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Research report

Comparative effects of TV watching, recreational computer use, and sedentary video game play on spontaneous energy intake in male children. A randomised crossover trial ☆

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ABSTRACT

To compare the effects of three screen-based sedentary behaviours on acute energy intake (EI) in children. Normal-weight males aged 9–13 years participated in a randomised crossover trial conducted in a laboratory setting between November 2012 and February 2013 in Auckland, New Zealand. EI during an ad libitum meal was compared for three 1-hour conditions: (1) television (TV) watching, (2) sedentary video game (VG) play, and (3) recreational computer use. The primary endpoint was total EI from food and drink. Mixed regression models were used to evaluate the treatment conditions adjusting for age, BMI, and appetite at baseline. A total of 20 participants were randomised and all completed the three conditions. Total EI from food and drink in the TV, computer, and VG conditions was estimated at 820 (SE 73.15), 685 (SE 73.33), and 696 (SE 73.16) kcal, respectively, with EI being significantly greater in the TV versus computer condition (+135; $P = 0.04$), a trend towards greater intake in the TV versus VG condition (+124; $P = 0.06$), but not significantly different between the computer and VG conditions (−10; $P = 0.87$). TV watching was associated with greater EI compared with computer use, and a trend towards greater EI compared with VG play.

Introduction

In New Zealand (NZ), around one-third of children are overweight or obese (Ministry of Health, 2012). The cause and effect model for overweight and obesity (Hummel, Wittig, Schneider, Gebhardt, & Hoffmann, 2013) identifies two direct factors influencing bodyweight: energy balance and biology. Almost all indirect factors in the model act via the energy balance pathway. One such indirect factor is sedentary behaviour, defined as any waking behaviour conducted in a sitting or reclined position and characterised by low energy expenditure (i.e. ≤1.5 METS) (Sedentary Behaviour Research Network, 2012).

Much of the literature linking sedentary time and increased bodyweight has used television (TV) watching as a proxy measure for sedentary behaviour (Tremblay et al., 2011). Indeed, health risks in children appear to be linked with self-reported measures of screen-based sedentary behaviours, including TV watching, recreational computer use, and sedentary video game (VG) play (Carson & Janssen, 2011; Mark & Janssen, 2008). However, evidence suggests that accelerometer-measured patterns of sedentary time are not associated with health risk in children and youth (Colley et al., 2013). It is therefore proposed that screen time may have a negative impact on health, while other sedentary behaviours, such as reading a book, may be neutral or have a positive impact (Colley et al., 2013).

A number of mechanisms have been proposed to explain the positive association between screen time and bodyweight, including decreased resting metabolic rate (Dietz & Gortmaker, 1985; Salmon, Bauman, Crawford, Timperio, & Owen, 2000) and displacement of physical activity (Jenvey, 2007). However, there is growing evidence to suggest that the relationship is best explained by the effects on dietary intake (Jackson, Djafarian, Stewart, & Speakman, 2009), via either advertising effects (Institute of Medicine Committee on Food Marketing and the Diets of Children and Youth, 2006; Lobstein & Dibb, 2005), or other non-advertising mechanisms, such as distraction (Bellissimo, Pencharz, Thomas, & Anderson, 2007; Hetherington, Anderson, Norton, & Newson, 2006; Temple, Giacomelli, Kent, Roemmich, & Epstein, 2007). These non-advertising effects may be of particular importance, given recent increases in both accessibility to competing screen-based activities, which may draw attention away from TV food advertising (Schmitt, Woolf, & Anderson, 2003), and availability of advertising free TV content, due to either online streaming or time-shifted TV viewing (Carlson, 2006).

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A number of studies have investigated the non-advertising effects of screen time on dietary intake. According to a Canadian population-based survey in children (Liang, Kuhle, & Veugelers, 2009), eating dinner in front of the TV was negatively associated with diet quality and positively associated with bodyweight, independent of overall time spent watching TV. Furthermore, results from a recent systematic review of laboratory-based studies showed that exposure to screens in the absence of advertising consistently increased acute energy intake (EI) compared with controls who were not exposed to screens (Marsh, Mhurchu, & Maddison, 2013). However, the majority of the studies focused on TV watching and no studies were identified that investigated the effects of recreational computer use. Only one study assessed the comparative effects of different screen-based activities (Lyons, Tate, Ward, & Wang, 2012).

As such, research is needed to assess the comparative effects of popular screen-based sedentary behaviours on EI. ESSAY (Effects of Screen-based Sedentary Activities on energY intake) was a cross-over trial designed to investigate the effects of three common screen-based sedentary behaviours, watching TV, recreational computer use, and sedentary VG play, on EI in boys aged 9–13 years.

Materials and methods

Study design

ESSAY was a laboratory based, randomised, crossover trial. Eligible participants were healthy, normal-weight (5th percentile to less than 85th percentile) males aged 9–13 years who were able to provide written informed consent, could understand and adhere to the study protocol, and had fasted for at least 1 hour prior to attending the study clinic. Due to the exploratory nature of this study, and previous research suggesting the possibility of a more complex relationship between screen exposure and energy intake in females (Patel, Bellissimo, Thomas, Hamilton, & Anderson, 2011), the decision was made to include only male participants to avoid complexity in the study design (Chaput et al., 2011). Further, normal weight males were included, as there is evidence that obese children are more susceptible to environmental cues to eat (Halford, Gillespie, Brown, Pontin, & Dovey, 2004), in addition to overweight children habituating slower to food compared with non-overweight children (Temple, Giacomelli, Roemmich, & Epstein, 2007).

Exclusion criteria were known food allergies and unstable bodyweight in the previous 6 months (greater than 4 kg change). Participants were identified from a list of children who lived in the greater Auckland area and were interested in participating in a previous study in our department (Screen-time Weight-loss Intervention Targeting Children at Home [SWITCH]), but were ineligible due to having a normal bodyweight. SWITCH recruited via schools, community centres, and word of mouth. Parents of the children were contacted by telephone and provided details of the study. A recruitment email was also sent out to a university staff email list. The study took place at the University of Auckland, NZ between November 2012 and February 2013. The study was conducted in accordance with the Declaration of Helsinki and received approval from the local Health and Disability Ethics Committee. Written informed consent was obtained from all participants and from a parent/caregiver.

Study procedure

On arrival at the clinic on the first study day, participants provided written informed consent. Baseline data were collected to confirm participant eligibility. Eligible participants were then randomised to the sequence in which they would be exposed to the three experimental conditions, namely, watching TV, recreational computer use, and sedentary VG play, using a computer-generated randomisation list. The allocation sequence was concealed until the point of randomisation. Participants then completed a baseline questionnaire.

Each of the three study days were scheduled at the same time of day for each participant, with at least a 7-day washout period (Bellisle, Dalix, & Slama, 2004). A typical session began within 1 hour of the participant finishing school (or at approximately the same time of day during school holidays). A pre-intervention questionnaire was administered and then the participant was shown to the study room. During each condition, pre-weighed food and drink were placed on a nearby table, which the participant was unable to reach from where they were sitting. The decision was made to put the food out of reach in an attempt to more accurately represent a real-world setting, where children would usually need to stand up to get their snacks.

The participant was shown how to operate the TV/computer/VG console and told he could eat as little or as much as he wanted during the experimental condition. The participant was then left alone in the room for 1 hour, with a researcher outside to deal with any issues and/or participant questions. After 1 hour the participant completed a post-intervention questionnaire, and the investigator weighed and measured the food and drink that remained.

TV watching condition

During the TV viewing exposure, participants could select between two "Man *versus* Wild" and two "Myth Busters" episodes, two TV programmes popular within this age group with age-appropriate content. Specific episodes with no food content were chosen. All food advertisements were removed from the TV programming. The participant had access to a remote control, which controlled the menu so they could pick and choose shows they wanted to watch and change to a different show/episode whenever they pleased. A comfortable sofa and a coffee table were set up in front of the TV to resemble a lounge setting.

Recreational computer use condition

For the computer condition, participants had Internet access and were permitted to play online games, and use email, YouTube, and social networking sites. The desktop computer was placed on an office desk and the participant sat on an office swivel chair. There was adequate room around the computer station to place food and drink. The room was set-up to resemble a home study setting.

Sedentary VG play condition

An Xbox 360 (Microsoft) VG console was used during the VG session. Participants had access to both "Sonic and Sega All-Stars Racing" and "Lego Batman". Both were new games judged to be popular for males aged 9–13 years. A comfortable sofa and a coffee table were set-up in front of the TV, which was attached to the video console, to resemble a lounge setting.

Experimental meals

During each condition participants had access to identical ad libitum meals. To allow for individual food and drink preferences, a number of options were made available. The foods provided were those reported to be commonly consumed by NZ children (Ministry of Health, 2003). Food and drink were divided into categories according to previously reported age- and gender-specific energy density thresholds (low energy density <1.6 kcal/g and high energy density >2.0 kcal/g) (Patterson, Wärnberg, Poortvliet,