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REVIEW

Effects of TV time and other sedentary pursuits

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Television (TV) viewing is the dominant recreational pastime at all ages, especially for children and adolescents. Many studies have shown that higher TV viewing hours are associated with higher body mass index (BMI), lower levels of fitness and higher blood cholesterol levels. Although the effect size estimated from observational studies is small (with TV viewing explaining very little of the variance in BMI), the results of intervention studies show large effect sizes. The potential mediators of the effect of higher TV viewing on higher BMI include less time for physical activity, reduced resting metabolic rate (for which there is little supporting evidence) and increased energy intake (from more eating while watching TV and a greater exposure to marketing of energy dense foods). Electronic games may have an effect on unhealthy weight gain, but are less related to increased energy intake and their usage is relatively new, making effect size difficult to determine. Thus, TV viewing does not explain much of the differences in body size between individuals or the rise in obesity over time, perhaps because of the uniformly high, but relatively stable, TV viewing hours. Reducing TV viewing hours is a difficult prospect because potential actions, such as social marketing and education, are likely to be relatively weak interventions, although the evidence would suggest that, if viewing could be reduced, it could have a significant impact on reducing obesity prevalence. Regulations to reduce the heavy marketing of energy dense foods and beverages on TV may be the most effective public health measure available to minimize the impact of TV viewing on unhealthy weight gain.


Keywords: television viewing; childhood obesity; food marketing; body mass index; physical activity

Introduction

The prevalence of obesity is increasing globally, and studies over the past two decades have examined both the role of television (TV) viewing and other sedentary behaviors as determinants of obesity and, to a lesser extent, the impact of reducing TV viewing on obesity. TV viewing is the dominant sedentary pastime, particularly, during childhood and adolescence. The seminal study by Dietz and Gortmaker was the first to place the relationship linking high TV viewing with a higher risk of overweight and obesity on the map, and since then, the evidence has expanded to support this relationship throughout the lifespan. There are also consistent relationships of high TV viewing with low levels of fitness and higher blood cholesterol in adulthood. Several potential mechanisms have been proposed to explain the relationship between TV viewing and obesity, including reduced time available for physical activity, reduced resting metabolic rate and increased energy intake. In more recent times, the focus has shifted onto the influence of TV advertising of food and beverages that targets children as an important driver of childhood and adolescent obesity.

Prevalence and trends in TV viewing

Comparisons of the amount of TV viewing across countries using consistent measures is limited, but the World Health Organization’s ‘Health behavior in school-aged children’ study involving 28 European countries showed that it varied considerably between countries. The prevalence of children aged 11–15 years who watched TV for 4 h or more per day ranged from 26.5 to 49.2%. The recommended daily time spent watching TV for children in Australia is less than 2 h, yet two Australian studies found that 59% and 75% of participants exceeded this recommended limit. Although there are fewer data on hours spent watching TV for adults, a US study found that 58.9% watch TV for more than 2 h per day.

Trend data are important to determine whether increasing TV viewing may be a driver of the increasing obesity burden.
epidemic. The data that are available suggest that trends in TV viewing have remained relatively stable or have decreased over recent decades. For example, the trends from the World Health Organization’s ‘Health behavior in school-aged children survey’ (for Austria, Finland, Hungary, Norway, Scotland, Sweden and Wales) found that the proportion of school-aged children watching TV for 4 h per day remained relatively unchanged between 1985 and 1986 and between 1997 and 1998.17 An Australian study reported a decrease of 33 min in TV viewing time from 1960 to 2003.18 Thus, although the prevalence data suggest that TV viewing remains high in children and adolescents and may contribute to the high prevalence of obesity, the time trend data suggest that increased TV viewing is unlikely to be a major driver of the increasing prevalence of obesity.

Magnitude of the association between TV and obesity

The 1985 foundation study by Dietz and Gortmaker1 was conducted using large national samples of US children aged 6–11 and 12–17 years. For all children, higher TV viewing was associated with a greater prevalence of obesity or supersize obesity than children watching less TV, and, for adolescents, for each additional hour of TV viewed per day, the prevalence of obesity was 2% higher. Further studies with children in the United States,2 Mexico3 and Canada19 and adults in Australia4 and the United States5 support the positive relationship, and many report a substantial effect size. For example, a study of the US children aged 10–15 years found that children watching TV for more than 5 h per day (33%) were 4.6 times more likely to be overweight than children watching TV for 2 h or less per day.2 Intervention studies, in particular, show larger effect sizes with reductions of about 0.45 kg/m² in body mass index (BMI) per hour of TV viewing reduction.20,21 The majority of studies, however, are cross-sectional in nature,3,4,9,16,22,23 and as such, they cannot provide evidence of causality24 and are prone to multiple sources of confounding.

The comprehensive study to determine the effect size of TV viewing and obesity is the meta-analysis conducted by Marshall et al.25 Their review used 52 independent samples from 30 studies (n = 44 707) of different designs to assess the relationship with careful attention to control for the major sources of bias. Overall, 96% of the studies showed the expected (positive) relationship, but the Pearson correlation for the effect of TV viewing on measures of body fatness was low at 0.084 (fully corrected). Although this was statistically significant because of the large numbers involved, in terms of clinical or population effect, it was considered insignificant by the authors. The effect size was moderate (0.26) for the single randomized controlled trial included in the analyses.26

Determinants of TV viewing

Some studies have related TV viewing time to potential determinants, especially the environmental factors in the home. Children and adolescents commonly have a TV in their bedroom, and recent studies found that hours of children’s TV viewing were significantly higher with the presence of a TV in the child’s bedroom.26,27 An Australian study (N = 164) found that changes in TV viewing over a 21-month period did not appear to be influenced by autonomy of choice, beliefs about TV viewing, the number of TVs in the home or the presence of a TV in the bedroom. It was, however, influenced by the child’s desire to turn off the TV and play with their parents, as well as home rules about how long they could watch TV.8 Other studies have found that having a TV in the bedroom, few family rules about TV viewing, and family meals in front of the TV are associated with more TV viewing in primary school-aged children.26

Mediators of the relationship between TV viewing and obesity

Dietz and Gortmaker1 suggested three potential explanations for the positive relationship between TV viewing and body size: (1) high TV viewing could be a cause of obesity, (2) obesity could be a cause of high TV viewing or (3) a third variable, such as socioeconomic status or parenting style, could be responsible for a spurious positive relationship between TV viewing and obesity. It is entirely plausible (and indeed likely) that all three explanations could be operating, in which case a vicious cycle could also be operating where TV viewing begets obesity, which begets higher TV viewing.28 These vicious cycles are more likely to be occurring in the super-obese, perhaps explaining the stronger relationships with TV viewing seen in this group.1

Taking the first of these possible explanations, a number of potential mechanisms could be proposed to explain the effect of TV viewing as a cause of obesity. Clearly, the hours spent watching TV are sedentary hours that are not spent being active. Some studies have shown that higher TV viewing is usually associated with less time spent in moderate-to-vigorous physical activity,29,30 whereas other studies have found that TV viewing does not displace physical activity.17,31,32 This relationship was assessed in the meta-analysis by Marshall et al.33 using 24 studies providing 41 independent samples (n = 143 235), and found a consistent and statistically significant relationship in the expected direction, although the effect size was small.

On the other side of the energy balance equation, TV viewing could be an energy intake problem. Indeed, many studies show consistent positive associations between energy intake and TV viewing. For example, a study of children aged 8–16 years (N = 4069) found the strength of the positive association between hours of TV viewing and energy intake
to be moderately strong for both male ($r = 0.26$) and female subjects ($r = 0.43$). A further study in adolescents ($N = 2546$) found that 96.5% of participants reported eating snacks and drinking soft drinks while watching TV, with an average contribution to daily energy allowance of 20% for male subjects and 15% for female subjects. It appears that children may learn to associate TV viewing with snacking at an early age, probably reinforced by the high percentage of food advertising during peak viewing times for children. About a third to a half of TV advertisements during programs scheduled for children are for food, with the vast majority (79–98%) from studies in the United Kingdom, Australia and the United States being advertisements for energy-dense foods or beverages.

A study conducted in 31 children during 1993 suggested that TV viewing had an effect on reducing resting metabolic rate and that this may be, in part, responsible for increasing the risk of obesity with high TV viewing. The absolute effect size, however, was small (about 30–46 kJ h$^{-1}$), and more recent research in a much larger sample size ($N = 266$ girls aged 7–12 years) showed that TV viewing was not associated with reduced resting metabolic rate. It was, however, associated with a higher consumption of energy-dense foods.

### The impact of decreasing TV viewing

Television viewing is a potentially modifiable form of sedentary behavior and, given its links to obesity, interventions that seek to reduce TV viewing may be useful at clinical and population levels. Recommendations in some countries are that children should have no more than 2 h per day of ‘recreational small screen time’ (that is, TV viewing and electronic games), an amount that is currently exceeded by a large percentage of children worldwide.

An early and influential intervention study was conducted in two neighboring US elementary schools, with one school ($N = 93$ students) being randomized to an intervention to reduce TV viewing and one school ($n = 100$ students) serving as a control. The intervention involved a total of 18 h of school-based lessons around self-monitoring of TV viewing, TV turnoff and reduced media use over 6 months. TV viewing was monitored through both self-report and proxy report (moderate agreement), as well as an electronic TV time manager. TV viewing, video game use and the number of meals consumed in front of a TV significantly decreased in the intervention group. Statistically significant reductions in BMI, triceps skinfold thickness, waist circumference and waist-to-hip ratio were observed in the intervention group. This study suggested that TV viewing is causally related to BMI and gave some confidence that reducing TV viewing could be promoted as an evidence-based intervention. The translation of this study into practice, however, is problematic. The study was small, and its design made it prone to bias with only two units (schools) for randomization, and it needs to be repeated with larger numbers of schools and participants. The other translation problem with the study is applying the intensity of the dose (especially the electronic TV manager) to large populations—it is unlikely to be practical.

Another US randomized, controlled, school-based trial involving five intervention ($N = 641$) and five control schools ($N = 654$) examined the impact of the school-based health behavior intervention known as ‘Planet Health’ on childhood obesity. ‘Planet Health’ aimed to reduce obesity through behavioral change, specifically targeting reduced TV viewing to less than 2 h per day, increased moderate-to-vigorous physical activity, decreased consumption of high-fat foods and increased consumption of fruits and vegetables. The intervention reduced obesity among female subjects in the intervention schools (from 23.6 to 20.3%), but not in male subjects. A post hoc analysis found that reductions in TV viewing explained much of the reduced prevalence of obesity (odds ratio of 0.85 for a 1-h reduction in TV viewing, $P < 0.02$).

A US trial of childhood obesity treatment assessed the effects of sedentary behavior and physical activity in a randomized controlled trial of 61 families with obese children aged 8–12 years. The three treatment arms were focused on increased physical activity, decreased sedentary behavior (mainly reducing TV viewing) or both, with all groups following the ‘Traffic Light Diet’ for the 1-year duration of the study. The decreased sedentary behavior group showed better changes in percentage overweight and percentage body fat than the increased physical activity group or the combined group. The authors suggested that the success of the decreased sedentary behavior group may have been related to the sense of control and choice being given to the children to choose how to allocate free time when encouraged to decrease TV viewing.

These three studies have been central to providing the evidence-based supporting interventions to reduce TV viewing time. The results are probably more readily translated into clinical practice, but could be translated into public health interventions if a wide reach of a sufficient dose of interventions to reduce TV viewing can be developed. Programs such as the ‘Activ8Kids’ and ‘Do More, Watch Less’ aim to reduce screen time for children to less than 2 h per day, and long term evaluations of such programs will be very important.

### Associations between other sedentary behaviors and obesity

The only other sedentary behavior, which has been studied in relation to obesity to any extent has been electronic game use, although reading/listening to the radio was not related to obesity in Dietz and Gortmaker’s original study.
Electronic games are relatively new devices, and so older studies had lower prevalent usage and found no association with obesity. More recent studies have had mixed results with some showing no associations and others suggesting that there may be a relationship. Two Portuguese studies of the children aged 7–9 (N = 3365) and 12–18 years (N = 450) found a link between obesity and other sedentary behaviors. The first found that normal weight children spent significantly less time using computers than overweight/obese children, whereas the second found a significant relationship between the use of electronic games and higher BMI. A further study of adolescents aged 14–17 years (N = 194) found a strong positive relationship between interactive media (internet surfing and video games) and percentage body fat and BMI. Of interest is that several studies that have found an association between sedentary behaviors other than TV viewing and obesity have also found no association between TV viewing and obesity. The meta-analysis by Marshall et al. found no association between electronic games usage and body fatness using six independent samples (N = 1722), although a statistically significant, but small effect size, relationship was shown between high electronic game use and low physical activity (10 independent samples, N = 119,942, r = −0.14).

Conclusions

Television viewing among children and adolescents is high enough to be a concern as a potentially important determinant of the high prevalence of obesity; however, the lack of increasing trends over time means that it cannot be implicated as a driver of the rise in obesity prevalence over the last three decades. It is also apparent that variance in TV viewing explains very little of the variance in BMI in individuals but significant reductions in TV viewing appear to result in significant reductions in BMI. These findings appear to be internally inconsistent and difficult to reconcile with each other. A possible coherent explanation for the findings is that TV viewing is an important determinant but is quite uniformly high, and therefore, it does not have sufficient variance to be able to explain variance in BMI. This is analogous to the situation of not being able to statistically detect a relationship between air pollution exposure and chronic bronchitis if everyone is exposed to about the same amount of heavy pollution—it is an important determinant but explains none of the observed variance in chronic bronchitis. If the pollution remained the same but then cigarette smoking increased, chronic bronchitis would increase (that is, showing divergent trends of pollution and bronchitis). If people removed themselves from the air pollution, their risks of chronic bronchitis would reduce. It is also likely that the pathway linking TV viewing to unhealthy weight gain is significantly, even predominantly, mediated through the increased energy intake. This clearly would not apply to any relationship between electronic games and obesity. It is unlikely that the interventions included in the published trials are able to be scaled up to population levels, and this probably explains why such interventions do not feature frequently in national plans of action for obesity reduction. The main options for population-wide interventions are through social marketing (including, paradoxically, through TV as the message medium) or through schools and a curriculum approach (for which there is always tight competition for space). Regulations to reduce the heavy marketing of energy-dense foods and beverages on TV may turn out to be the intervention of choice to reduce the impact of TV viewing on childhood and adolescent obesity.

Conflict of interest

The authors have declared no conflict of interests.

References

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