



Review

Systematic review of sedentary behavior and cognitive development in early childhood



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ABSTRACT

Objective. To comprehensively review observational and experimental studies examining the relationship between sedentary behavior and cognitive development during early childhood (birth to 5 years).

Method. Electronic databases were searched in July, 2014 and no limits were imposed on the search. Included studies had to be peer-reviewed, published, and meet the a priori determined population (apparently healthy children aged birth to 5 years), intervention (duration, types, and patterns of sedentary behavior), comparator (various durations, types, or patterns of sedentary behavior), and outcome (cognitive development) study criteria. Data extraction occurred in October and November 2014 and study quality and risk of bias were assessed in December 2014.

Results. A total of 37 studies, representing 14,487 participants from nine different countries were included. Thirty-one studies used observational study designs and six studies used experimental study designs. Across study designs, increased or higher screen time (most commonly assessed as television viewing (TV)), reading, child-specific TV content, and adult-specific TV content had detrimental (negative) associations with cognitive development outcomes for 38%, 0%, 8%, and 25% of associations reported, respectively, and beneficial (positive) associations with cognitive development outcomes for 6%, 60%, 13%, and 3% of associations reported, respectively. Ten studies were moderate quality and 27 studies were weak quality.

Conclusions. The type of sedentary behavior, such as TV versus reading, may have different impacts on cognitive development in early childhood. Future research with reliable and valid tools and adequate sample sizes that examine multiple cognitive domains (e.g., language, spatial cognition, executive function, memory) are needed. Registration no. CRD42014010004.

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Introduction

The health consequences of excessive sedentary behavior across the lifespan are increasingly being recognized (LeBlanc et al., 2012; Tremblay et al., 2011; Thorp et al., 2011). The early childhood period, defined here as birth to five years, is critical for establishing healthy habits of minimal sedentary behavior for immediate and future optimal health. Sedentary behavior habits formed during early childhood track overtime (Jones et al., 2013; Biddle et al., 2010). Further, early childhood is characterized by rapid growth and development that lays the foundation for lifelong health and well-being; (Wellness Alberta Health, 2011) therefore, excessive sedentary behavior may have unique health consequences during this period (Christakis, 2009).

Cognitive development is a key component of early childhood development (Nelson and Luciana, 2008). Optimal cognitive development in early childhood is characterized by the emergence and growth of cognitive abilities and skills within multiple domains (Nelson and Luciana, 2008), including language (Tomasello, 2010), memory (Bauer et al., 2010), and executive function (i.e., the ability to regulate attention and action) (Garon et al., 2008). Historically, research examining the impact of excessive sedentary behavior on cognitive development has focused on screen-based sedentary behavior, in particular, television viewing (TV) (Christakis, 2009; Tremblay et al., 2012).

The American Academy of Pediatrics (AAP) has recognized the risk of excessive screen-based sedentary behavior during early childhood for over 20 years (American Academy of Pediatrics Committee on Public Education, 1999). AAP's most recent policy statement discourages exposure to screens for children aged <2 years and recommends ≤2 hours/day of total non-educational screen time for children ≥2 years (Council on C, Media, Strasburger VC, 2011). Similar guidelines have been developed in Australia in 2010 and Canada in 2012 that also recommend no screen time for children aged <2 years, but <1 hour/day of screen time is recommended for children aged 2–4 years (Tremblay et al., 2012) or 2–5 years (Department of Health and Aging (DoHA), 2010). The Australian (Department of Health and Aging (DoHA), 2010) and Canadian (Tremblay et al., 2012) guidelines along with guidelines developed in the United Kingdom (Department, 2011) in 2011 also recommend that children do not sit or be restrained, for example in a car seat or high chair, for long periods (e.g., ≥1 hour) without interruption. However, only the screen time recommendations within the Canadian guidelines were informed by published systematic review evidence.

The associations between sedentary behavior and several health indicators including cognitive development among children ≤4 years were systematically reviewed in 2011 to help inform the Canadian Sedentary Behaviour Guidelines for the Early Years (LeBlanc et al., 2012). Eight studies, of low to moderate quality evidence, examining the relationship between sedentary behavior and cognitive development were identified. This review concluded that increased TV was associated with poor cognitive development outcomes (LeBlanc et al., 2012).

A critical gap identified in the previous review (LeBlanc et al., 2012) was a lack of evidence on the appropriate dose of minimal sedentary behavior needed for optimal development in young children aged ≤4 years. In addition, there was little evidence on specific TV content (e.g., child versus adult programming) and no evidence on other types of sedentary behavior (e.g., reading, interactive electronic games). Further, included studies were limited by subjective parent report measures of the exposure. It should be noted that this previous review excluded cross-sectional study designs to focus on the highest quality

of evidence and to ensure that a manageable number of potential studies were identified for multiple health indicators (LeBlanc et al., 2012). Given the shortage of information on the relationship between sedentary behavior and cognitive development during early childhood, cross-sectional studies may provide additional insight and help highlight future research priorities.

Findings from surveillance studies have indicated that an improved understanding of the relationship between sedentary behavior and cognitive development during early childhood is urgently needed (Hnatiuk et al., 2014). Current estimates show that a large proportion of young children are engaging in excessive amounts of sedentary behavior. For instance, a recent review, using objective measures, found children aged 2–5 years were sedentary for an average of 34% to 94% of their day (Hnatiuk et al., 2014). Further, data in Australia and Canada indicated ≥78% of children were exceeding screen time recommendations based on the national sedentary behavior guidelines (Colley et al., 2013; Hinkley et al., 2012). A large proportion of children (≥80%) start to engage in screen time before the age of 2 years (Carson et al., 2013; Zimmerman et al., 2007a). These children may be at increased risk for poorer cognitive development. Therefore, the purpose of this paper was to comprehensively review observational and experimental studies examining the relationship between sedentary behavior and cognitive development in early childhood.

Methods

Protocol and registration

This review is registered with the international prospective register of systematic reviews PROSPERO network (<http://www.crd.york.ac.uk/prospero/>): Registration no. CRD42014010004. The PRISMA statement for reporting systematic reviews and meta-analyses was followed (Moher et al., 2009).

Information sources and search strategy

A librarian with expertise in systematic reviews (LS) developed the search strategies for the review, which were run through the following databases on July 17, 2014: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations, Ovid MEDLINE(R) Daily and Ovid MEDLINE(R) (1946 to Present), Ovid EMBASE (1974–Current), Ovid ERIC (1965–Current), Ovid PsycInfo (1806–Current), EBSCO CINAHL Plus with Full-text (1937–Current), EBSCO SPORTDiscus with Full-text (1975–Current), EBSCO Child Development & Adolescent Studies (1895–Current), Elsevier Scopus, (1960–Current). See Supplementary Material A for the complete search strategies. No study design, date, or language limits were imposed on the search. However, to limit results to scholarly literature, publication type limits were applied to databases that included non-scholarly literature (SPORTDiscus and Child Development & Adolescent Studies). Records were imported into EndNote software where duplicate records were removed.

Two independent reviewers (NK and SH) scanned titles and abstracts of potentially relevant records and examined full text articles. For records meeting the initial screening criteria, and for those with inclusion discrepancies between reviewers, full text articles were obtained. Inclusion discrepancies were resolved for full text articles by discussions between reviewers or with a third reviewer (VC) when required. Studies published in languages other than English were only included if the article could be translated with Google Translate (Balk et al., 2012). Reference lists of included articles and relevant reviews were also checked for additional relevant studies. Eight key informants, identified through the included studies, were contacted via e-mail and asked to list the five most important papers that they were aware of that related to the systematic review. However, none of the key informants responded to this request.

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