



Relationship between children's physical activity, sedentary behavior, and childcare environments: A cross sectional study

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ABSTRACT

The purpose of this study was to investigate the relationship between the childcare environment and physical activity and sedentary behavior of toddlers and preschoolers.

A total of 68 toddlers (1.0–2.9 years) and 233 preschoolers (3.0–5.9 years) were recruited from 11 childcare services in 2013 within the Illawarra and Shoalhaven region of NSW, Australia. For this study analysis was conducted in 2016. The childcare environment was assessed using the Environment and Policy Assessment Observation (EPAO) instrument, and childcare services categorized as low, medium, or high based on their scores. Time spent in physical activity and sitting was assessed over one week using activPAL accelerometers. Relationship between EPAO and children's physical activity and sedentary behavior was assessed using multilevel mixed-effects linear regression.

Toddlers who attended high EPAO services sat more (8.73 min [−10.26, 27.73]) and stood less (−13.64 min [−29.27, 2.00]) than those who attended low EPAO services. Preschoolers who attended high EPAO services sat less than those in low and medium services (mean [95%CI] = −7.81 min [−26.64, 11.02]). Sub-categories of the EPAO that were associated with less time sitting were: sedentary environments for toddlers and portable play equipment for preschoolers.

This study extends previous research by identifying differences between toddlers and preschooler's physical activity and sedentary behaviors in relation to childcare environments. A greater understanding of how the childcare environment relates to sitting time for both toddlers and preschool aged children is needed.

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1. Introduction

The early years (0–5 years) is a critical time in establishing healthy levels of physical activity and sedentary behavior (Reilly et al., 2004). Optimal levels of these behaviors at this age are associated with more favorable health outcomes in childhood and adolescence (Bower et al., 2008; Vanderloo et al., 2014). Of concern is that a high proportion of young children currently do not meet physical activity and sedentary behavior recommendations (Hinkley et al., 2012; Pujadas Botey et al., 2016; Ellis et al., n.d.), thereby potentially impacting long-term health outcomes.

In recent years, the number of children attending childcare services has escalated with the majority of children in developed countries now attending some sort of formal childcare each week (OECD, 2016). This makes childcare services ideal environments to promote healthy levels

of physical activity and sedentary behavior. Healthy lifestyles (including physical activity and sedentary behaviors) is also a mandated part of most early childhood curricula (Stegelin, 2005; Australian Children's Education and Care Quality Authority (ACECQA), 2011) and childcare services offer environments, both indoors and outdoors, for active play opportunities (ERIC Digest, 2001).

A number of studies have investigated the relationship between the childcare environment and young children's physical activity. (Hesketh Kvan Sluijs, 2016; Vanderloo and Tucker, 2015; Henderson et al., 2015) Such studies have reported positive relationships with physical activity and the availability of portable or fixed equipment, teacher-led physical activity lessons, and staff behaviors (such as staff intentionally engaging with children in active play or providing positive or negative comments in relation to physical activity) (Bower et al., 2008; Kreichauf et al., 2012; Goldfield et al., 2012; Trost et al., 2009). Staff involvement in the promotion of active play, the use of positive statements and prompts about physical activity have been associated with increased child activity within childcare environments (Vanderloo et al., 2014; Gubbels et al., 2011). In contrast, other studies have identified negative

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relationships between staff participation during indoor play (Brown et al., 2009; Henderson et al., 2015) and larger peer group size with physical activity (Gubbels et al., 2011). Staff participation refers to the levels of staff engagement with children in active play and how staff initiate play experiences with children (Brown et al., 2009). Whilst peer group size refers to the number of children assigned to a group that is supervised by a staff member (Gubbels et al., 2011). Previous studies have reported an association between social environmental factors and physical activity. Understanding these relationships is important as it helps to identify specific factors that could be targeted within childcare environments to improve children's physical activity and reduce children's sedentary time. However, a number of limitations have been identified with these studies including: the number and type of environmental factors investigated, the instruments used to measure physical activity and/or sedentary behavior and age range of participants. To date, few studies have reported on such relationships among younger children (i.e. children aged <2.5 years) and limited studies have investigated the relationship between childcare environments and objectively measured sedentary behavior. Therefore, the aim of this study was to investigate the relationship between childcare environments and objectively measured physical activity and sedentary behavior among toddlers and preschoolers.

2. Methods

2.1. Setting and participants

Cross sectional data was collected between August and November 2013 from 11 childcare services that were part of an overarching administering organization, operating within the Illawarra and Shoalhaven region of NSW, Australia (population 0.5 M) (Australian Bureau of Statistics, 2014). Parent consent was obtained prior to data collection. The Human Research Ethics Committee at the University of Wollongong approved the study (HE12/443).

2.2. Assessment of the childcare environment

The childcare environment was objectively assessed using the validated Environment Policy and Observation instrument (EPAO) (Ward, 2008; Gubbels et al., 2011). Prior to data collection, four data collectors participated in an intensive full day workshop, inclusive of general observational techniques, a review of the EPAO and its uses, description of indoor and outdoor space, lessons on interview techniques and procedures, instructions and demonstration of record keeping and the completion of a mock assessment alongside an experienced observer. An inter-observer agreement was completed with inter-observer agreement averaging 84.5% (Ward, 2008). Following the workshop, the trained data collectors unobtrusively completed observations within childcare services over two full days. One day was spent observing the preschool-aged children and the other day observing the toddler-aged children.

The complete EPAO instrument assesses the physical activity, sedentary behavior, and nutrition environments, policies, and practices. However, for this study only the physical activity and sedentary behavior component of the EPAO was used. This component comprised eight subscales (Ward et al., 2008; Lyn et al., 2013), however, only six subscales were reported in this study. The document review subscale pertaining to policy on physical activity and training and curriculum review were omitted due to all services belonging to the same overarching organization (thus having identical written policies). The six subscales included in this study were: 1) Active Opportunities (frequency and total minutes of indoor and outdoor active play, structured-educator led physical activity opportunities and unstructured physical activity opportunities); 2) Sedentary opportunities (time spent seated beyond 30 min period (excluding nap and meal times), use of small screen devices (computers, DVD, iPads); 3) Sedentary Environments;

4) Portable Play Equipment (e.g. ball play, climbing structures, floor and jumping play equipment, parachute, push/pull toys, riding toys, rocking/twisting toys, sandpit, water play, slides, balancing surfaces, hoops and tricycle tracks); 5) Fixed Play Equipment (e.g. climbing structures and balancing equipment); and 6) Staff Behaviors (educators restricting play as punishment, engaging in physical activity with children, providing positive or negative prompts relating to physical activity, and providing formal physical activity lessons). Observations also identified the presence of small or large outdoor running spaces (obstructed and unobstructed), suitable indoor space for gross motor activities, and displays, books, and posters relating to physical activity and sedentary behavior.

Each subscale was scored using recommendations from Bower et al. (2008) and Vanderloo et al. (2014) Initially, all item responses were converted to a three-point scale (ranging from 0 to 2). Sedentary Opportunities and Sedentary Environment subscales were reversed scored; thus, lower levels of sedentary behavior signified higher values (Bower et al., 2008). For each of the six subscales, the converted responses were then tallied and divided by the number items in each subscale. To standardize each score, the average was then multiplied by 10, which provided an overall score out of 20 for each subscale (Bower et al., 2008). A total EPAO score was calculated by averaging all of the subscale scores, with a more supportive environment equating to a higher score and a less supportive environment equating to a lower score (Vanderloo et al., 2014; Ward et al., 2008). Childcare services were then stratified based on their total EPAO score: centres that scored <70 were classified as low EPAO centres, those scoring 70–79 were classified as medium EPAO centres, and those scoring >80 were classified as high EPAO centres.

2.3. Physical activity and sedentary behavior

ActivPAL accelerometers were used to assess physical activity and sedentary behavior. The activPAL accelerometer has proven to be a practical, reliable and valid instrument that objectively and successfully captures data on children's sitting, standing and stepping activities (Davies et al., 2012; De Decker et al., 2013; Dowd et al., 2012). The small activPAL device (53x35x7mm) was secured to a child's upper thigh within a pouch using a Velcro garter. The activPAL was fitted upon arrival and removed prior to the children leaving the childcare service in the afternoon. Toddlers (1.0–2.9 years) fitted with an activPAL were all mobile and able to demonstrate competent walking skills. The Centre for Physical Activity and Health Research (CPAHR) MATLAB program with fifteen-second epoch files were used to calculate sitting/lying, standing, physical activity and non-wear time for each participant per day (Hamilton et al., 2004). Children needed to wear the activPAL ≥ 180 min/day for a day to be considered valid (Ellis et al., n.d.). Sitting breaks and bouts were determined from activPAL outputs. Data were collected between 1 and 5 days depending on the number of days the children attended the service. All the childcare services included in this study scheduled a nap during each day (± 1 h), this period was excluded from the total wear time (Ellis et al., n.d.).

2.4. Statistical methods

All analyses were performed using STATA version 13. ActivPAL-specific software (v 5.9.1.1) was used to download activPAL data (Ellis et al., n.d.). This program was used to calculate for each participant the sitting, standing, stepping and non-wear time for each day. This time was recorded in epochs of 15 s. After the program calculated non-wear time for each participant, data were imported into Microsoft Excel 2011 for Mac (Microsoft Corporation, 2010) to calculate the total minutes of wear time, sitting, standing, and stepping. Non-wear time was identified and removed if the activPAL recorded series of 0 counts for over 30 min (120 consecutive counts). These non-wear bouts were manually removed from the total minutes monitored, and Excel files were

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