



Reducing Recreational Sedentary Screen Time

A Community Guide Systematic Review

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Context: Sedentary time spent with screen media is associated with obesity among children and adults. Obesity has potentially serious health consequences, such as heart disease and diabetes. This Community Guide systematic review examined the effectiveness and economic efficiency of behavioral interventions aimed at reducing recreational (i.e., neither school- nor work-related) sedentary screen time, as measured by screen time, physical activity, diet, and weight-related outcomes.

Evidence acquisition: For this review, an earlier (“original”) review (search period, 1966 through July 2007) was combined with updated evidence (search period, April 2007 through June 2013) to assess effectiveness of behavioral interventions aimed at reducing recreational sedentary screen time. Existing Community Guide systematic review methods were used. Analyses were conducted in 2013–2014.

Evidence synthesis: The review included 49 studies. Two types of behavioral interventions were evaluated that either (1) focus on reducing recreational sedentary screen time only (12 studies); or (2) focus equally on reducing recreational sedentary screen time and improving physical activity or diet (37 studies). Most studies targeted children aged ≤ 13 years. Children’s composite screen time (TV viewing plus other forms of recreational sedentary screen time) decreased 26.4 (interquartile interval= $-74.4, -12.0$) minutes/day and obesity prevalence decreased 2.3 (interquartile interval= $-4.5, -1.2$) percentage points versus a comparison group. Improvements in physical activity and diet were reported. Three study arms among adults found composite screen time decreased by 130.2 minutes/day.

Conclusions: Among children, these interventions demonstrated reduced screen time, increased physical activity, and improved diet- and weight-related outcomes. More research is needed among adolescents and adults.

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Context

Obesity prevalence in the U.S. has nearly tripled among children and adolescents over the past 3 decades, with obesity affecting approximately

17% of all U.S. children and adolescents, and more than one third of U.S. adults.¹ Obese children are more likely to have risk factors associated with cardiovascular disease² and Type 2 diabetes,³ and are more likely to become obese adults.^{4,5} Among adults, obesity is associated with

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are described in the [Appendix](#) (available online). When available, summary effects for adults are presented in the text.

Screen time. Forty-nine study arms from 39 studies^{35–39, 41–49, 51, 54–59, 61, 63, 65, 67, 69–80, 82, 83} reported duration of commercial TV viewing or composite screen time among children and adults. Among children, 27 study arms from 19 studies^{37–39, 41–43, 45, 48, 55, 67, 70, 72–77, 80, 82} reported a median decrease of 22.2 (IQR= –76.8, –0.60) minutes/day of commercial TV viewing. In addition, 34 study arms from 32 studies^{35–38, 42–45, 47, 49, 51, 54, 56–59, 61, 63, 65, 69, 71, 72, 74–76, 78, 79} reported a median decrease in composite screen time of 26.4 (IQR= –74.4, –12.0) minutes/day (Table 2). Among adults, one study⁵⁵ reported a median decrease in commercial TV viewing of 33.0 minutes/day. Three study arms (in two studies)^{46, 83} reported a median decrease in composite screen time of 130.2 (range = –142.8, –128.4) minutes/day.

[Appendix Figure 2](#) (available online) displays effect estimates and, when available, 95% CIs, for the absolute change in minutes per day of composite screen time among children. For controlled trials, participants receiving screen time interventions were compared with either no screen time intervention or usual care (e.g., usual classroom lessons). There were 11 screen-time-only study arms with a median baseline composite screen time of 156.0 (IQR=114.0, 201.0) minutes/day and a median decrease of 82.2 (IQR= –105.4, –52.1) minutes/day. Removing pre–post study arms, the median decrease was 69.6 (IQR= –99.6, –27.9) minutes/day. Also, 23 screen-time-plus study arms with a median baseline composite screen time of 162.0 (IQR=144.0, 204.0) minutes/day had a decrease of 21.6 (IQR= –38.4, –12.9) minutes/day. Removing the pre–post study arms, the median decrease was 22.8 (IQR= –29.7, –2.3) minutes/day.

Screen-time-only studies had a greater effect on reducing composite screen time, with high-intensity screen-time-only showing the greatest effect. Studies with electronic monitoring devices, which are electronic devices that connect to a TV, DVD player, or video-game console that set time limits, reported greater reductions than those without devices. Six screen-time-only and five screen-time-plus high-intensity studies with an electronic monitoring device reported median composite screen time reductions of 91.8 (IQR= –125.4, –70.8) minutes/day and 52.8 (IQR= –119.4, –19.2) minutes/day, respectively. In addition, one high-intensity screen-time-only study and 11 high-intensity screen-time-plus study arms (from 12 studies) without an electronic monitoring device reported median reductions of 37.1 minutes/day and 17.4 minutes/day (IQR= –28.2 minutes/day, –4.8 minutes/day), respectively.

Physical activity. Forty-seven study arms from 35 studies^{36, 38, 41, 42, 44, 46–49, 52, 54–63, 65, 66, 68, 69, 71–80, 83} reported physical activity. Additional information is in the [Appendix](#) (available online).

Dietary behaviors. Forty study arms from 32 studies included dietary behaviors as outcomes among children^{35–38, 40–42, 44, 47–50, 54–59, 63, 65, 66, 68, 70–72, 77, 79–82} and adults.^{46, 83} Additional information is in the [Appendix](#) (available online).

Weight-related. Thirty-nine study arms from 33 studies^{35, 36, 41, 42, 44, 46–57, 61, 63–69, 71–75, 78–80} reported weight-related outcomes. Among children, two screen-time-only^{35, 36} and 12 screen-time-plus study arms from 12 studies^{48–51, 55, 63–67, 72, 78} reported a median decrease in BMI z-score of –0.13 (IQR= –0.23, –0.01) (Table 2). Body fat percentage was assessed by one screen-time-only⁴⁴ and seven screen-time-plus study arms from five studies,^{52, 53, 65, 69, 78} which found a median decrease of –3.5 (IQR= –5.4, –0.90) percentage points (pct pts). One screen-time only study⁴⁰ and three screen-time-plus studies^{49, 67, 70} measured fat mass by skin-fold thickness in normal weight samples and reported a median decrease of –1.0 (range= –2.5, –0.44) mm. Among adults, two studies^{46, 55} reported BMI decreases of –0.18 kg/m² and –0.19 kg/m².

Obesity Prevalence

No screen-time-only studies reported obesity prevalence. [Appendix Figure 3](#) (available online) displays screen-time-plus effect estimates for absolute pct pt change in obesity prevalence among children. Ten high-intensity screen-time-plus study arms with a median obesity prevalence at baseline of 10.3% (IQR=5.4%, 21.5%) reported a median decrease of 2.1 (IQR= –3.9, –1.1) pct pts. Four low-intensity study arms with a median baseline of 12.3% (range=6.0%, 23.7%) reported a median decrease of 4.6 (range= –7.6, –1.1) pct pts. Combining high- and low-intensity study arms ($n=14$), the median baseline obesity prevalence was 10.3% and the median decrease was 2.3 (IQR= –17.7, –6.0) pct pts, which is a relative reduction of approximately 20%. For the 14 screen-time-plus study arms that reported obesity prevalence, the median reduction in composite screen time was –23.7 (IQR= –28.2, –13.2) minutes/day, which is similar to the median reduction in composite screen time in all screen-time-only and screen-time-plus studies combined (–26.4 [IQR= –74.4, –12.0] minutes/day), but is less than the screen-time-only studies of –82.2 (IQR= –105.4, –52.1) minutes/day. It was not possible to examine physical activity and dietary results, which may have contributed to this reduction in obesity, because of the variety of outcome measures used.

Table 2. Selected Outcomes for Children Stratified by Intervention Type and Intensity

Outcomes	Screen-time-only ^a			Screen-time-plus ^b			Combined screen-time-only and screen-time-plus
	High intensity ^c	Low intensity ^d	High and low intensity combined	High intensity	Low intensity	High and low intensity combined	
Recreational sedentary screen time							
Commercial TV viewing (minutes/day)							
No. of study arms	6	3	9	13	5	18	27
Median change	-46.8 (-210.0, -34.8)	-0.6 (-120.6, 0.0)	-45.6 (-162.6, -15.0)	-13.8 (-52.2, 6.0)	-18.0 (-78.0, 0.0)	-16.2 (-70.8, 3.6)	-22.2 (-76.8, -0.60)
Composite screen time (minutes/day)							
No. of study arms	7	4	11	17	6	23	34
Median change	-82.2 (-117.6, -67.2)	-51.6 (-116.4, -23.4)	-82.2 (-117.6, -37.2)	-21.6 (-44.4, -10.8)	-19.2 (-28.2, 10.8)	-21.6 (-34.2, -9.0)	-26.4 (-74.4, -12.0)
Physical activity							
Accelerometer counts (counts/day)							
No. of study arms	NR	NR	NR	7	NR	7	NA
Median change	—	—	—	4 arms: 66.0 (40.8, 115.0) Contingent ^e (3 arms): 130.0 (127.8, 150.0)	—	4 arms: 66.0 (40.8, 115.0) Contingent ^e (3 arms): 130.0 (127.8, 150.0)	—
Pedometer steps (steps/day)							
No. of study arms	2	1	3	4	2	6	9
Median change	679.0 (298, 1,150)	992.0	992.0 (298, 1,150)	1,359.5 (-258.0, 4,972.0)	-377.0 (-993.0, 239.0)	310.0 (-441.8, 2,996.4)	381 (-9.5, 1,743.9)
Duration of moderate to vigorous physical activity (minutes/day)							
No. of study arms	2	1	3	9	4	13	16
Median change	27.6 (-2.4, 30.0)	-70.6	-2.4 (-70.6, 30.0)	1.2 (-4.5, 20.2)	5.1 (-2.5, 15.4)	4.4 (-3.0, 14.7)	2.3 (-4.2, 16.7)

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Table 2. Selected Outcomes for Children Stratified by Intervention Type and Intensity (*continued*)

Outcomes	Screen-time-only ^a			Screen-time-plus ^b			Combined screen-time-only and screen-time-plus
	High intensity ^c	Low intensity ^d	High and low intensity combined	High intensity	Low intensity	High and low intensity combined	
Diet							
Total energy intake (kcal/day)							
No. of study arms	1	NR	NR	5	NR	NR	6
Median change	-75	-	-	-117.9 (-373.1, 28.5)	-	-	-121.0 (-268.0, 0.59)
Snack intake (kcal/day)							
No. of study arms	1	1	2	1	NR	NR	3
Median change	-233.7	-123.7	-178.7	-281.9	-	-	-233.7
Sugar-sweetened beverage intake (relative percent change)							
No. of study arms	NR	NR	NR	8	6	14	NA
Median change	-	-	-	-17.2 (-54.7, -9.2)	-1.6 (-40.9, 5.4)	-10.9 (-50.0, 3.5)	-
Fruit and vegetable intake (servings/day)							
No. of study arms	NR	NR	NR	9	5	14	NA
Median change	-	-	-	0.16 (-0.25, 0.43)	0.5 (-0.85, 1.04)	0.21 (-0.38, 0.53)	-
Weight-related outcomes							
BMI (kg/m ²)							
No. of study arms	3	1	4	9	2	11	15
Median change	-0.44 (-0.45, -0.04)	-0.09	-0.27 (-0.45, -0.04)	-0.21 (-0.65, 0.07)	0.13 (0.10, 0.16)	-0.08 (-0.40, 0.10)	-0.09 (-0.44, -0.04)
BMI z-score							
No. of study arms	1	1	2	7	5	12	14
Median change	-0.20	0.01	-0.11	-0.11 (-0.19, 0.02)	-0.20 (-0.34, -0.02)	-0.11 (-0.19, 0.05)	-0.13 (-0.23, -0.01)

(continued on next page)

Table 2. Selected Outcomes for Children Stratified by Intervention Type and Intensity (continued)

Outcomes	Screen-time-only ^a		Screen-time-plus ^b			Combined screen-time-only and screen-time-plus
	High intensity ^c	Low intensity ^d	High and low intensity combined	High intensity	Low intensity	
Percent body fat (pct pts)						
No. of study arms	1	NR	NR	5	2	8
Median change	-2.54	—	—	-4.9 (-5.9, 2.8)	-0.38 (-0.83, 0.08)	-3.5 (-5.4, -0.90)
Morbidity						
Obesity prevalence (pct pts)						
No. of study arms	NR	NR	NR	9	4	13
Median change	—	—	—	-2.0 (-2.8, -1.1)	-4.6 (-7.6, -1.1)	-2.3 (-4.5, -1.2)

Note: All medians are followed by interquartile interval if there are ≥ 5 study arms, range if there are < 5 study arms. Not all studies are represented in the table because of inconsistent outcome measures.

^aScreen-time-only interventions only focus on reducing recreational sedentary screen time.

^bScreen-time-plus interventions focus on reducing recreational sedentary screen time and increasing physical activity and/or improving diet.

^cHigh-intensity interventions must include use of an electronic monitoring device to limit screen time or at least three personal or computer-tailored interactions.

^dLow-intensity interventions include two or fewer personal or computer-tailored interactions.

^eScreen time contingent on physical activity.

NA, not applicable; NR, not reported; pct pts, percentage points.

Economic Evidence

Two economic studies^{84,85} were identified from the search results for the effectiveness review, and from a separate search (1966 through 2014) within specialized databases (available at www.thecommunityguide.org/obesity/supportingmaterials/SSscreentime.html). Detailed evidence tables are available at www.thecommunityguide.org/obesity/supportingmaterials/SET-screentime.pdf. The two studies targeted children and estimated or modeled the:

1. intervention cost from quantities of labor and materials identified in the intervention descriptions;
2. number of cases of adult overweight prevented, because cases of overweight were prevented in childhood;
3. economic benefits as the difference in cost between the additional healthcare resources consumed by overweight adults compared with normal weight adults; and
4. improved QALYs lived as the difference between the greater number of QALYs lived by normal weight adults compared with overweight adults.

Both studies modeled a screen-time-plus intervention⁵⁹ under various parameter values and found it to be cost effective based on a conservative threshold of \$50,000 per QALY saved. The second study also modeled a screen-time-only intervention⁴² and found the intervention not to be cost effective.⁸⁵

Applicability

Findings from this review are applicable to children aged ≤ 13 years in the U.S. and other high-income countries. Few studies targeted adults^{46,83} and none targeted adolescents aged >13 years. Most studies in this review included normal-weight participants and seven studies^{36,46,52,53,57,67,79} targeted overweight or obese participants. Interventions were found to be effective regardless of weight status. More than half of the studies^{35,37-43,45-47,49,51,53,56-59,62,67,68,70-72,77-79,82,83} reported race/ethnicity, and nine studies^{38,40,49,61,71,72,75,76,82} targeted low-income populations. Studies were found to be effective across race/ethnicity and low-income populations.

Five studies^{36,40,64,69,79} performed a stratified analysis to examine effectiveness on SES disparities. Four of these studies examined the effectiveness on weight-related outcomes (e.g., BMI, obesity prevalence), of which three showed greater reductions in low-income participants compared with high-income participants. One study,⁴⁰ conducted in Special Supplemental Nutrition Program for Women, Infants, and Children clinics, reported a greater increase in meeting American Academy of Pediatrics recommendations among children whose parents were non–high school graduates compared to parents who were high school graduates.

Discussion

Summary of Findings

There is strong evidence that screen-time-only and screen-time-plus interventions are effective at reducing recreational sedentary screen time, increasing physical activity, improving diet, and improving or maintaining weight status. These findings are applicable to children aged ≤ 13 years of various races/ethnicities living in various countries and settings. In addition, evidence shows these interventions may reduce obesity prevalence and disparities in weight status between children of high and low SES.

Evidence Gaps

Although evidence shows that behavioral interventions to reduce recreational sedentary screen time are effective, research gaps remain. Future studies should examine which characteristics (e.g., intensity and duration) and components (e.g., family-based social support, electronic monitoring device) are most effective. In addition, follow-up research should examine how long intervention effects are maintained.

Research is needed among adolescents and adults, and by degree of urbanization. Research among adolescents aged >13 years is needed because time spent with screen media increases as children age¹⁸ and adolescents have access to many electronic devices.⁸⁶ More research among adults is needed because only two studies were found.^{46,83} Studies should also consider degree of urbanization. Most included studies were implemented in urban or suburban settings, and it remains unknown if similar interventions would be successful in rural settings, where the barriers to physical activity are more frequent (e.g., lack of parks or sidewalks).⁸⁷

It would also be beneficial to consider other outcomes of reduced screen time, such as improved sleep,⁸⁸ improved family and peer relationships,⁸⁹ and substitution of other sedentary behaviors. For example, does a reduction in screen time result in the substitution of

other sedentary behaviors (e.g., reading for leisure or listening to music)?

Evidence about the effect of more recent mobile devices such as smartphones and tablets was rarely reported in this body of evidence. It is unknown to what extent these devices are associated with weight status, and whether decreases in their use would be associated with outcomes included in this review. Research on screen time interventions should be broadened to include the use of mobile devices and should report the context and duration for the use of multiple electronic devices.

Lastly, only two studies provided economic data, emphasizing the need for more economic evaluations of these interventions. Studies that model economic outcomes for children need to incorporate averted healthcare costs, improved academic productivity, and increased quality of life during the childhood years.

Limitations

This review had several limitations. First, most of the articles were from peer-reviewed literature; thus, there is a potential publication bias. The team attempted to address this by searching gray literature, but only two dissertations met the inclusion criteria. Second, a formal meta-analysis was not possible, owing to varied study designs and few studies reporting CIs or SEs. Additionally, calculating an effect estimate that included all studies reporting a particular outcome was not possible because of heterogeneous measures. In addition, the team reported the data point closest to the conclusion of the intervention because too few studies reported maintenance of outcome. Therefore, review results do not reflect maintenance of outcome. Additionally, much of the screen time, dietary, and physical activity data were self-reported, and warrant cautious interpretation of results. Finally, no screen-time-only studies reported obesity prevalence, resulting in an obesity prevalence effect estimate based solely on screen-time-plus studies.

Conclusions

Since the original Community Guide screen time review, the number of studies on behavioral interventions to reduce sedentary screen time has increased greatly, underscoring the importance of recreational sedentary screen time. The interest might be a result of the link between screen time during childhood and childhood obesity or lowered scores for self-esteem and decreased academic achievement,⁹ or the link between childhood/adolescent TV viewing and overweight, poor fitness, and elevated cholesterol in adulthood.¹²

A 2014 review of reviews reported on the effectiveness of reducing time in sedentary behaviors and found results

similar to those of this review.⁹⁰ Half of the studies defined sedentary time as recreational screen time, and all found some level of effectiveness at reducing sedentary behavior. The authors report that interventions targeting children aged <6 years may be more effective because of parental control, and that the more effective interventions included family social support, behavioral interventions, and electronic TV monitors.

The members of the obesity team for this review were Leigh Ramsey Buchanan, Cherie R. Rooks-Peck, Ramona K. C. Finnie, Holly R. Wethington, Charlotte A. Pratt, Janet E. Fulton, Donna B. Johnson, Leila C. Kahwati, Gilbert Ramirez, Randy Elder, Shawna Mercer, and Karen Glanz. All obesity team members contributed to the conceptualization of the review and interpretation of results.

LRB, CRRP, RKCF, HRW abstracted studies, conducted analyses, and drafted the manuscript. CAP, JEF, DBJ, LCK, GR, and KG provided revisions to draft manuscripts. VJ designed and carried out the economic analysis for this review.

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Appendix

Supplementary data

Supplementary data associated with this article can be found at <http://www.thecommunityguide.org/obesity/obesity-AJPM-app-behavioral.pdf>.