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Pre-meal screen-time activities increase subjective emotions, but not food intake in young girls

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ABSTRACT

Purpose: To determine the effect of pre-meal screen-time activities on subjective emotions, subjective appetite, and food intake (FI) in 9–14 year-old girls.
Methods: In this clinical study, 31 girls completed four 45-min treatment conditions of television viewing (TVV), video game playing (VGP), a challenging computer task (CT), and sitting without screen exposure (control) in a randomized order. Each treatment condition was followed immediately by an *ad libitum* pizza lunch, and FI was calculated from the weight of the consumed pizza. Subjective appetite was assessed at baseline, 15, 30, and 45 min during the treatment condition, and upon trial completion at 75 min. Subjective emotions were assessed at baseline and at 45 min.
Results: FI was not affected by screen type, but was positively correlated with body composition (fat mass [FM, kg], fat free mass [FFM, kg]) in all treatment conditions. Subjective appetite was not affected by screen type, but increased with time in all treatment conditions ($p < 0.0001$). Subjective emotions were affected by VGP only. Anger, excitement, frustration, and upset feelings were increased at 45 min following VGP. VGP led to increased frustration compared to control ($p = 0.0003$), CT ($p = 0.007$) and TVV ($p = 0.0002$).
Conclusion: Exposure to TVV or CT before eating did not affect subjective emotions, subjective appetite, or FI, and no difference was found between screen activities and the control condition for average appetite or FI. Despite a change in subjective emotions during the VGP condition, there was no increase in subjective appetite or subsequent FI. These findings suggest that physiologic signals of satiation and satiety are not overridden by environmental stimuli of pre-meal screen-time exposure among young girls. (Clinical trial number NCT01750177).

1. Introduction

The prevalence of obesity is increasing globally in parallel with increased screen-time activities that includes watching television, playing videogames and using computers (Marshall, Biddle, Gorely, Cameron, & Murdey, 2004; Swinburn & Shelly, 2008). According to data from the 2004 Canadian Community Health Survey (CCHS), more than 2 h per day of screen-time doubles the risk of overweight/obesity (Sheilds, 2008). Encouragingly, recent data from 2013 indicated that 77% of 5- to 13-year-olds in Alberta, Canada did not exceed the recommended maximal 2 h of screen-time per day and 74% met the daily physical activity recommendations (Pujadas Botey, Bayrampour, Carson, Vinturache, & Tough, 2016). However, a study using 2008-09 data from over 51,000 youth attending grades 6 to 12 (aged 11–17 years old) in all Canadian provinces reported that over 50% of these older children exceeded 2 h per day and averaged 7.8 h per day on recreational screen-time activity (Leatherdale & Ahmed, 2011). Similarly, more than half of a cohort of grade 6 to 10 Canadian youth (aged 11–15 years) that was sampled in the 2001/2002 World Health

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Organization Health Behavior in School-Aged Children survey exceeded the 2-h screen-time recommendation (Mark, Boyce, & Janssen, 2006).

It is well documented that individuals consume more food at mealtime when distracted or under conditions of high cognitive load (Bellissimo, Pencharz, Thomas, & Anderson, 2007; Brunstrom & Mitchell, 2006; Mellecker, Lanningham-Foster, Levine, & McManus, 2010). Screen-time activities such as television, video games, and computer tasks can act as distractors, and are suggested to limit the capacity of an individual to monitor physiological signals associated with satiety, ultimately leading to an increase in caloric intake (Brunstrom & Mitchell, 2006). Randomized clinical trials suggest that television viewing (TVV) acts as a distracter in children, delaying satiation and reducing satiety signals from previously consumed food (Bellissimo et al., 2007; Francis & Birch, 2006; Patel, Bellissimo, Thomas, Hamilton, & Anderson, 2011). Children consume the caloric equivalent of approximately 20% and 25% of their daily energy intake in front of the TV during weekdays and weekends, respectively (Gore, Foster, DiLillo, Kirk, & Smith West, 2003; Matheson et al., 2004; Van den Bulck & Van Mierlo, 2004), and it has been reported that TVV is positively related to fatness in a dose-dependent manner (Sluyter et al., 2013).

In addition to TVV, there is some evidence that video game playing (VGP) may act as a distracter by inhibiting satiety and disrupting habituation to the sensory properties of food (Epstein, Temple, Roemmich, & Bouton, 2009). Although more than 50% of children reported eating while playing computer or video games (Christakis, Ebel, Rivara, & Zimmerman, 2004), study results regarding VGP and food intake (FI) are mixed. In one study, lower FI was reported in 9–14 year old normal weight boys following VGP (Branton et al., 2014), but in another, engaging in pre-meal sedentary VGP induced increased spontaneous next meal energy intake among 15–19 year old normal weight boys (Chaput et al., 2011).

Performing a difficult, knowledge-based task on a computer (computer task, CT) may create a stressful and biologically demanding situation for the user (Chaput & Tremblay, 2007), potentially leading to increased caloric intake. A randomized cross-over study in 15 healthy university female students found that sitting for 45 min in a comfortable chair versus performing a reading-writing task using a computer resulted in the same energy expenditure, but the *ad libitum* energy intake was 218 kcal higher after computer work (Chaput & Tremblay, 2007).

Heightened emotion has been suggested to be a contributor of increased FI following screen-time activities. A recent study among children that examined the effects of a happy, sad, or neutral video clip on FI reported that high emotion (happy or sad) caused children to become distracted, and increased their FI compared to the neutral video clip (Bevelander, Meiselman, Anschutz, & Engels, 2013).

A direct comparison of the effects of pre-meal TVV, VGP and CT on subsequent FI among young girls has not been investigated. Differences in subjective emotions from screen-time activities on subsequent FI may provide insight into the environmental factors contributing to FI regulation. Therefore, the objective of the present study was to investigate the effects of pre-meal sedentary screen-time activities on subjective appetite and subjective emotions, and on subsequent mealtime FI. We hypothesized that sedentary screen-time activities would influence subjective emotions, and increase subjective appetite and mealtime FI in young girls. Since there are sex-specific correlations between some health risks and sedentary behaviors (Liwander, Pederson, & Boyle, 2013), findings from the present study may further our understanding and provide support for sex-specific guidelines and policies regarding sedentary behavior.

2. Methods

2.1. Participants

Thirty-one girls aged 9–14 years were recruited through advertisements placed in the local newspaper and at various locations throughout the community, and by word of mouth. The Research Ethics Board at Mount Saint Vincent University approved the study.

Inclusion criteria were girls born at full-term, normal birth weight, able/willing to consume the assigned food, and regular breakfast consumers. Exclusion criteria were dieting, taking medications that would affect study outcomes, and any significant learning, behavioral or emotional difficulties. After an initial telephone interview to acquire information about the inclusion and exclusion criteria, a screening session was scheduled in the Department of Applied Human Nutrition at Mount Saint Vincent University to obtain consent and assent from the parents and children, respectively.

2.2. Experimental design

This study used a randomized, within-subject, repeated-measures design. Each participant came to our laboratory on five occasions. The purpose of the first visit was for screening and to obtain written consent, anthropometrics and body composition, and to familiarize the participants with the facility and the study protocols in order to minimize apprehension during the first test session. During the screening visit the girls were asked to rate their pizza preference for cheese and pepperoni. The following four sessions consisted of the treatment conditions; treatment order was randomly assigned and balanced (Statistical Analysis Software [SAS] version 9.2, SAS Institute Inc., Cary, NC). Sessions were scheduled on four separate mornings, at least one week apart.

Following a 10–12 h overnight fast, participants consumed a standard breakfast of skim milk (250 mL, 90 kcal, Baxter, Saint John, NB, Canada), breakfast cereal (26 g, 90 kcal, Honey Nut Cheerios, General Mills, Mississauga, ON, Canada) and orange juice (236 mL, 110 kcal, Tropicana Products Inc, Bradenton, FL, USA) at home (total 290 kcal). They were asked not to consume any food between the standard breakfast and the study session, 2 h later. Participants arrived at the Department of Applied Human Nutrition at Mount Saint Vincent University at 1000 or 1100; the session start times were consistent throughout the 4 visits (i.e., always 1000 or 1100).

Upon arrival, participants were asked if they consumed their entire breakfast, if any other foods were consumed 10–12 h prior to arrival, and if they were taking any medications. Following the treatment condition, they were given a pizza lunch with instructions to eat until they were comfortably full. They were given 30 min to eat two varieties of Deep 'N Delicious 5" pizza (pepperoni and three-cheese). Questionnaires were administered at baseline, throughout the treatment condition, and immediately following meal consumption.

2.3. Treatment conditions

The four treatment conditions were 45 min in length. In the TVV condition, girls sat alone and watched two episodes of Hannah Montana (Walt Disney Studios Home Entertainment, Burbank, USA). Headphones were provided to avoid distractions. In the VGP condition, girls played Angry Birds (Rovio Entertainment Ltd, Espoo, Finland) using PlayStation 3 (Sony Computer Entertainment, Inc., Tokyo, Japan). They were seated individually and encouraged to challenge themselves through score count before they moved up a level. During the CT condition, girls participated in a "Netscape" activity that was created by the researchers about popular culture.