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Research review

The non-advertising effects of screen-based sedentary activities on acute eating behaviours in children, adolescents, and young adults. A systematic review

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ABSTRACT

29 Sedentary screen time may be an important determinant of childhood obesity. A number of potential
30 mechanisms to explain the link between screen time and increased bodyweight have been proposed;
31 however, the relationship appears to be best explained by the effects on dietary intake, which is attrib-
32 uted to either food advertising or effects independent of food advertising. Technological advances have
33 allowed for greater accessibility and exposure to advertisement-free screen-based media. This review
34 was conducted to systematically synthesise the evidence from laboratory based studies which have
35 investigated the non-advertising effects of screen time (TV viewing, sedentary video games, and com-
36 puter use) on dietary intake in children, adolescents, and young adults. MEDLINE, PubMed, PsychInfo,
37 CINAHL, and Embase were searched from inception through 5 July 2013. Ten trials met the inclusion
38 criteria and were included in the review. Risk of study bias was judged to range from low to high. Screen
39 time in the absence of food advertising was consistently found to be associated with increased dietary
40 intake compared with non-screen behaviours. Suggested explanations for this relationship included: dis-
41 traction, interruption of physiologic food regulation, screen time as a conditioned cue to eat, disruption of
42 memory formation, and the effects of the stress-induced reward system. Due to the limited number of
43 high-quality studies available for this review, our findings are preliminary. More work is required to bet-
44 ter establish the link between dietary intake and advertisement-free screen time and assess whether dif-
45 ferences exist between the different screen-based activities.
46

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68 Interruption of physiologic food regulation. 00
 69 Screen-based activities as conditioned cues to eat 00
 70 Memory 00
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79 **Introduction**

80 The aetiology of obesity is complex (Michael, Rudolph, & Jules,
 81 1997). Yet despite this complexity, environmental changes, rather
 82 than genetic, have been identified as the most important determi-
 83 nant for the increase in adiposity in recent years (Rey-Lopez,
 84 Vicente-Rodriguez, Biosca, & Moreno, 2008), with screen-based
 85 sedentary behaviour acknowledged as one such critical
 86 environmental change (Kautiainen, Koivusilta, Lintonen, Virtanen,
 87 & Rimpelä, 2005). While sedentary behaviours include any waking
 88 activities requiring very little energy expenditure (≤ 1.5 metabolic
 89 equivalents) and which involve sitting or lying down (Sedentary
 90 Behaviour Research Network., 2012), screen-based sedentary
 91 behaviours refer to a sub-set of these activities and include watch-
 92 ing television (TV), playing video games, or using a computer.
 93 Accessibility to these screen-based sedentary activities has in-
 94 creased at an alarming rate in recent decades and has been linked
 95 with a dramatic increase in sedentary time (Nelson, Neumark-
 96 Stzainer, Hannan, Sirard, & Story, 2006). This issue of sedentariness
 97 due to increased screen time is a growing public health concern.
 98 Evidence from longitudinal studies has linked screen-based seden-
 99 tary behaviours with increased body mass index (BMI) in children,
 100 even after adjusting for physical activity levels (Elgar, Roberts,
 101 Moore, & Tudor-Smith, 2005; Proctor et al., 2003; Robinson,
 102 1999). The implications of this are compounded by the finding that
 103 screen time appears to be a relatively stable behaviour, tracking
 104 from childhood to both adolescence (Valerio et al., 2006) and
 105 adulthood (Biddle, Pearson, Ross, & Braithwaite, 2010).

106 A large number of interventions have been conducted in recent
 107 years in an attempt to curb the effects of screen-based sedentary
 108 behaviours on obesity. Despite such interventions tending to pro-
 109 duce statistically significant improvements in measures of both
 110 sedentary time and BMI, improvements have often been small
 111 and of little clinical significance (DeMattia, Lemont, & Meurer,
 112 2007; Leung, Agaronov, Grytsenko, & Yeh, 2012). This inability of
 113 interventions to effect large changes in outcomes may be the con-
 114 sequence of our limited understanding of the specific mechanisms
 115 by which screen-based sedentary behaviours and obesity are
 116 linked. A better appreciation of these mechanisms may allow tar-
 117 geting of specific health-related behaviours responsible for the
 118 relationship between screen time and obesity. It is therefore pro-
 119 posed that in order to design and implement more effective
 120 screen-based sedentary behaviour interventions, we first need to
 121 better describe the mechanisms by which these activities are
 122 linked with obesity.

123 Two main mechanisms have been proposed for the link be-
 124 tween screen-based activities and obesity: (1) the effects of screen
 125 time on decreased physical activity levels (Jenvey, 2007; Robinson,
 126 2001), and (2) the effects of screen time on increased energy intake
 127 (Boulos, Vikre, Oppenheimer, Chang, & Kanarek, 2012; Hastings
 128 et al., 2003; Robinson, 2001). Evidence for the displacement of
 129 physical activity is conflicting, (Marshall, Biddle, Gorely, Cameron,
 130 & Murdey, 2004), and data suggest that even independent of phys-
 131 ical activity, TV watching remains an important risk factor for adi-

132 posity (Ekelund et al., 2006; Gebremariam et al., 2013). Indeed, the
 133 connection between screen time and increased energy intake ap-
 134 pears better substantiated by research.

135 Food advertising has been shown to influence both food con-
 136 sumption and food preferences, especially in children (Boyland
 137 et al., 2011; Harris, Bargh, & Brownell, 2009; Robinson, 2001). An
 138 important finding is that food advertising is not only positively
 139 associated with food intake (Bellisle, Dalix, & Slama, 2004; Blass
 140 et al., 2006; Jackson, Djafarian, Stewart, & Speakman, 2009), but
 141 that it is also associated with decreased consumption of fruit and
 142 vegetable intake (Boynton-Jarrett et al., 2003; Coon, Goldberg, Rog-
 143 ers, & Tucker, 2001). Within a laboratory setting, children have also
 144 been shown to consume greater amounts of sweet foods (high and
 145 low in fat) and high-fat savoury foods following exposure to food
 146 advertisements on TV compared with children who only viewed
 147 non-food advertisements (Halford, Gillespie, Brown, Pontin, & Do-
 148 vey, 2004). These findings are particularly disturbing given that
 149 food companies often target children, as evidenced by the perva-
 150 siveness of food advertisements during children’s programming
 151 (Boyland, Harrold, Kirkham, & Halford, 2011; Effertz & Wilcke,
 152 2012; Haug et al., 2009; Kelly, Chapman, King, & Hebden, 2011).

153 However, there is also a growing body of evidence to suggest
 154 that screen-based activities, even in the absence of TV food adver-
 155 tising, increase dietary intake (Chaput et al., 2011; Volkow, Wang,
 156 Fowler, Tomasi, & Baler, 2012). This is of significance for two main
 157 reasons: (1) accessibility to video content without TV food adver-
 158 tisements has increased, and (2) youth are now exposed to a num-
 159 ber of competing screen-based activities that may draw attention
 160 away from TV advertisements. Firstly, with respect to accessibility,
 161 technological advances have enabled consumption of greater
 162 amounts of advertisement-free video content via video-on-de-
 163 mand technologies (Carlson, 2006). Such technologies allow adver-
 164 tisement-free video content to be streamed or downloaded to
 165 media devices, such as computers or portable media players. This
 166 has resulted in young people now having some control over how
 167 much TV advertising they are exposed to. Secondly, with respect
 168 to competing screen-based behaviours, there is evidence to suggest
 169 that TV viewing is now combined with other screen-based activi-
 170 ties, which may distract the viewer’s attention away from advertis-
 171 ing. In 2003 it was reported that 46% of time spent watching TV
 172 was actually spent engaged in a secondary behaviour, such as so-
 173 cial interactions and playing, with non-TV viewing behaviours
 174 occurring most during programming which required less visual
 175 attention, such as advertisements. This effect was greatest amongst
 176 children (Schmitt, Woolf, & Anderson, 2003). More recently, the
 177 mobile functionality of newer screen-based media devices, in-
 178 cluded smartphones and tablets (e.g. iPads), has increased the
 179 accessibility to competing screen-based behaviours and has cre-
 180 ated a multi-screen world (Phalen & Ducey, 2012), where adoles-
 181 cents report using multiple screens to facilitate filtering out of
 182 unwanted content, including advertisements (Jago, Sebire, Gorely,
 183 Cillero, & Biddle, 2011).

184 Within this contemporary screen environment, differences ex-
 185 ist in the way adolescents, young adults, and older adults

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