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Limiting Television to Reduce Childhood Obesity: Cost-Effectiveness of Five Population Strategies

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Abstract

Objective: To quantify the potential population-wide costs, number of individuals reached, and impact on obesity of five effective interventions to reduce children's television viewing if implemented nationally.

Study Design: Utilizing evidence from systematic reviews, the Childhood Obesity Intervention Cost Effectiveness Study (CHOICES) microsimulation model estimated the cost, population reach, and impact on childhood obesity from 2020 to 2030 of five hypothetical policy strategies to reduce the negative impact of children's TV exposure: (1) eliminating the tax deductibility of food and beverage advertising; (2) targeting TV reduction during home visiting programs; (3) motivational interviewing to reduce home television time at Women, Infants, and Children (WIC) clinic visits; (4) adoption of a television-reduction curriculum in child care; and (5) limiting noneducational television in licensed child care settings.

Results: Eliminating the tax deductibility of food advertising could reach the most children [106 million, 95% uncertainty interval (UI): 105–107 million], prevent the most cases of obesity (78,700, 95% UI: 30,200–130,000), and save more in health care costs than it costs to implement. Strategies targeting young children in child care and WIC also cost little to implement (between $0.19 and $32.73 per child reached), and, although reaching fewer children because of the restricted age range, were estimated to prevent between 25,500 (95% UI: 4600–59,300) and 35,400 (95% UI: 13,200–62,100) cases of obesity. Home visiting to reduce television viewing had high costs and a low reach.

Conclusions: Interventions to reduce television exposure across a range of settings, if implemented widely, could help prevent childhood obesity in the population at relatively low cost.

Keywords: BMI; cost-effectiveness analysis; food and beverage advertising; obesity; public health; television viewing

Introduction

US youth spend an enormous amount of time viewing screen devices, including smartphones, tablets, computers, gaming devices, or television sets. Despite growing use of mobile devices, such as smartphones and tablets, much of children's time is still spent viewing traditional television sets.[1] National surveys conducted before the COVID-19 pandemic estimated that 2- to 8-year olds view nearly 2 hours of traditional television daily, about a quarter of which is viewed on a traditional set.[2] Teens and tweens are estimated to view about two and a half hours of television daily, with about 43% viewed on a traditional set.[3] As children and youth continue to spend larger amounts of

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time at home without alternative activities due to COVID-19, current time spent engaging with screen devices is likely substantially larger than these estimates.

A large body of high-quality evidence has demonstrated that television watching is one of the strongest modifiable risk factors for childhood obesity.[4–10] Increased energy intake from exposure to large amounts of advertising for unhealthy foods and beverages appears to be the primary pathway through which television viewing increases obesity risk, rather than through reduced physical activity.[4–6,11–16] Children are particularly vulnerable to having their behaviors influenced by advertising, as young children especially have difficulty understanding the persuasive intent of advertising.[13]

Although several major food companies joined the Children's Food and Beverage Advertising Initiative (CFBAI) in 2007, pledging to only advertise products to children adhering to a set of nutritional criteria determined by the Interagency Working Group on Foods Marketed to Children (IWG), children's exposure to unhealthy food advertising has by no means been eliminated.[17] Only 1.4% of food advertisements on children's programming actually adhere to the IWG guidelines.[18] Although a substantial portion of food and beverage advertising has shifted to digital devices,[4,19] children still see about 10 food-related ads each day on television alone.[17]

Exposure to unhealthy food and beverage advertising is a crucial concern for health equity. Children from lower income families and children of color, who bear a disproportionate share of the burden of the childhood obesity epidemic,[20] are also exposed to more television food advertising. Lower income 0- to 8-year olds view 34 minutes more of traditional TV each day than their higher income peers; among 9- to 18-year olds, this difference grows to 59 minutes. Black children are exposed to 50% more food ads each day compared with white children,[21] whereas a larger proportion of food advertisements on Spanish-language children's television are for nutritionally poor foods compared with the share on English-language children's television.[22]

Recent investigations have modeled the potential impact of policies and programs that could be implemented to improve nutrition and physical activity behaviors on childhood obesity.[23–25] However, the potential public health impact of policies and programs to reduce television time exposure has not been assessed, despite substantial evidence for television's impact on obesity risk. We may thus be missing an opportunity to identify potentially effective strategies that could be considered as part of a public health obesity prevention toolkit. This article aims to estimate and compare the potential impact of the national implementation of five different interventions to reduce television viewing and/or television marketing exposure among US children on the childhood obesity epidemic.

Methods

We used the Childhood Obesity Intervention Cost Effectiveness Study (CHOICES) approach for this study. CHOICES has conducted cost-effectiveness analyses of several childhood obesity prevention policies and programs to identify their potential population reach, impact on childhood obesity, and opportunity for health care cost savings.[23–28]

The CHOICES cost-effectiveness analysis process involves (1) the engagement of an advisory group of community partners, public health practitioners, and researchers to select potential interventions with well-defined activities that could be scaled up through policy strategies; (2) a systematic evidence review to identify rigorous estimates of intervention effect; (3) a detailed cost-calculation process; and (4) a microsimulation modeling approach to estimate population reach, impact, and cost-effectiveness, as well as uncertainty surrounding these estimates, over 10 years.[29,30] This study was determined to be Not Human Subjects Research by the Harvard T.H. Chan School of Public Health Institutional Review Board.

Main Outcomes

The key outcomes from the CHOICES cost-effectiveness analysis for a 10-year period include the total number of individuals reached by the intervention, impact on BMI; number of cases of obesity prevented; total implementation costs; health care cost savings; and net costs (implementation costs minus health care cost savings).

Intervention Selection

From 2011 to 2015 and again in 2018, we engaged a group of national and local advisors with expertise in policy, public health practice, and research in childhood obesity prevention. This group helped to determine a list of public health interventions to prevent childhood obesity with the potential to have a population impact through either wide-scale policy or community health programmatic implementation. The list was also informed by a systematic evidence review conducted by the CHOICES research team.

After selecting a subset of this initial list of interventions that focused on preventing obesity through television, advertising, or overall screen time reduction, we searched for studies that quantified the impacts of each of the interventions on BMI, BMI *z*-score, or television viewing, to be able to ultimately input information on the intervention's effect on child weight into the microsimulation model. Randomized controlled trials as well as natural and quasi-experiments were prioritized.[30]

From our initial search, 1982 articles were identified; of these, 216 abstracts were reviewed after a title screen, 33 were reviewed in full after an abstract screen, and 9 were included to estimate the impacts of effects for five interventions that could be theoretically implemented as wide-reaching policies. The five intervention strategies are as follows:

1. Eliminating TV advertisement tax subsidy: Elimination of the tax-deductibility of TV advertising costs for nutritionally poor foods and beverages advertised to children and adolescents ages 2–19 years[31,32] [note: this intervention was modeled in previous iterations of the CHOICES model,[29,33] but was revisited in this analysis

with an updated version of the model[34] and a different time period (2020–2030 instead of 2015–2025)].

2. Home visits to reduce television viewing: Implementation of a home visiting program with dissemination of a screen time managing device that can automatically limit time to a prespecified allowance, impacting 4- to 7-year olds.[6,35]
3. Special Supplemental Nutrition Program for Women, Infants, and Children (WIC) motivational interviewing to reduce television time: Incorporation of motivational interviewing to decrease home television viewing during WIC clinic visits, impacting 2- to 4-year olds.[36]
4. Fit5Kids child care curriculum to reduce television time at home: Implementation of the Fit5Kids curriculum, which engages children and parents/caregivers in reducing television viewing at home, in preschool settings nationwide, impacting 2- to 5-year olds.[37,38]
5. Policy to reduce TV time in licensed early child care and education (ECE) settings: Limiting noneducational television viewing in licensed ECE settings to 30 minutes per week in all US states through a state-by-state regulatory policy change, impacting 2- to 5-year olds.[39]

Estimating Impact on Obesity

We first estimated the impact of each intervention on television viewing behaviors, and then linked this with an estimate of the impact of television reduction on BMI (Supplementary Figs. S1–S5). To estimate the impact of eliminating the tax subsidy,[29,33] we used estimates of the price elasticity of demand for advertising to children (0.74 for ages 2–9 years and 0.61 for ages 10–19 years)[40] and combined these with estimates of the current corporate tax rate and estimates of the proportion of advertising that would be affected.[19,41]

To estimate the average impact of each television reduction intervention on children's BMI, we used published estimates from randomized controlled trials and quasi-experimental evaluations of each intervention's impact on hours of television viewed per day: −1.76 h/day [standard deviation (SD): 0.57] for home visits[6]; ⁻0.30 (SD: 0.13) h/day for WIC motivational interviewing[36]; and −0.55 (95% confidence interval: −0.98 to −0.12) h/day for Fit5Kids (a combined estimate from two trials).[37,38]

One of the intervention strategies, a policy limiting noneducational television viewing to 30 min/week in licensing child care settings, currently lacks experimental evidence. In this study, we assumed the impact would be the difference between existing levels of noneducational television viewing in licensed child care and the level of noneducational television viewing mandated by the proposed policy.

To estimate the average increase in a child's BMI caused by one extra hour of television each day, we reviewed recently completed systematic reviews and meta analyses[42–46] to identify randomized controlled trials of television reduction interventions that included objectively measured child weight change as an outcome. We limited studies to those that intervened on television time alone and had a minimum 6-month follow-up. We identified two studies: a 7-month cluster randomized trial of an intervention that demonstrated reductions of 1.37 hours of television time per day and 0.45 BMI units ($p = 0.002$),[5] and a second randomized trial that found comparable results in a younger sample.[6]

Population Reach

We consulted our advisory group of community partners, practitioners, and researchers for plausible implementation scenarios to estimate the number of people reached by each proposed intervention if implemented through the proposed policy strategy. We reviewed government and nongovernmental reports on program participation where available[35,47] to estimate the percentage of eligible children who could be reached by the implementation of each policy strategy.

Costs

We followed standard guidelines for resource identification, measurement, and valuation.[48] Using a societal perspective, we accounted for implementation costs, including opportunity costs (*e.g.*, the time cost of unpaid volunteers), regardless of payer. Costs were accounted for if they were incremental costs, that is, additional costs that would accrue due to implementing the intervention strategy that go above and beyond existing resources. Costs were identified using estimates of resource use from the original intervention studies or by consulting with individuals with direct experience implementing similar programs. All costs were calculated in 2019 dollars. Future costs were discounted at 3% annually. Labor costs were estimated using the Bureau of Labor Statistics and assuming an average fringe benefit rate of 45.56%.[49]

More details on the effect, reach, and cost estimates are in Supplementary Table S1.

Microsimulation Model

We used data on the cost, population reach, and effectiveness and the CHOICES microsimulation model to estimate outcomes related to childhood obesity for the US population from 2020 to 2030 for each policy strategy, along with estimates of uncertainty for each outcome. The microsimulation model simulates the experiences of individuals in the US population related to height/weight trajectories, health, and health care costs from 2020 to 2030, accounting for projected population growth.[34] To account for uncertainty in model inputs, we calculated 95% uncertainty intervals (UI), using 1000 Monte Carlo iterations for a simulated nationally representative population of 1 million individuals. Further details on the CHOICES microsimulation model are available elsewhere.[24,29,34]

We used the microsimulation model to estimate average reductions in child BMI and the number of cases of childhood obesity prevented in the year 2030 attributable to each intervention if implemented nationwide. We also stratified results by race/ethnicity (non-Hispanic black, non-Hispanic white, Hispanic, and non-Hispanic other).

Annual health care cost savings projections were based on published estimates of obesity-related health care costs.[29,50] We also estimated the total number of individuals reached by each intervention and the total costs for the 10-year modeling period.

In a sensitivity analysis, we also considered that the estimated effect of an hour of television viewing on children's BMI, which was based on two trials that took place before the CFBAI,[5,6] may be weaker now that the CFBAI is in effect, as the per-hour exposure to advertising should be lower. We thus conducted analyses of each intervention assuming that the impact of an hour of TV viewing on BMI would have declined proportionately to the amount that children's exposure to food and beverage advertising is estimated to have declined from the start of the CFBAI in 2007 until 2017 (18% for 2- to 11-year olds, 28% for 12- to 19-year olds).[17]

Results

Population Reach

The estimated number of children reached from 2020 to 2030 by the TV reduction interventions ranged from 380,000 children for a TV home visiting program to 106 million children for eliminating the TV advertising tax subsidy. The reach for home visiting was particularly low because the target population is limited to children 4–7 years old with BMI >75th percentile who are eligible for a home visiting program (using data from the most extensive federal program, the Maternal, Infant, and Early Childhood Home Visiting Program[35]), whereas the elimination of TV advertising tax would impact virtually all children in the United States ages 2–19 years old (Table 1).

Impact on Childhood Obesity

All five interventions were estimated to result in fewer cases of childhood obesity in 2030 compared with no intervention. Eliminating the TV advertising tax subsidy would have a small impact on reducing average BMI per person (0.03 BMI units; 95% UI: 0.02, 0.05), but, due to its broad reach, would result in the greatest reduction in cases of childhood obesity (78,700 cases; 95% UI: 30,200, 130,000). Conversely, home visiting would have the greatest impact on reducing mean BMI per person (0.58 BMI units; 95% UI 0.14, 1.21), but the smallest population reduction in cases of childhood obesity due to its limited population reach.

The mean reduction in BMI per person as well as the cases of childhood obesity prevented over 10 years were comparable for ECE TV regulations (0.14 BMI units; 35,400 cases), Fit5Kids (0.14 BMI units; 25,500 cases), and WIC motivational interviewing (0.10 BMI units; 29,500 cases) (Table 1).

Table 1. Estimated 10-Year Cost-Effectiveness and Economic Outcomes for Obesity Prevention for Five Television or Advertisement Reduction Interventions, 2020–2030 (Mean [95% Uncertainty Interval])

	Eliminating TV advertisement tax subsidy	Policy to reduce TV time in licensed child care settings	Fit5Kids child care curriculum to reduce TV time at home	Motivational interviewing to reduce TV time during WIC clinic visits	Home visits to reduce TV viewing
Children reached by the intervention (million)	106 (105, 107)	9.39 (9.12, 9.62)	5.65 (5.51, 5.77)	8.81 (8.56, 9.07)	0.380 (0.347, 0.415)
Implementation costs (million)	$7.71 ($7.71, $7.71)	$23.8 ($17.0, $32.5)	$185 ($181, $189)	$1.72 ($1.72, $1.72)	$245 ($202, $285)
Implementation cost per child reached by the intervention	$0.07 ($0.07, $0.07)	$2.54 ($1.81, $3.46)	$32.73 ($32.08, $33.38)	$0.19 ($0.19, $0.20)	$645.39 ($543.31, $724.65)
Health care cost savings per dollar invested	$20.36 ($8.11, $33.61)	$0.95 ($0.34, $1.93)	$0.09 ($0.02, $0.20)	$7.96 ($0.97, $18.82)	$0.03 ($0.01, $0.07)
Net costs (million)	–$149 (–$251, –$54.8)	$1.12 (–$18.9, $18.8)	$169 ($148, $183)	–$11.9 (–$30.6, $0.0543)	$237 ($188, $280)
Likelihood of net cost savings	99.9%	43%	0%	97%	0%
Total cases of childhood obesity prevented in 2030	78,700 (30,200, 130,000)	35,400 (13,200, 62,100)	25,500 (4600, 59,300)	29,500 (3390, 64,900)	6250 (1670, 12,300)

WIC, Women, Infants, and Children.

10-Year Costs and Cost-Effectiveness

Eliminating TV advertising tax subsidies is projected to save more in health care costs related to obesity prevention than it would cost to implement, with net costs (total implementation costs minus health care cost savings) over 10 years of −$149 million (95% UI: −$251, −$54.8 million). The WIC motivational interviewing intervention is also projected to be cost-saving (−$11.9 million, 95% UI: −$30.6, 0. 0543 million), with a 97% likelihood of cost savings. The remaining three strategies had a wide range of projected 10-year net costs, from $1.12 million for ECE TV regulations, to $169 million for Fit5Kids and $237 million for home visits (Table 1).

Stratification by Race/Ethnicity

None of the modeled television reduction interventions were estimated to widen racial/ethnic disparities in childhood obesity; reductions in estimated obesity prevalence in 2030 were not meaningfully different by race/ethnicity for any of the interventions (results not shown).

Discussion

Exposure to food and beverage advertising on television remains a potent driver of childhood obesity.[10] In this cost-effectiveness analysis of five potential population strategies to reduce childhood TV viewing time or exposure to TV food and beverage advertising, we found that several could reduce childhood obesity at relatively low implementation cost. Two of the strategies were estimated to save more in obesity-related health care costs over 10 years than they cost to implement (reducing the tax deductibility of advertising and the WIC motivational interviewing intervention), comparing favorably with nutrition or physical activity-focused strategies that have been previously modeled with the CHOICES methodology.[23,24]

Reducing the tax deductibility of TV advertising for foods/beverages is estimated to prevent the largest number of cases of childhood obesity at the lowest cost per child, suggesting it could be an effective low-cost policy tool across the population if there were political will to implement it. Meanwhile, incorporating counseling to reduce television viewing into WIC and requiring licensed child care settings to limit noneducational television could be a practical and low-cost intervention, but would be limited to young children in these specific settings.

Although the home visiting strategy had the smallest population reach and highest implementation cost of all strategies modeled, it had the largest per-person impact on BMI reduction, suggesting it may be a particularly helpful strategy for individuals at higher risk. Home visiting programs have been relatively underutilized for obesity prevention efforts[51]; future research could focus on how best to leverage these programs for higher risk children at lower cost.

In addition to the overall population benefits seen for these interventions, none appear to widen racial or ethnic disparities in obesity, an encouraging signal given the substantial disparities in childhood obesity that exist by race and ethnicity among children.[20] Further research is needed to better understand whether any of these interventions may have differential effects by race, ethnicity, income, or other relevant social determinants of health, especially given inequities in exposure to marketing,[21] and to understand how cost-effectiveness may differ by these factors.

An important limitation of this study is that we could not estimate the impact of reducing excessive mobile device use. This is important due to the rapidly increasing amounts of time that children spend on such devices[2,3]—especially as many children continue to stay at home and attend school using digital devices during the COVID-19 pandemic.

However, it is not yet clear whether mobile device use impacts childhood obesity risk as much as television does, particularly given that such devices are often used to access streaming video content, which may result in different exposures compared with traditional television.[52] There is a near-absence of research on food and beverage marketing exposure on digital devices or interventions to limit use, limiting our ability to estimate the cost-effectiveness of interventions focused on use of mobile devices. At the same time, children still spend substantial amounts of time viewing television.[2,3] Furthermore, although television advertising for foods and beverages has decreased post-CFBAI,[17] children, particularly children of color, are still exposed to harmful food and beverage advertising.[21]

Other limitations include incomplete evidence for one of the interventions modeled; the modeled effect of the ECE television regulations strategy was based on hypothetical impacts on television viewing, not on effect measures obtained from intervention trials. Although the results of this strategy should be interpreted with some caution, estimating the potential population benefits of this intervention can still provide useful insight for policymakers.

In addition, although it is certainly possible that there may be nonlinearities in both costs (*e.g.*, due to economies of scale with bulk purchasing, or due to nonlinear increases in health care costs related to increasing BMI) and effects, we lacked evidence on these potential nonlinearities to use in our microsimulation model. Recent evidence suggests that nonlinearities in health care costs for children with obesity are only seen at very extreme BMI values for children.[53]

Although we were able to make some estimates of different effects of TV reduction by race/ethnicity, we also were not able to fully explore the potential for heterogeneous impacts of reduced TV time or advertising exposure, given the lack of data on such differences in the literature.

Finally, our model focuses on potential impacts on child BMI and related health care costs; it cannot take into account potential unintended consequences of the implementation of these interventions, both positive and negative, such as potentially improving social emotional outcomes[54] or shifting advertising strategies.

Conclusions

Policy intervention strategies to reduce exposure to noneducational television time can reduce obesity risk, yet they are not widely implemented. This cost-effectiveness modeling study suggests that over 10 years, implementing such strategies could be good value approaches to improving population health. Policymakers and public health practitioners should consider using television reduction strategies as part of a broader toolkit of cost-effective obesity prevention strategies.

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Author Disclosure Statement

No competing financial interests exist.

Supplementary Material

Supplementary Figure S1
Supplementary Figure S2
Supplementary Figure S3
Supplementary Figure S4
Supplementary Figure S5
Supplementary Table S1

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