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Television viewing associated with adverse dietary outcomes in children ages 2-6

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Abstract

The aim of this paper was to systematically review the evidence for the association between television viewing and diet in children ages 2-6. Data sources included PubMed, PsychINFO, EMBASE, ERIC, SportDISCUS, Sociological Abstracts, Web of Science, and hand searches of reference lists of relevant articles. Twelve studies were reviewed in which the relationship between television viewing and diet was assessed in children between the ages of two and six. All but one study reported significant relationship between television viewing time and adverse dietary outcomes. Parent-reported television viewing time was used to assay child television viewing in all included studies. Food frequency survey was the most frequent method of dietary assessment, and parent served as proxies for children in all studies. Lower fruit and/or vegetable intake was the most frequently reported dietary outcome, followed by increased energy intake with increased television viewing. The majority of studies reported adverse dietary outcomes with as little as 1 hours of daily television exposure. While these results are consistent with recommendations from child health advocates to limit television viewing in young children, they also suggest that further efforts to limit television viewing in young children may be needed to aid in obesity prevention.

Keywords

television; preschool; diet; obesity; nutrition; sedentary

Introduction

Obesity in children is a problem of growing concern that affects children of all ages. Although its etiology is multifactorial, environmental contributors to obesity, such as diet and physical activity behaviors play an essential role[1-4]. Research suggests that these diet

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and physical activity behaviors are established during early childhood[5, 6], which make the preschool years (ages 2-6) a developmentally critical period in which to establish healthy eating behaviors in children[7-14]. Twelve percent of children ages 2-5, and 18.2% of children ages 6-11 are obese [15], which points to a need to galvanize efforts to prevent obesity in young children. The American Academy of Pediatrics (AAP) has called for a reduction in television viewing in children as one strategy to prevent childhood obesity. In light of evidence of a positive relationship between television viewing and obesity in children[16-24] AAP recommends that children two and older limit total media time to 1-2 hours daily [25, 26].

Prior review studies have supported a positive relationship between television viewing and obesity in children[27-29], however, too few have explored this pathway to elucidate potential mediators such as diet. Fewer still have examined television viewing during early childhood, which is a critical period for the development of food preferences and eating behaviors [9, 30-33]. In a review of sedentary behaviors and fatness in children, Must and Tybor concluded that a significant, positive relationship existed between television viewing and obesity, but this finding was consistent only among adolescent children [34]. In a subsequent review of risk factors of overweight and obesity in school-aged children, Must, Barrish and Bandini also reported that the relationship between television viewing and obesity was inconsistent [28]. In a similar review in children ages 2-18, Rey-López, Vicente-Rodriguez and Moreno [29] examined the relationship between sedentary behaviors and the development of obesity. Of the studies than included children younger than 10, half reported significant positive associations between television viewing and adiposity. Moreover, the authors cited increased consumption of energy dense foods as a possible link between television viewing and overweight in children [29]. Caroli, Argentieri, Carone, and Masi assessed the role of television in obesity prevention in their 2004 literature review. Unlike previous reviews of television viewing in children, their review examined television viewing in relation to diet as well as obesity. In addition to a positive relationship between television viewing and obesity Caroli, Argentieri, Carone, and Masi reported that television viewing was positively related to excess consumption of foods of poor nutritional quality [27]. Notably, however, their review was descriptive rather than systematic, and the methods and scope of the review were poorly described.

Despite a substantial literature describing the relationship between television viewing and obesity in children, the relationship between television and diet is not well described. While it is clear that a relationship exists between television and obesity, the relationship is inconsistent across studies. It is speculated that the relationship between television and obesity is mediated by diet, which may be more strongly related to obesity than television viewing alone. More importantly, these relationships in early childhood, during which children may be more developmentally susceptible to the effects of television, are also inadequately described in the literature. No reviews, to our knowledge, have examined the relationship between television and diet in young children, for whom the obesogenic effects of television may be especially damaging. Therefore, the purpose of this article is to examine the relationship between TV viewing time and dietary intake among children aged 2-6 years.

Methods

Search Strategies

Systematic literature searches were performed in September 2011 using seven electronic databases: PubMed, PsychINFO, EMBASE, ERIC, SportDISCUS, Sociological Abstracts, and Web of Science. A summary of search terms, databases and articles yielded is presented in Table1 below.

Search terms and key words were identified for each database with the assistance of a research librarian. In addition reference lists from included articles, as well as conference proceedings, were hand searched. A flow diagram of the search and results is presented in Figure 1 below.

Selection criteria—Only primary research articles available in English were included in the final review. Additionally, articles needed to include children ages 2-6 years, a measure of child television viewing time, and a measure of child diet. Articles were excluded if they did not examine the relationship between child television viewing time and diet, if the study had fewer than 10 participants, or, in the case of studies with participants younger than two or older than 6, if the analysis did not stratify by age such that children ages 2-6 could be examined separately. Because of the limited number of randomized control trials (n=2), only observational studies were included.

Articles were twice screened for inclusion by review of titles and abstracts by the first author, and full text articles were obtained for each of the articles that met the initial inclusion criteria. Articles were independently reviewed for adherence to inclusion criteria by two of the three authors.

Critical appraisal and data synthesis—Potential articles were evaluated for quality using the Health Evidence Bulletin, Wales (HEBW tool) *questions to assist with the critical appraisal of an observation study* (e.g. cohort, case-control, cross-sectional studies)[35]. Briefly, the HEBW tool was developed by the Support Unit for Research Evidence (SURE) at Cardiff University to establish protocols and instruments to summarize and describe the strength of health-related evidence[36]. The HEBW methodology is described in detail elsewhere (http://hebw.cf.ac.uk/projectmethod/title.htm). Potential quality evaluation instruments were identified from two recent literature review of tools for assessing study quality [37, 38]. The HEBW tool was selected for its adaptability for use with a variety of study designs, simplicity, and use in recent publications [39-41]. It is included as Appendix Exhibit A.

Articles were distributed such that each article would be independently evaluated for quality by two of the three authors. Discontinuities were discussed among the two reviewers, with the remaining author serving to resolve any disagreements that could not be resolved via discussion. Potential articles were rated as “acceptable” if they met relevancy criteria (part A), and had no more than two “no” responses for questions contained in parts B-D of the instrument. Papers that were rated as “not acceptable” were critically discussed by the two reviewers and excluded from the review. A summary of the data extracted from included

studies is provided in Table 2. Data extraction was initially completed by the first author, then verified by one of the two co-authors.

Results

Identification of included studies

A total of 517 unique articles were yielded from the initial search of the electronic databases and hand searching methods. After review of titles and abstracts, 492 articles did not meet the inclusion criteria and were excluded, resulting in 25 remaining articles for which the full texts were sought. Upon critical review of these articles using the HEBW tool, an additional 13 articles did not meet inclusion criteria and were excluded, resulting in 12 remaining articles included in the final review.

Description of included studies

Table 2 contains a description of select characteristics of included studies. All included studies contained at least some children between ages of two to six years in their sample, and samples ranged in age from one to 11 years. For studies that included children younger than two or older than six, separate analyses were available for children between the ages of two and six (n=3). Among the included studies, 13,386 children between two and six years of age were included.

For all studies, child TV viewing time was parent-reported, and three (25%) studies additionally included measures of other electronic media use (computer time and video game use). Similar to measures of television viewing time, child diet measures for all included studies were parent-reported. Seven studies used food frequency questionnaires to assess child diet, three used 24-hour dietary recall surveys, two studies used food diaries (one study used food diaries in addition to 24-hour dietary recall surveys). One study (Tremblay et al, 2010) reported that child diet was parent-reported, but no additional information was given regarding the survey modality.

Eleven (91.0%) of the 12 included studies reported significant associations between television and adverse dietary behaviors in young children. Only one study [42], failed to find a significant relationship between television viewing and diet. Six studies reported significant inverse relationships between television viewing and fruit and/or vegetable intake [43-48], which was the most commonly reported dietary finding. For two of these studies [47, 48], however, this relationship was only significant in boys. Four studies reported that television viewing was associated with higher total energy intake [43, 46, 49, 50], and two studies reported that television viewing was positively associated with snacking frequency [47, 51]. Several studies reported that television viewing was positively related to consumption of select foods, which included sweet snacks, energy drinks[43], fast foods [46], snack foods, sugar-sweeetened beverages, fruit juice, whole or 2% milk, and processed meats [46]. Other miscellaneous dietary outcomes related to television viewing included lower intake of brown bread [45], higher intake of energy from total fat and trans fat, and lower intakes of 1% or skim milk, calcium, and dietary fiber [46].

Television viewing time associated with adverse dietary outcomes ranged from 10 minutes to three or more hours of viewing time per day. Television time was modeled as a categorical variable in the majority of included studies (n=7)[42, 44, 46, 47, 50, 52, 53], four of which treated television time as a dichotomous exposure [44, 47, 52, 53]. Two studies[46, 54], in which television viewing was categorized into "none, less than 1 hour a day, 1–3 hours a day, 4–6 hours a day, 7–9 hours a day, and 10 or more hours a day", reported an adverse association between television and diet at 1 hour of viewing per day. Of the studies to model television viewing time continuously [43, 45], 10 minutes of daily television viewing was the smallest increment of exposure at which a relationship between TV and diet was reported [43].

Discussion

To our knowledge, this is the first systematic review study of television viewing and diet in children ages 2-6. All but one study reported a significant relationship between television viewing time and adverse dietary outcomes in this population. In the majority of studies, television viewing time was modeled categorically with viewing categories in 1 hour increments, which is evidence of a relationship between as little as 1 hour of daily television viewing and maladaptive dietary behaviors in young children.

Ariza, Chen, Binns and Christoffel[42] was the only study that failed to find a significant relationship between television viewing and diet in young children. This study was unique among included articles in that the sample was comprised exclusively of overweight Hispanic children. It is possible that the relationship between television viewing and diet in obese children may be attenuated due to a ceiling effect. Moreover, homogeneity in television viewing and diet among obese children may impair the necessary contrasts in exposure and outcome needed to observe a relationship. Finally, it bears mentioning that the relationship between television viewing and diet was not the primary focus of the analysis, and thus there may have been inadequate power to examine this relationship.

Our findings are consistent with the American Academy of Pediatrics' (AAP) position on screen time and media use. The AAP recommends that children older than two limit screen time to one or two hours per day of quality programming, noting that television use may contribute to obesity in children by way of advertisements for unhealthy foods, which may adversely affect eating behaviors[55]. Prior research has also pointed to a link between television and diet in children. In a 2001 descriptive review, Robinson noted a relationship between television and child obesity, which may be a mediated [56] by increased caloric intake as a result of exposure to food advertising (57). Research in older children lends further evidence of an adverse relationship between diet, television and food ads. In a prospective study of public school students, each additional hour of television viewing increased daily energy intake by 167 kcal [57]. In further analyses, foods commonly advertised, such as sweet baked snacks, candy, fried potatoes, fast food entrées, salty snacks and sugar-sweetened beverages, mediated the relationship between television viewing and changes in total energy intake[57].

An important limitation common to all studies included in this review was the use of parent-report methods to assess child television viewing which may be subject to bias [58]. In a 2007

review of measures of television viewing in children and adolescents, Bryant, Lucove, Evenson, and Marshall reported that studies of younger children were more likely to use parent-report methods[59]. Overall, self- and parent- reported methods were by far the most commonly used television assessment methods, whereas direct measurement of television used was reported in only five of the 88 studies included in the review [59]. An additional limitation of this review is the cross-sectional study design of included studies, which represent the predominance of research to date on the relationship between television viewing and diet in preschool-aged children. With cross-sectional designs, the temporal sequence between television viewing and diet are unclear, which make it difficult to determine if there is a causal relationship[60].

Conclusion

This study points to a significant association between television viewing and obesity-related dietary behaviors in young children. In the majority of studies, adverse dietary outcomes were associated with as little as 1 hour of television viewing per day, which is evidence that the guidelines for television use in young children should be strengthened. The current guidelines recommend that children older than two limited electronic media used (which included television) to 1-2 hours per day electronic media use. The findings of this review, however, suggest that guidelines for television viewing use in young children should be further delimited.

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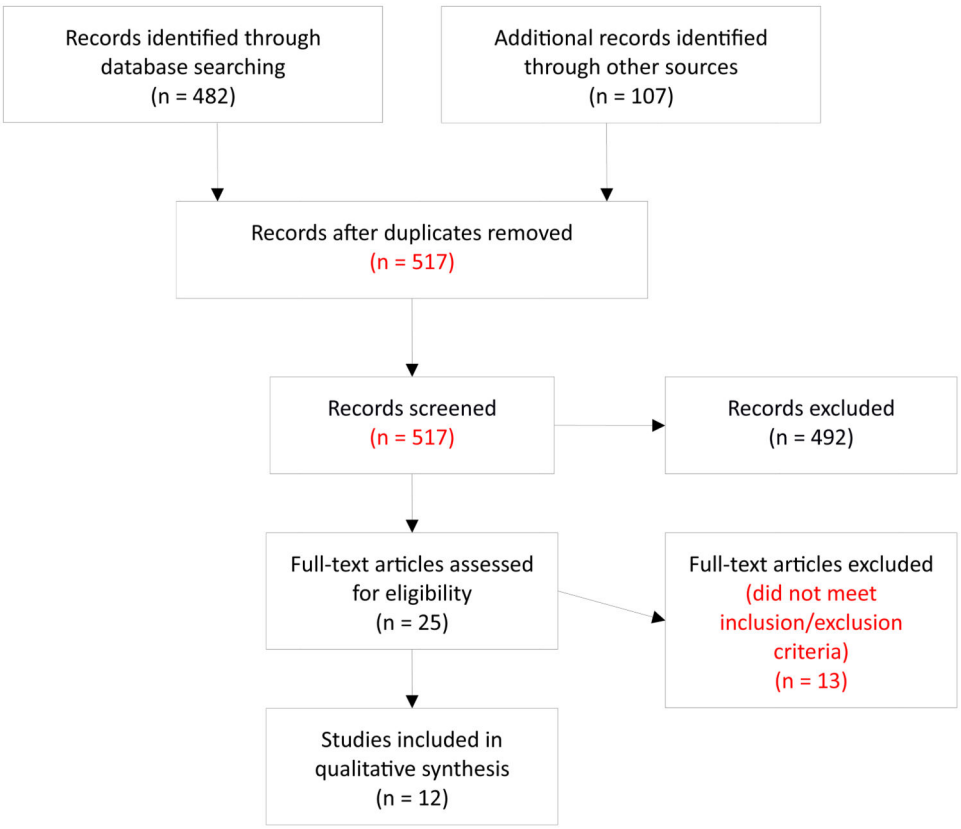

Figure 1. Flow diagram of search and results

Table 1

Electronic databases in order searched

Database	Search terms	Unique articles
PubMed	Leisure activities, life style, television, child, preschool overweight, obesity, diet, food and beverages, eating, food habits	198
PsychINFO	Television, sedentary, leisure, inactive, inactivity, overweight, obesity, preschool, early childhood, young child	79
EMBASE	Preschool child, television viewing, obesity	69
ERIC	Television, sedentary, leisure, inactive, inactivity, overweight, obesity, preschool, early childhood, young child	21
SportDISCUS	Television, sedentary, leisure, inactive, inactivity, overweight, obesity, preschool, early childhood, young child	24
Sociological Abstracts	Television, sedentary, leisure, inactive, inactivity, overweight, obesity, preschool, early childhood, young child	35
Web of Science and hand searching	References of included articles and conference proceedings	91
Total number of articles		517

Table 2

Summary of studies of TV viewing and diet in young children

Study	Design	Child participants	Assessment of child TV	Child diet assessment	Key findings	Modeling of TV exposure
Ariza et al., 2004 (42)	Cross-sectional	250 overweight Hispanic children, ages 5-6	Parent-reported TV time in minutes	Parent reported frequency of consumption of select foods	No significant relationships between diet and TV identified, although this was not the primary focus of the analysis	Average daily use in hours (binary); >3h/d or ≤3h/d
Brown et al., 2010 (51)	Cross-sectional, prospective	4,983 children ages 4-7	Parent-reported TV time in minutes	Parent reported consumption of select foods using 24-h dietary recall.	In cross-sectional analysis, TV weakly correlated with snacking in separate models using children ages 4-5 (β = 0.073, *P*<0.001), and 6-7 (β = 0.070, *P*<0.001). In prospective analysis, TV exposure at ages 4-5 weakly correlated with snacking at ages 6-7 (β = 0.060, *P*<0.001).	Average daily use in hours (continuous)
Campbell et al., 2006 (43)	Cross-sectional	560 children ages 5-6	Parent-reported TV time in minutes	Parent-reported frequency of select foods using food frequency questionnaire.	TV viewing (minutes per day × 10) associated with higher energy intake (β = 81.9), greater sweet snack (β = 0.2) and high-energy drink consumption (β = 0.4), and lower vegetable intake (β = 0.2).	Average daily use in minutes (continuous)
Dubois et al., 2008 (44)	Cross-sectional	1,549 children ages 4-5	Parent-reported TV time in minutes.	Parent reported consumption using 24-h dietary recall.	TV viewing (≥3 h/d) associated with eating meals and snacks while watching television (*d* = 0.0446), lower daily consumption of fruits and vegetables (*d* = 0.0594). TV did not increase the odds of drinking soft drinks every day.	Average daily use in hours (binary) ≥3h/d or <3h/d
Gubbels et al., 2009 (45)	Cross-sectional	2,578 children age 2	Parent-reported TV time in minutes	Parent-reported frequency of consumption of select foods.	TV viewing inversely correlated with intake of fresh fruit (r = -0.22, *P*≤0.01), and vegetables (r = -0.15, *P*≤0.01), and positively correlated with intake of sugar-sweetened drinks (r = 0.16, *P*≤0.01) and snacks (r = 0.22, *P*≤0.01).	Average daily use in hours (continuous)
Manios et al., 2009 (49)	Cross-sectional	2,374 Greek children ages 1-5	Parent-reported TV time in minutes	Parent-reported consumption using 24-h dietary recall, food diary and weighing.	TV associated with higher total energy intake (β = 46.5, *P*=0.008).	Average daily use in hours (binary); ≥2h/d or <2h/d
Miller et al., 2008 (46)	Cross-sectional	1,203 children age 3	Parent-reported TV time in minutes	Parent-reported consumption using food frequency questionnaire.	TV viewing positively associated with intakes of SSB (β = 0.09), fruit juice (β = 0.11), whole or 2% milk (β = 0.08), fast food (β = 0.49), snack food (β = 0.12), red and processed meats (β = 0.08), total daily energy intake (β = 41.1), and percent energy intake from total fat	Average daily use in hours (categorical); 0-1/2h/d, >1/2-<2h/d, 2h/d, >2h/d

Study	Design	Child participants	Assessment of child TV	Child diet assessment	Key findings	Modeling of TV exposure
					(β = 0.39), trans fat (β = 0.05), and polyunsaturated fats (= 0.05), and polyunsaturated fats (β = 0.11). TV viewing was inversely associated with intakes of fruit and vegetables (β = -0.17), skim or 1% milk (β = -0.11), calcium (β = -37.9), dietary fiber (β = -0.44), and percent of total energy intake from protein β = -0.23).	
Nelson et. al, 2006 (53)	Cross-sectional	526 children ages 2- 4	Parent-reported TV time in minutes	Parent-reported frequency of consumption of select foods using adapted NHANES questionnaire.	TV positively associated with intake of “nonjuice fruit drinks” (*d* = 0.2741).	Average daily use in hours (binary); ≤2h/d or >2h/d
Proctor et al., 2003 (50)	Prospective cohort	106 children ages 4 (at enrollment) to 11 (at last follow-up)	Parent-reported TV + video game time in minutes.	Parent-reported consumption using food diary.	TV associated with higher energy intake at baseline (*d* = -1.0901).	Average daily use in hours (categorical, tertiles); low (1.1 ± 0. h/d), medium (1.6 ± 0.7h/d), and high (2.4 ± 1.6h/d)
Sasaki et al., 2010 (47)	Cross-sectional	449 children ages 2 to 6	Parent-reported TV + video game time in minutes.	Parent-reported, methodology unclear.	TV positively associated with snacking frequency (OR = 2.71, *P*<0.01), and negatively associated with daily consumption of breakfast (OR = 0.29, *P*<0.01).	Average daily use in hours (binary); <2h/d or ≥2h/d
Taveras et al., 2006 (54)	Cross-sectional	240 children ages 2 to 5	Parent-reported TV + computer time in minutes.	Parent-reported frequency of consumption of select foods.	TV viewing (each hour) associated with greater consumption of fast food (OR = 1.60, 95% CI = 1.03, 2.49).	Average daily use in hours (continuous)
Tremblay et al., 2010 (48)	Cross-sectional	1,192 children aged 4	Parent-reported TV time in minutes.	Parent-reported child frequency of fruits and vegetables	TV inversely associated intake of vegetables (r = -0.123, *P*<0.01) in boys only.	Average daily use in hours (continuous)