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Obesity Prevention

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

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Summary

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, PsycINFO, 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 2 and 6. 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 h 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: Diet, obesity, pre-school, television.

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Introduction

Obesity in children is a problem of growing concern that affects children of all ages. Although its aetiology is multifactorial, environmental contributors to obesity, such as diet and physical activity behaviours, play an essential role (1–4). Research suggests that these diet and physical activity behaviours are established during early childhood (5,6), which make the pre-school years (ages 2–6) a developmentally critical period in which to establish healthy eating behaviours in children (7–14). In the United States, 12% 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 (TV) viewing in children as one strategy to prevent childhood obesity. In light of evidence of a positive relationship between TV viewing and obesity in children (16–24), AAP recommends that children 2 and older limit total media time to 1–2 h daily (25,26).

Prior review studies have supported a positive relationship between TV 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 TV viewing during early childhood, which is a critical period for the development of food preferences and eating behaviours (9,30–33). In a review of sedentary behaviours and fatness in children, Must and Tybor concluded that a significant positive relationship existed between TV 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 TV 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 behaviours and the development of obesity. Of the studies that included children younger than 10, half reported significant positive associations between TV viewing and adiposity. Moreover, the authors cited increased consumption of energy-dense foods as a possible link between TV viewing and overweight in children (29). Caroli, Argentieri, Carone and Masi assessed the role of TV in obesity prevention in their 2004 literature review. Unlike previous reviews of TV viewing in children, their review examined TV viewing in relation to diet as well as obesity. In addition to a positive relationship between TV viewing and obesity, Caroli, Argentieri, Carone and Masi reported that TV 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 TV viewing and obesity in children, the relationship between TV and diet is not well described. While it is clear that a relationship exists between TV and obesity, the relationship is inconsistent across studies. It is speculated that the relationship between TV and obesity is mediated by diet, which may be more strongly related to obesity than TV viewing alone. More importantly, these relationships in early childhood, during which children may be more developmentally susceptible to the effects of TV, are also inadequately described in the literature. No reviews, to our knowledge, have examined the relationship between TV and diet in young children, for whom the obesogenic effects of TV 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, PsycINFO, EMBASE, ERIC, SportDISCUS, Sociological Abstracts and Web of Science. A summary of search terms, databases and articles yielded is presented in Table 1.

Search terms and keywords 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 Fig. 1.

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 TV viewing time and a measure of child diet. Articles were excluded if they did not examine the relationship between child TV viewing time and diet, if the study had fewer than 10 participants, or, in the case of studies with participants younger than 2 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

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
PsycINFO	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

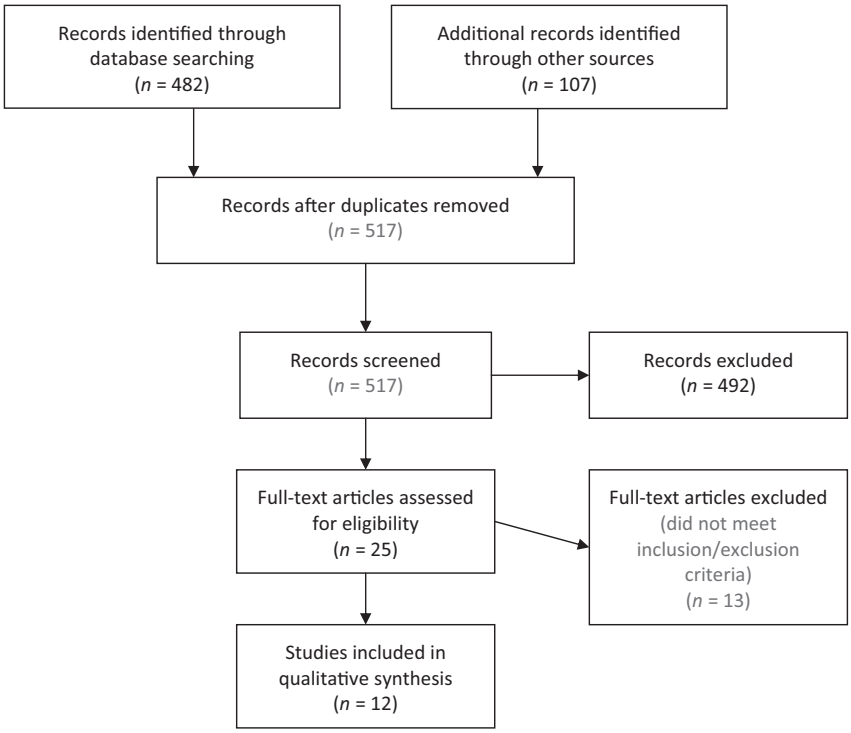

Figure 1 Flow diagram of search and results.

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 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 reviews 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 1.

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 ages between 2 and 6 years in their sample, and samples ranged in age from 1 to 11 years. For studies that included children younger than 2 or older than 6, separate analyses were available for children between the

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	Modelling of TV exposure
Ariza *et al.*, 2004 (43)	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); >3 or ≤3 h d^{-1}
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 ($\beta = 0.073$, $P < 0.001$) and 6–7 ($\beta = 0.070$, $P < 0.001$). In prospective analysis, TV exposure at ages 4–5 weakly correlated with snacking at ages 6–7 ($\beta = 0.060$, $P < 0.001$).	Average daily use in hours (continuous)
Campbell *et al.*, 2006 (44)	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 ($\beta = 81.9$), greater sweet snack ($\beta = 0.2$) and high-energy drink consumption ($\beta = 0.4$), and lower vegetable intake ($\beta = 0.2$)	Average daily use in minutes (continuous)
Dubois *et al.*, 2008 (45)	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^{-1}) associated with eating meals and snacks while watching TV ($d = 0.0446$), 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); ≥3 or <3 h d^{-1}
Gubbels *et al.*, 2009 (46)	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 fruits ($r = -0.22$, $P \leq 0.01$) and vegetables ($r = -0.15$, $P \leq 0.01$), and positively correlated with intake of sugar-sweetened drinks ($r = 0.16$, $P \leq 0.01$) and snacks ($r = 0.22$, $P \leq 0.01$).	Average daily use in hours (continuous)
Manios *et al.*, 2009 (49,52)	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 ($\beta = 46.5$, $P = 0.008$)	Average daily use in hours (binary); ≥2 or <2 h d^{-1}

Table 2 *Continued*

Study	Design	Child participants	Assessment of child TV	Child diet assessment	Key findings	Modelling of TV exposure
Miller *et al.*, 2008 (47)	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 ($\beta = 0.09$), fruit juice ($\beta = 0.11$), whole or 2% milk ($\beta = 0.08$), fast food ($\beta = 0.49$), snack food ($\beta = 0.12$), red and processed meats ($\beta = 0.08$), total daily energy intake ($\beta = 41.1$) and per cent energy intake from total fat ($\beta = 0.39$), trans fat ($\beta = 0.05$) and polyunsaturated fats ($\beta = 0.11$). TV viewing was inversely associated with intakes of fruits and vegetables ($\beta = -0.17$), skim or 1% milk ($\beta = -0.11$), calcium ($\beta = -37.9$), dietary fibre ($\beta = -0.44$) and per cent of total energy intake from protein $\beta = -0.23$).	Average daily use in hours (categorical); 0–1/2 h d^{-1}, >1/2–<2 h d^{-1}, 2 h d^{-1}, > 2 h d^{-1}
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); ≤2 or >2 h d^{-1}
Proctor *et al.*, 2003 (50)	Prospective cohort	106 children ages 4 (at enrolment) 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^{-1}), medium (1.6 ± 0.7 h d^{-1}) and high (2.4 ± 1.6 h d^{-1})
Sasaki *et al.*, 2010 (48)	Cross-sectional	449 children ages 2–6	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); <2 or ≥2 h d^{-1}
Taveras *et al.*, 2006 (54)	Cross-sectional	240 children ages 2–5	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 (42)	Cross-sectional	1,192 children age 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)

CI, confidence interval; OR, odds ratio; SSB, sugar-sweetened beverages; TV, television.

ages of 2 and 6 ($n = 3$). Among the included studies, 13,386 children between 2 and 6 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 TV 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-h dietary recall surveys, two studies used food diaries (one study used food diaries in addition to 24-h dietary recall surveys). One study (42) 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 TV and adverse dietary behaviours in young children. Only one study (43) failed to find a significant relationship between TV viewing and diet. Six studies reported significant inverse relationships between TV viewing and fruit and/or vegetable intake (42,44–48), which was the most commonly reported dietary finding. For two of these studies (42,48), however, this relationship was only significant in boys. Four studies reported that TV viewing was associated with higher total energy intake (44,47,49,50), and two studies reported that TV viewing was positively associated with snacking frequency (48,51). Several studies reported that TV viewing was positively related to consumption of select foods, which included sweet snacks, energy drinks (44), fast foods (47), snack foods, sugar-sweetened beverages, fruit juice, whole or 2% milk and processed meats (47). Other miscellaneous dietary outcomes related to TV viewing included lower intake of brown bread (46), higher intake of energy from total fat and trans fat, and lower intakes of 1% or skim milk, calcium and dietary fibre (47).

TV viewing time associated with adverse dietary outcomes ranged from 10 min to 3 or more hours of viewing time per day. TV time was modelled as a categorical variable in the majority of included studies ($n = 7$) (43,45,47,48,50,52,53), four of which treated TV time as a dichotomous exposure (45,48,52,53). Two studies (47,54), in which TV viewing was categorized into 'none, less than 1 h a day, 1–3 h a day, 4–6 h a day, 7–9 h a day, and 10 or more hours a day', reported an adverse association between TV and diet at 1 h of viewing per day. Of the studies to model TV viewing time continuously (44,46), 10 min of daily TV viewing was the smallest increment of exposure at which a relationship between TV and diet was reported (44).

Discussion

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

Ariza, Chen, Binns and Christoffel's study (43) was the only one that failed to find a significant relationship between TV 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 TV viewing and diet in obese children may be attenuated due to a ceiling effect. Moreover, homogeneity in TV 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 TV 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 AAP's position on screen time and media use. The AAP recommends that children older than 2 limit screen time to 1 or 2 h d^{-1} of quality programming, noting that TV use may contribute to obesity in children by way of advertisements for unhealthy foods, which may adversely affect eating behaviours (55). Prior research has also pointed to a link between TV and diet in children. In a 2001 descriptive review, Robinson noted a relationship between TV 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, TV and food ads. In a prospective study of public school students, each additional hour of TV 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 TV viewing and changes in total energy intake (57).

An important limitation common to all studies included in this review was the use of parent-reported methods to assess child TV viewing, which may be subject to bias (58). In a 2007 review of measures of TV viewing in children and adolescents, Bryant, Lucove, Evenson and Marshall reported that studies of younger children were more likely to use parent-reported methods (59). Overall, self- and parent-reported methods were by far the most commonly used TV assessment methods, whereas direct measurement of TV used was reported in only 5 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 TV viewing and diet in pre-school-aged children. With cross-sectional designs, the temporal sequence between TV viewing and diet is unclear, which makes it difficult to determine if there is a causal relationship (60).

Conclusion

This study points to a significant association between TV viewing and obesity-related dietary behaviours in young children. In the majority of studies, adverse dietary outcomes were associated with as little as 1 h of TV viewing per day, which is evidence that the guidelines for TV use in young children should be strengthened. The current guidelines recommend that children older than 2 limit electronic media use (which included TV) to 1–2 h d^{-1}. The findings of this review, however, suggest that guidelines for TV viewing use in young children should be further delimited.

Conflict of Interest Statement

No conflict of interest was declared.

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Appendix 1

Health Evidence Bulletins – Wales: Questions to assist with the critical appraisal of an observational study, e.g. cohort, case control, cross-sectional (Type IV evidence)

Sources used: Critical Appraisal Skills Programme (CASP, Anglia and Oxford RHA) questions and Polgar A, Thomas SA. Chapter 22. Critical evaluation of published research in Introduction to research in the health sciences. 3rd edition. Melbourne: Churchill Livingstone, 1995; Undertaking systematic reviews of research on effectiveness. University of York: NHS Centre for Reviews & Dissemination, 2001; Weightman AL, Barker, JM, Lancaster J. Health Evidence Bulletins Wales Project Methodology 3. Cardiff: UWCM, 2000.

Paper details

Authors:

Title:

Source:

A/ What is this paper about?

	Yes	Can't tell	No
1. Is the study relevant to the needs of the Project?			
2. Does the paper address a clearly focused issue?			
in terms of			
• the population studied?			
• (case-control study only) Is the case definition explicit and confirmed?			
• the outcomes considered?			
• Are the aims of the investigation clearly stated?			

B/ Do I trust it?

	Yes	Can't tell	No
3. Is the choice of study method appropriate?			
4. Is the population studied appropriate?			
• (cohort study) Was an appropriate control group used – i.e. were groups comparable on important confounding factors?			
• (case-control study) Were the controls randomly selected from the same population as the cases?			
5. Is confounding and bias considered?			
• Have all possible explanations of the effects been considered?			
• (cohort study) Were the assessors blind to the different groups?			
• (cohort study) Could selective dropout explain the effect?			
• (case-control study) How comparable are the cases and controls with respect to potential confounding factors?			
• (case-control study) Were interventions and other exposures assessed in the same way for cases and controls?			
• (case-control study) Is it possible that overmatching has occurred in that cases and controls were matched on factors related to exposure?			
6. (cohort study) Was follow-up long enough?			
• Could all likely effects have appeared in the timescale?			
• Could the effect be transitory?			
• Was follow-up sufficiently complete?			
• Was dose response demonstrated?			

C/ What did they find?

	Yes	Can't tell	No
7. Are tables/graphs adequately labelled and understandable?			
8. Are you confident with the authors' choice and use of statistical methods, if employed?			
9. What are the results of this piece of research? Are the authors' conclusions adequately supported by the information cited?			

D/ Are the results relevant locally?

	Yes	Can't tell	No
10. Can the results be applied to the local situation? Consider differences between the local and study populations (e.g. cultural, geographical, ethical) which could affect the relevance of the study.			
11. Were all important outcomes/results considered?			
12. Is any cost information provided?			
13. Accept for further use as Type IV evidence?		Refer to team leader	

Comments:

Draft Statement (if appropriate):

(Remember to include the relevant target group [age range, sex, etc.]; the measured outcomes/benefits with quantitative information if available; and the health gain notation)