispanic & Vietnamese North VA WIC participants;	Focus Group	NA	NA	Identified 3 common factors: 1) not understanding how PA impacts health; 2) impact of using food to influence behavior; and 3) loss of parental control when children enter child care/preschool.

Authors	Type of Study	Sample Size	Age Range (Mean Age)	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Sherman et al, 2001	Qualitative study, focus groups	18 children and their mothers	26 to 56 month old/ 44 months old	Nov-Dec 1999	Black and non-Hispanic White WIC Clinic Cincinnati, OH	Focus Group	83% BMI >95th percentile	NA	10 major themes including growth charts do not determine health; consider children overweight if they are inactive or lazy or teased about their weight or ate well; mother's beliefs determine perception of their child's weight status; home life influences eating & activity habits; mothers report difficulty controlling child's eating habits; food used as a reward.
Taveras et al, 2008	Cross-sectional survey, telephone interview	446 parents & their children	2-12 (7±2.8)	NI	Boston, MA	Questionnaire	Avg BMI @ 94th percentile	Screen time	Overweight parents of children ages 2-6 were < likely than parents of ages7-13 to receive counseling in primary care setting on PA, nutrition or screen time; minorities report ↓ quality counseling on nutrition & PA.

Table 4 – Summary of systematic reviews assessing benefits of play in increasing moderate to vigorous physical activity (MVPA) in children (birth to 5 years), 2010.

Authors	Type of Study	Sample Size	Age Range Mean Age	Study Timeline	Demographics & Location	MVPA	Diet/WT Status	Environment	Results
Dunton et al, 2009	Systematic review	15 articles	3-18	Reviews published after 1/1/06	NA	NA	BMI	GIS Parent & child self-reports	Obesity & environment associations differ by gender, age, SES & population density.
Kamath et al, 2008	Systematic review of RCT & meta-analysis	34 RCTs	2-18	Database inception to Feb 2006	NA	Self Reported or Accelerometer	Self Reported or Dietary Recall	NA	Trials with young children ↓ sedentary activity (SA) > than in adolescents; trials lasting >6 mos had ↓SA levels & ↓ BMI.
Klesges et al, 2008	External validity review	19 RCTs	0-18 years	1980-2004	US & International	NA	BMI	NA	Studies lacked comprehensive description of eligible & non participants; lacked reporting of contextual factors in controlled intervention trials, cost estimates, impact measures & adaptations to interventions.
Pugliese et al, 2007	Meta-analysis review (30 studies)	23,310 (aggregate sample size)	2-18	1960-2005	AZ (Studies included U.S. and non-U.S. countries)	Self-Report Mechanical/ electrical device	NA	NA	Parental support & encouragement related to child & adolescent PA levels; Significant difference from self-reporting & other report methods; Convenience sampling showed larger effect sizes than principled sampling methods.

Discussion

This systematic review of the literature was successful in identifying studies assessing strategies for increasing moderate to vigorous physical activity in the prevention of overweight infants, toddlers and preschool children. Table 5 presents a list containing the citations used to answer the proposed research questions in this paper. The first question referred to the effectiveness of increasing physical activity as a means to prevent and treat childhood obesity. Of the 37 journal articles included in this review, a solitary study conducted by Moore, et al concluded that physical activity levels in early childhood predicts future body fat (35). However, 23 (65%) studies identified physical activity as a preventive measure and as a successful weight loss intervention when combined with nutrition education, counseling and long term trials involving entire families (29, 31).

The second question referred to the impact of physical activity on cognitive growth in child development programs. Eight (22%) of the articles reviewed, demonstrated a positive effect on language development, dramatic play and enhancing comprehension of preschool learning concepts. Integrating physical activity also promotes socialization, as well as healthy gross and fine motor development required for building effective cognition.

The third question was identifying the assessment tools available to evaluate young children's physical activity levels in child care settings. Validity studies were conducted on two observational instruments, OSRAC-P and NAP SACC, both of which promise to be helpful tools in obtaining the contextual data required to more aptly describe the types of activities influencing sedentary and MVPA in child care settings and homes. This data is needed to support training requirements for caregivers/parents in support of young children's physical activity levels (15,16,23,37,43,48,51-53,).

Table 5. Literature Review Evaluation Questions, 2010 *(*Physical Activity = PA)*

Lead Author, Publication Year	Is PA* an effective means of preventing and treating obesity?	What impact does incorporating PA in early childhood development programs have on cognitive development?	What assessment tools are available to assess young children's PA* in child care settings?	What influences PA levels in preschool children?
Alhassan , 2007	-	-	Accelerometer	Merely increasing outdoor free time does not influence MVPA.
Anderson, 2008	Yes	-	Parent Survey	Amount of screen time; SES; race & ethnicity; high BMI
Bellows, 2008	Yes	Promotes dramatic play	Parent & Teacher Interviews	Teacher training, classroom space, time, equipment,
Benjamin, 2008 (2 studies)	Yes	-	Parent Surveys	More structured activities; amount of space & availability of portable equipment
Brown, 2009 (2 studies)	Yes	PA can be integrated to enhance learning.	OSRAC-P	Teacher initiated activities, child care policies & practices, integrating PA into school readiness outcomes
Brown, 2006	-	-	OSRAC-P	Children's social-emotional behaviors, environment and adults/caregivers
Butte, 2006	Yes	-	Accelerometer	Environment; age, gender, BMI status & screen time
Dowda, 2009	-	-	Accelerometer & ECERS	Child care quality; fixed equipment vs. portable equipment
Drummond, 2009	Yes	Increases language and promotes healthy development.	NAP SACC	Child care quality
Dunton, 2009	Yes	-	Child/Parent Self-Report	Gender, age, SES & population density
Finn, 2002	-	-	Accelerometer	Child care quality, father's BMI & activity level; infant prematurity
Fitzgibbon, 2006	Yes	-	Survey	Cultural relevance of intervention
Kamath, 2008	-	-	Accelerometer	Longer intervention trials
Kaphingst, 2009	Yes			Child care policies & state regulations
Klesges, 2008	-	-	-	Studies reporting internal and external validity along with contextual factors
Klohe-Lehman, 2007	Yes	-	TBAQ & Pedometers	Gender & weight status
Lindsay, 2009	Yes	-	Parent Interviews	Social class, physical environments & culture
Lumeng, 2006	Yes	-	HOME	Home environments, maternal education & mental health status; screen time
McCormick, 2008	Yes	-	-	Community based comprehensive weight management interventions
McIver, 2009	-	Promotes socialization	OSRAC-P & H	Open spaces & portable equipment
McGarvey, 2006	Yes	-	Parent Interviews	Parental awareness, culture, safe environments, & child care attendance
McWilliams, 2009	Yes	Develops important social/behavioral skills and stimulates learning environment	EPAO & NAP SACC	Open spaces, portable equipment, caregivers education level; child care policies
Moore, 2003	Yes	-	Accelerometer	Increased preschool PA levels predicts future body fat
Pate, 2008	-	-	OSRAC-P	Child care environment
Pate, 2004	Yes	-	Accelerometer	Child care environment; race & gender

Lead Author, Publication Year	Is PA* an effective means of preventing and treating obesity?	What impact does incorporating PA in early childhood development programs have on cognitive development?	What assessment tools are available to assess young children's PA* in child care settings?	What influences PA levels in preschool children?
Pugliese, 2007	-	-	Accelerometer	Parental socialization behavior
Roemmich, 2006	Yes	-	Accelerometer	Built Environment; proximity to parks
Sherman, 2001	Yes	-	Parent Interviews	Parental awareness & behavior; weight status; heredity
Taveras, 2008	Yes	-	Parent Interviews	Parent's education & weight status; time spent with primary care physicians & their ability or time to counsel on PA
Topp, 2009	Yes	Increased nutrition education and dietary habits	Fitness testing	Community based comprehensive culturally relevant weight management interventions
Trost, 2003	Yes	-	OSRAC-P	Parent and child's weight status; gender
Williams C, 2009	Yes	Promotes gross motor skill development; enhances comprehension of preschool learning concepts	PA Surveys	Motor skill development; teacher training
Williams HG, 2008	Yes	Promotes locomotor and object control skills	Accelerometer & CHAMPS CMSP;	Motor skill performance
Worobey, 2009	-	-	Motionlogger	Caregiver's handling

The aforementioned instruments and accelerometers are currently the most effective tools to assess activities in child care settings. The ECERS, EPAO, HOME and TBAQ instruments have also been validated for use in identifying the environmental and social-ecological factors influencing children's MVPA (18,49,23,41).

The last question examined the factors influencing physical activity levels in early childhood. Culturally adapting programs to meet the needs of the target population is one of the primary features of a successful intervention (29,30,42,54). Similar to other health behaviors, parental educational and lifestyles impact the physical activity levels of young children. Interventions that take into account levels of acculturation of minorities and include culturally relevant strategies are more effective (55). Moreover, studies have also demonstrated a correlation between built environments, space, availability of supplies i.e., balls, rope, etc., amount of time spent outdoors, reduced physical activity and childhood obesity with older children and adolescents (21, 25, 56).

Implications for Further Research and Policy

The fine tuning and development of additional physical activity assessment tools for preschool children should hasten the support for continued research. A total of 7 reviews included were cross-sectional studies which do not allow for cause and effect conclusions. Future studies should be longitudinal and prospective, the preferred methods in determining evidence-based strategies and stratified to include a representative number of preschool children. The systematic literature review identified assessment and observational instruments developed under rigorous scrutiny which will help capture contextual data. This information is needed to identify which interventions are the most cost-effective and best supports MVPA in young children (55). Moreover, this review has shown the commonalities of existing research on child care policies

and settings that are most suitable for promoting physical activity in young children. These tools should facilitate further studies essential for policy makers to develop consistent physical activity and screen time regulations and reliable quality child care indicators.

Researchers recognized the complex social ecological framework and determinants of health challenging young children meeting the NASPE daily guidelines of 60 minutes structured and 60 minutes unstructured physical activity. The most common factors negatively influencing children's physical activity levels are: gender, age, social-economic status, race, ethnicity, parental/caregiver's weight status, infant prematurity, maternal education and mental health and extended family health beliefs. Moreover, the findings are consistent with other researchers, Baranowski et al, Franzini et al, Roberts, and Epstein, et al related to built environments, topography, neighborhoods, quality of child care settings, availability of fixed vs. portable equipment, teacher's physical activity training and enthusiasm also influence a child's confidence and safety in their motor skill development (56-59). Nevertheless, efforts to maintain a healthy weight should start early in childhood and continue throughout adulthood, as this is likely to be more successful than efforts to lose substantial amounts of weight and maintain weight loss once obesity is established. The future health care and public health costs associated with the co-morbidities stemming from childhood overweight/obesity, i.e., high blood pressure, high cholesterol, type 2 diabetes, heart disease, stroke, gallbladder disease, arthritis, sleep disturbances, and certain types of cancers threatens to overburden already limited resources (4).

Although the Healthy People 2020 goals have yet to be established, increasing physical activity levels is a promising public health policy which should reduce the concomitant risks of the childhood overweight/obesity epidemic (60). The proposed Healthy People 2020 goals currently under evaluation include objectives related to screen time, physical activity, as well as marketing, macro- and micro-nutrient intake targeting children two years and older. Hopefully

the research cited in this systematic literature review will garner the necessary support for their inclusion to expand data collection and evidence based strategies to children of younger ages.

Conclusions

At the start of this review, state child care regulators and policy makers had yet to capitalize on the existing research cited herein. Some states are on their way to adopting consistent regulations. One example is the Texans Care for Children Policy Briefing Paper which outlines their support for physical activity levels and screen time restrictions for children birth to five years of age in child care settings (61). Even though only one study in the U.S. correlated future body fat to physical activity in young children, given the childhood obesity epidemic, further U.S. studies are desperately needed. This is no more evident than in minority populations (American Indian, Hispanics and African-Americans) who consistently demonstrate multiple risk factors associated with existing health disparities.

This systematic literature review clearly establishes the need for additional carefully designed, scientifically rigorous research, preferably RCTs, to initiate proactive approaches to primary prevention strategies to combat childhood obesity. This is evidenced by the lack of data available for this age group and the ability of this review to ascertain the impact of incorporating physical activity in children's cognitive development. Expanding search criteria to include cognition and physical activity might have yielded additional evidence. In reviewing these findings several important limitations need to be considered. There were a limited number of randomized controlled trials, the majority of the studies used convenience sampling methods which affects the ability to generalize their findings to other populations or whether to conclusively state that the interventions made a difference in the physical activity levels of young children (45). According to Pugliese et al, convenience sampling is inclined to show larger effect sizes than principled sampling methods (28). Another limitation of this systematic literature

review was that it only provides a descriptive summary of the findings instead of a meta-analysis. Finally, studies conducted abroad or including children with disabilities or conditions which would preclude physical activity were excluded.

The recent emphasis in early childhood development settings on school readiness requires reframing to integrate physical activity into children's learning outcomes. Promoting children's health and well being changes the focus to enhancements that develop language, self-regulation, motor skill competency and socialization (62). This positive approach is more readily understood by parents who do not agree with the conventional methods of allied health professionals descriptions of causes and consequences of childhood obesity in their very young children (55).

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