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Reducing Sugar-Sweetened Beverage Consumption

ideas 42

Using behavioral interventions to promote health in Ashland, Kentucky

Despite widespread awareness of the harmful health effects of sugar, many people don't focus on cutting back on drinks with high sugar content when trying to make healthier choices. And for those who do try, many find changing beverage habits can be difficult. We designed and tested two interventions aimed at helping people build healthier beverage consumption habits in an Appalachian community with high rates of both chronic diseases (including obesity) and sugar-sweetened beverage (SSB) consumption.

Summary

Sugar-sweetened beverages (SSBs) such as sodas, sweetened juices and teas, sports drinks, and energy drinks are a large risk factor in the development of obesity, diabetes, heart disease, and other diet-related chronic diseases.[1] Rates of SSB consumption have been rising for decades, and now about half of the U.S. population consumes one or more sugary drink on any given day.[2] In rural and lower-income communities, such as in many parts of Appalachia, those rates can be much higher: among a group of kids and adults we surveyed in Ashland, Kentucky, 90% reported drinking at least one SSB per day.

Highlights

- In rural and lower-income communities, consumption of at least one sugar-sweetened beverage daily can be as high as 90%.
- Consuming sugar-sweetened beverages is a large risk factor for certain health issues.
- Behavioral design can help people build healthier beverage consumption habits.

Behavioral influences in drinking SSBs

In order to better understand what is driving the high rates of SSB consumption in Ashland, and what gets in the way for people who want but struggle to drink fewer SSBs, we conducted a series of observations, surveys, and interviews in the community. We found a set of factors, some structural and others behavioral, influencing people's choices.

We identified **five behavioral barriers** that make it harder for people to make healthier choices.

1. **Automaticity:** Consuming SSBs is often an automatic behavior, not the result of a conscious decision. Certain cues—locations, activities, times of day—unconsciously trigger a desire for SSBs. As these triggers repeat over time, SSB consumption becomes more of a habit and less of a deliberate choice.

[1] Malik, Vasanti S. et al. 2010. "Sugar-Sweetened Beverages, Obesity, Type 2 Diabetes Mellitus, and Cardiovascular Disease Risk." *Circulation* 121(11): 1356–64.

[2] Rosinger A, Herrick K, Gahche J, Park S. (2017). Sugar-sweetened beverage consumption among U.S. adults, 2011–2014. NCHS data brief, no 270. Hyattsville, MD: National Center for Health Statistics.

2. **Present bias:** The rewards of drinking SSBs are immediate and salient, while the consequences are delayed and vague. Delaying gratification is hardest when the mental resources needed for self-control are depleted due to stress, being tired, or (ironically) using self-control on other diet-related decisions.
3. **Mental models:** People often have misconceptions about whether drinks are "healthy" or "unhealthy" and underestimate how much sugar is really in their drinks. For example, many people we spoke with in Ashland believed sports drinks were a healthy option.
4. **Social norms**: People set their reference point for appropriate SSB consumption based on what they perceive is normal and appropriate for "people like me."
5. **The value of value:** Families feel licensed to purchase large quantities of unhealthy foods when they can achieve a financial goal like stretching their dollar. At local stores in Ashland, SSBs are almost always on sale in some form, and water often costs around the same amount (without being nearly as appealing).

We also identified **three macro-level factors** shaping the choice environment. Addressing these factors was largely out of the scope of this project, but they were important to keep in mind because the structural and behavioral barriers they create make attempts to reduce SSB consumption more complex.

1. **Neurophysiology:** People are hard-wired to love sugar. Our brains evolved to find sugar highly rewarding because it was a scarce, valuable resource for our ancient ancestors. Now, with SSBs containing far more sugar than anything our ancestors consumed, they tap into our brain's reward system in a way that can overwhelm our ability to make well-reasoned decisions.[3]
2. **Advertising:** Soda companies have invested billions of dollars in marketing SSBs to influence people's preferences and purchases.[4] In Appalachia, we found one type of campaign has been particularly effective: linking Appalachian identity with drinking Mountain Dew. In our interviews we heard some people call Mountain Dew "a way of life" in the region.
3. **Water contamination:** There have been several salient instances of tap water contamination in parts of Appalachia, in large part due to inadequate approaches to both funding local water systems and regulating companies producing contaminants such as C8, a suspected carcinogen used in the production of Teflon.[5] We learned many residents of Appalachian communities were skeptical of water quality year-round,[6] perhaps due to the fact that contamination was typically only announced after the fact.

[3] King, B. M. (2013). The modern obesity epidemic, ancestral hunter-gatherers, and the sensory/reward control of food intake. *American Psychologist*, *68*(2), 88.

[4] Federal Trade Commission (2013). A review of food marketing to children and adolescents: follow-up report. http://www.ftc. gov/os/2012/12/121221foodmarketingreport.pdf

[5] Pytalski, J. (2018). Water in Appalachia Needs a Trillion Dollar Solution. *West Virginia Public Broadcasting*. http://www.wvpublic.org/post/water-appalachia-needs-trillion-dollar-solution (5 February 2019).

[6] McSpirit, S. & Reid, C. (2011). Residents' Perceptions of Tap Water and Decisions to Purchase Bottled Water: A Survey Analysis from the Appalachian, Big Sandy Coal Mining Region of West Virginia. *Society & Natural Resources*, *24*(5), 511-520.

Behavioral solutions

ideas42 partnered with Our Lady of Bellefonte Hospital (OLBH) and Ashland Schools in northeastern Kentucky in order to develop and test new ways of helping people with (or at risk of) diet-related chronic diseases make healthier drink choices.

A curriculum for Fit Families

At OLBH, we designed a two-session curriculum to help families participating in the hospital's Fit Families wellness program make different choices about beverages. Families in the program attend regular sessions with a health coach in order to work on making healthier choices related to their diet and physical activity. The program's staff and participants reported having the most difficulty changing habits around sugary drinks. The curriculum we developed was designed to help families meet their health goals by providing the tools and support they needed to break old habits and create new ones.

The first activity was a "values affirmation" activity, a simple exercise that research shows helps instill a positive mindset before stressful situations. This activity was immediately followed by an activity about sugar, including making the quantities and effects of sugar in SSBs more concrete and salient. The pairing of these first two activities was intended to help participants feel both motivated and empowered to make changes. Next, to channel that motivation, participants completed a goal-setting activity in which they identified an appropriate goal and anticipated possible obstacles to meeting it. They also received a checklist to bring home about simple changes they could make in their home, such as using smaller glasses for SSBs and larger ones for water.

One month later in the second session, participants revisited and updated their goals with the health coach before going through two activities focused on grocery store purchases. In those activities, families calculated how much money they were spending on SSBs (to again build motivation for behavior change), and then filled out a grocery list using a simple, color-coded guide to SSB alternatives, so they could consider the best choices for their family's health and budget in a more deliberate way than relying on habits or what looks appealing in the store. Families took home the guide to SSB alternatives and a pad of the behaviorally informed grocery lists, to use together at home.

Making a Splash

We also developed a second intervention, tailored for elementary school students in an afterschool program in Ashland. Our research in Ashland suggested many people (especially kids) did not find water appealing, particularly in comparison to SSBs. Since we know that habits early in life are extremely important for long-term health outcomes, we started to think about how to make water more fun and flavorful for kids. We also learned that many in Appalachia also find tap water unappealing because of concerns about possible contamination, so we considered ways of increasing water's appeal by making it safer. The solution we came up with was a program called *Fruit Splash* that taught students how to make fruit-infused water and then gave them access to all the resources they needed to make flavorful pitchers of filtered and fruit-infused water at home.

In the first week, the students learned how to make fruit-infused water, tried a few different flavors, and answered surveys about which drinks they liked and how often they had different drinks. The next week, they received a combined filtering-infusing pitcher to take home along with a box that contained a recipe card and enough fruit to make three pitchers of the recipe at home. They continued to receive boxes of fruit (for recipes they had pre-selected) for nine more weeks, before we collected another round of surveys to measure the impact of the program. To make the logistics of this pilot work, we devised a system of ordering, picking up, and packaging fresh fruit each week which wouldn't have been possible without the generous support from our partners at Ashland Schools and OLBH.

Our Results

Fit Families

We evaluated the intervention designed for the Fit Families program by randomly assigning each family to receive either the two-session curriculum (62 individuals in 19 families at Session 1) or a control that consisted of standard public health resources and coaching (67 individuals in 23 families at Session 1). To measure drink consumption, we had participants in both groups complete a Beverage Intake Questionnaire in each session, as well as respond to occasional text messages about drink consumption.

Based on the results of our analysis, those who received the intervention consumed **9.2 fluid ounces (or just over one serving) fewer of SSBs per day on average**[7] after the intervention period compared to the control group, which represents **a reduction of 48%** from a baseline average of 19.2 fluid ounces per day. This overall effect is not statistically significant, in part because a portion of our sample was unexpectedly consuming close to zero SSBs at baseline, thus having no room to drink less. We did, however, find a statistically significant[8] interaction between treatment assignment and baseline SSB consumption, indicating the intervention's effectiveness depends on the participant's baseline SSB consumption: those consuming high levels of SSBs at baseline benefited the most, and those consuming the lowest levels benefited the least (or not at all). For those drinking one or more SSBs at baseline, the intervention reduced SSB consumption by 16 fluid ounces (or 2 servings) per day compared to the control group, a 54% drop from a baseline average of 29.7 fluid ounces per day.

While there was no significant interaction effect between age and treatment status, the intervention appeared to be relatively more effective for kids compared to adults, with kids assigned to the treatment condition consuming 12.8 fluid ounces fewer of SSBs per day compared to 7.7 fluid ounces fewer per day for adults. For more details on the results, see the Appendix.

[7] $p>0.10$, 95% CI [0.5,17.9]

[8] $p<0.001$

Figure A: Plot of mean SSB consumption over time between groups

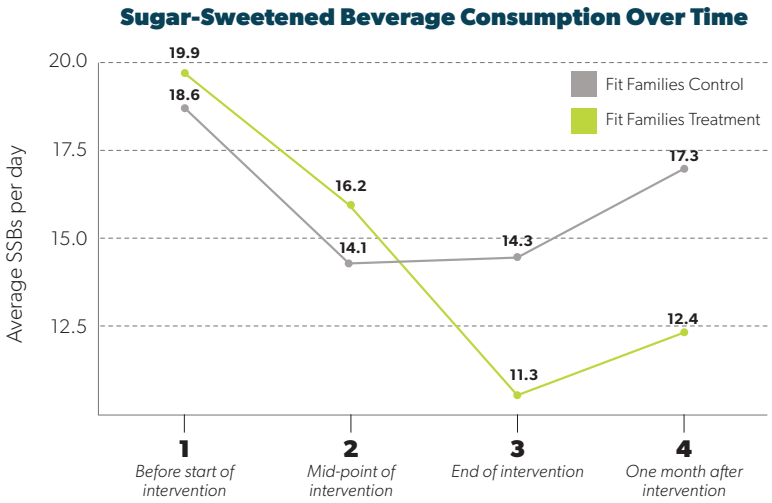
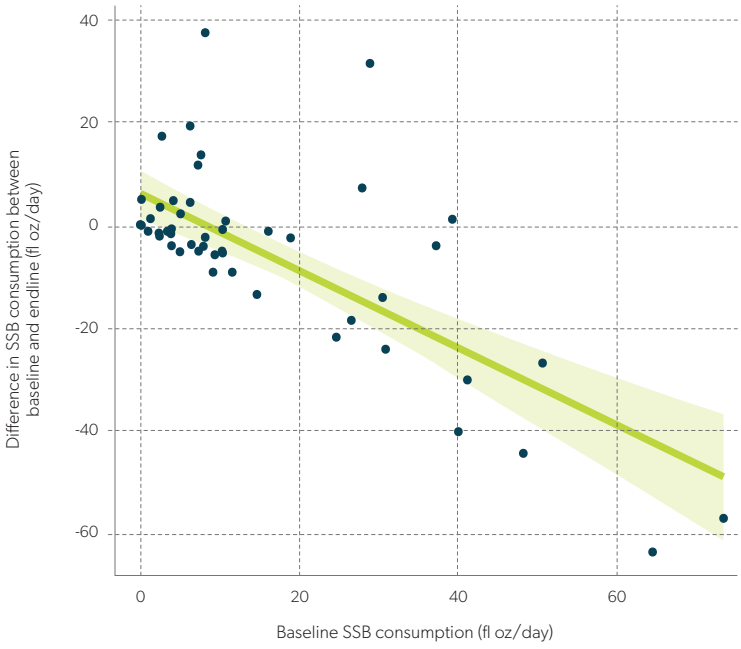


Figure B: Plot of association between treatment effect (y-axis) and baseline SSB consumption (x-axis), showing that the effectiveness of the treatment depends on a participant's baseline SSB consumption

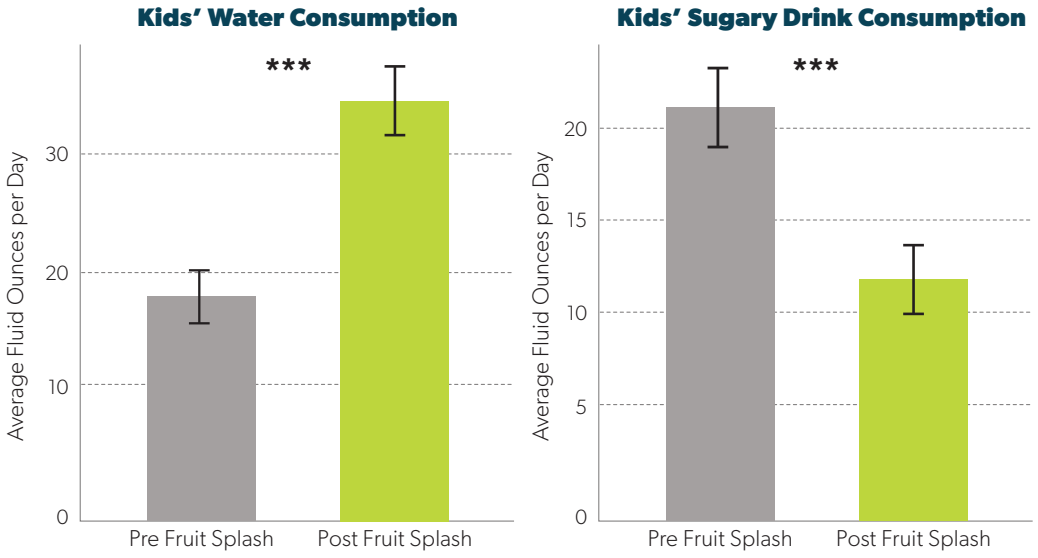


Fruit Splash

Since the *Fruit Splash* program was an unexpected opportunity that grew out of our work with OLBH, we decided to run a 10-week pilot to evaluate whether the program showed enough promise to warrant a more rigorous, larger scale evaluation. Sixty students and their families volunteered to participate, filling out questionnaires about their beverage intake before and after the pilot.

After Fruit Splash, the students reported drinking about **twice as much water (34.9 vs 17.6 fl oz per day)[9] and close to half as many ounces of SSBs (11.8 vs 21.1 fl oz per day)[10] as they had reported before.** Based on these results, kids who participated in Fruit Splash went from consuming over 60 grams of sugar per day from drinks to about 35 grams—a substantial difference of 28 grams of sugar per day, though still more than the daily recommended amount of sugar for kids (for both food and drinks) of 25 grams. The parents showed a similar pattern, reporting drinking 53% more water (34.0 vs 22.2 fl oz per day)[11] and 26% fewer SSBs (12.5 vs 16.9 fl oz per day)[12] after the pilot compared to before. Students also reported liking flavored and plain water significantly more at the end of the program, suggesting that the pilot had affected both their attitudes and behaviors toward water.

Figure C: Plots showing kids' mean water consumption (left) and SSB consumption (right) before and after Fruit Splash



**** group means significantly different, p <0.01*

[9] p<0.001

[10] p<0.001

[11] p<0.001

[12] p>0.10

Conclusion

Sugar-sweetened beverage consumption is a major contributor to several health issues in the U.S., and yet it's a difficult behavior to change because of a combination of structural and behavioral factors. In two different interventions in an Appalachian community, we demonstrated how behavioral science can help fill this gap, making it easier for people to form and maintain healthy habits around beverage consumption. One intervention used a behaviorally informed set of activities to help families deliberately strategize how to change habits, and the other used fruit-infused water as a way to get kids excited about drinking more water. Both interventions had a significant impact on the drinks people reported consuming, lending support for the value of behavioral science in efforts to improve the health of our communities.

Support for this research was provided by the Robert Wood Johnson Foundation. The views expressed here do not necessarily reflect the views of the Foundation.

Appendix

The following figures and tables provide more detail on the sample and results of the Fit Families intervention (Figures 2-7) and Fruit Splash pilot (Figures 9-15), as well as the materials used in each intervention (Figures 1 and 8). For the Fit Families intervention, we are reporting analyses based on the Beverage Intake Questionnaire data. We also collected data via text message, but due to low initial opt-in rates (41% of participants volunteered their phone number) and low response rates (49%), we do not have confidence these data provide an unbiased measurement of the intervention's impact.

Figure 1. Summary of Fit Families intervention components and materials

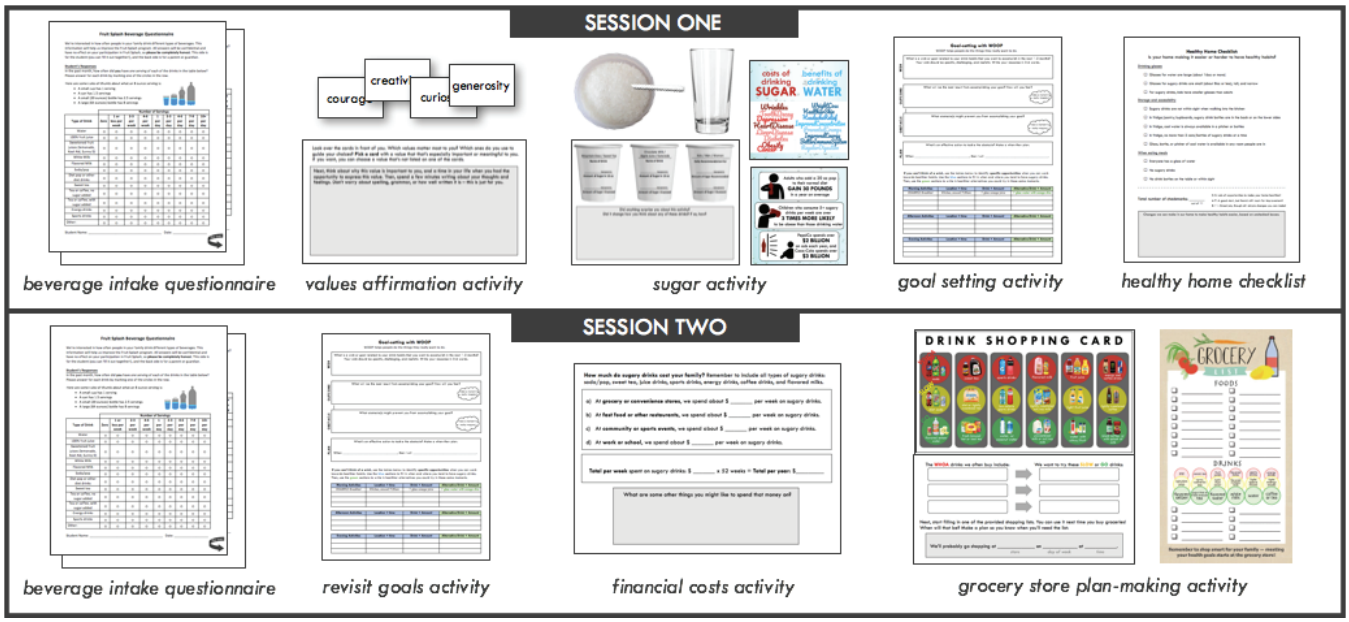


Figure 2. Demographics of Fit Families intervention sample

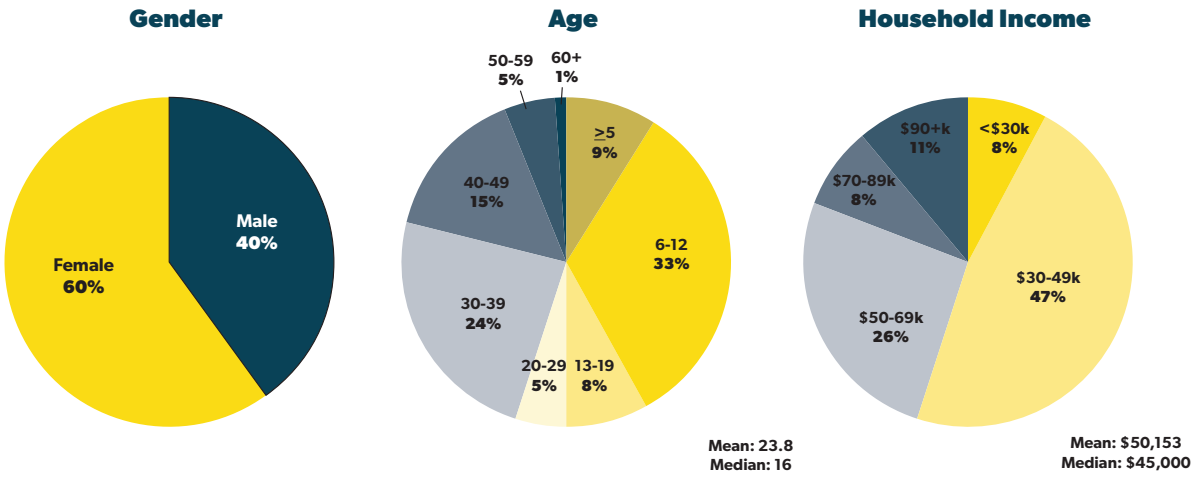


Figure 3. Sample size and attrition over time

	Number of families				Number of adults				Number of kids			
Session #	***1***	***2***	***3***	***4***	***1***	***2***	***3***	***4***	***1***	***2***	***3***	***4***
Treatment	19	19	18	12	28	30	28	19	31	32	27	20
Control	23	23	21	13	29	31	26	14	35	36	27	19
Total	**42**	**42**	**39**	**25**	**57**	**61**	**54**	**33**	**66**	**68**	**54**	**39**

Figure 4. Balance table

Measure	Treatment	Control	P-value
Baseline SSB (5210, family avg servings/day)	2.62	2.27	0.47
Baseline BMI (family avg)	28.6	29	0.84
Household Income	$45,156	$54,361	0.45
Household Size	3.86	3.64	0.46
Duration in program	10.9	10.8	0.95

Figure 5. Descriptive statistics (means and standard deviations, in fluid ounces per day) of SSB consumption over time among Fit Families participants

	Treatment			Control		
Session #	***Adults***	***Kids***	***Total***	***Adults***	***Kids***	***Total***
1	11.6 (17.0)	27.7 (55.8)	19.9 (42.3)	13.0 (11.7)	23.3 (18.2)	18.6 (16.2)
2	8.9 (10.9)	23.0 (34.9)	16.2 (26.9)	10.4 (11.2)	17.3 (16.5)	14.1 (14.7)
3	8.6 (13.1)	13.9 (15.5)	11.3 (14.5)	10.4 (25.9)	17.9 (17.4)	14.3 (22.0)
4	7.3 (12.2)	17.2 (27.8)	12.4 (21.9)	15.8 (28.6)	18.4 (19.9)	17.3 (23.6)

Figure 6. Differences in SSB consumption between baseline and endline across subgroups of interest (subgroup-treatment interactions not statistically significant)

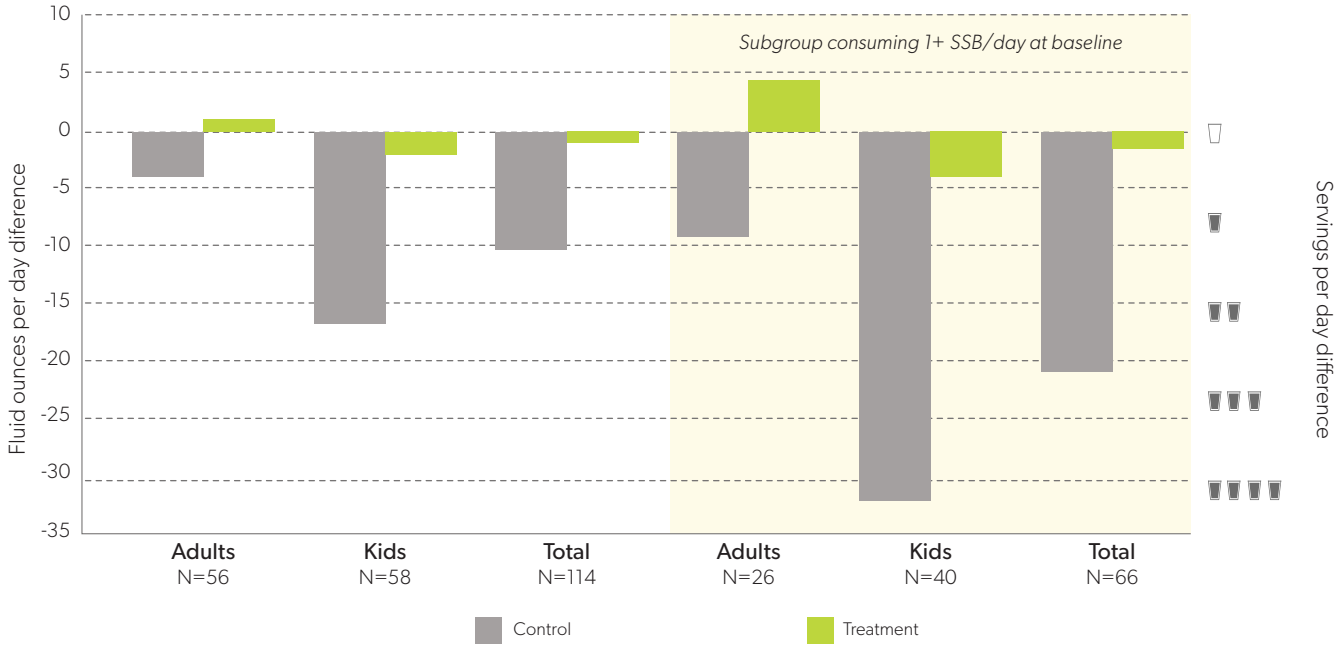


Figure 7. Regression results, for outcome of SSB consumption difference between baseline and endline (Session 3–Session 1)

Predictor Variable	Model 1		Model 2		Model 3		Model 4	
	Coeff	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*	*Coeff*	*p-val*
Treatment assignment	-8.83	0.21	3.28	0.53	-9.18	0.3	6.86	0.08
SSBs Session 1	-	-	-0.42	0.009	-	-	-0.44	0.001
Treatment x SSBs_1	-	-	-0.5	0.003	-	-	-0.48	0.001
Household size	-	-	-	-	-2.86	0.5	1	0.5
Household income	-	-	-	-	0.002	0.25	0	0.37
Duration in program	-	-	-	-	1.19	0.18	0.003	0.99
Baseline family BMI	-	-	-	-	0.59	0.45	0.03	0.91
Baseline family SSB	-	-	-	-	-7.14	0.06	-0.16	0.91
Estimated R^2	0.019		0.746		0.078		0.904	
N	106		106		78		78	

These models were run as mixed effects linear regression models, using the lme4 and lmertest packages in R. Family-level clustering was accounted for in all models by adding Family ID as a random effect. The models were specified as follows:

- Model 1: linear regression regressing the SSB consumption difference on treatment assignment, with no controls.
- Model 2: same as Model 1, plus control for baseline SSB consumption, as well as interaction between baseline SSB consumption and treatment assignment.
- Model 3: same as Model 1, plus stratification variables added as controls (household size, household income, duration in program, baseline BMI family avg, baseline SSBs family avg).
- Model 4: same as Model 3, plus control for baseline SSB consumption, as well as interaction between baseline SSB consumption and treatment assignment.

Note: R^2 estimated based on results of models specified in the same way without controlling for family-level clustering, because R^2 not provided by lme4 package used to run mixed effects models.

Figure 8. Summary of Fruit Splash components and materials

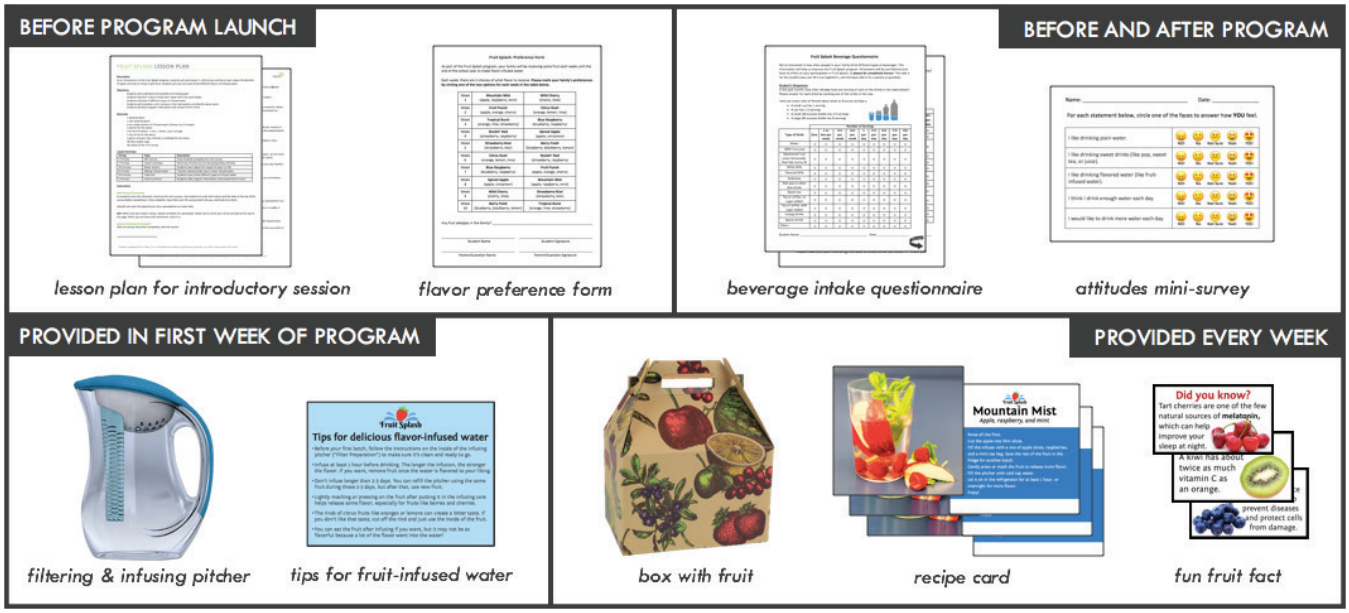


Figure 9. Descriptive statistics (means and standard deviations, in fluid ounces per day) of water and SSB consumption among participants in the Fruit Splash pilot, with annotations for significantly different means

	Water	SSBs	N
Kids pre	17.6 (18.9)	21.1 (15.7)	61
	***	***	
Kids post	34.9 (20.4)	11.8 (12.8)	52
Parents pre	22.2 (21.0)	16.9 (17.1)	53
	***		
Parents post	34.0 (16.7)	12.5 (15.6)	43
Total pre	19.8 (19.9)	19.2 (16.4)	114
	***	**	
Total post	34.5 (18.8)	12.1 (14.1)	95

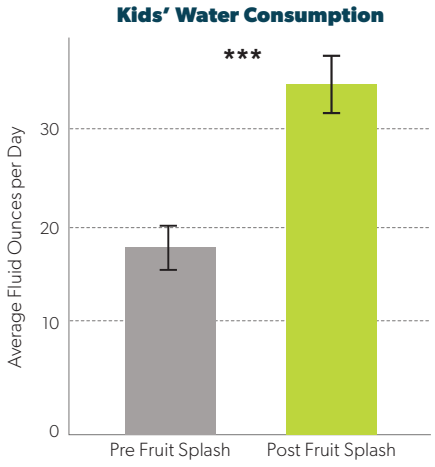
* p<0.10, ** p<0.05, *** p<0.01

Figure 10. Descriptive statistics (means and standard deviations, on 1-5 scale) for responses to Fruit Splash mini-survey, with annotations for significantly different means

	Like plain water	Like flavored water	Like sugary drinks	Think I drink enough water	Want to drink more water	Like drinking water more than before	Enjoyed the program	N
Kids pre	3.6 (1.1)	3.1 (1.2)	3.6 (1.0)	3.3 (1.0)	3.8 (1.0)	-	-	35
	***	***		***				
Kids post	4.1 (0.8)	3.8 (1.1)	3.3 (1.3)	4.0 (0.9)	4.1 (0.9)	4.7 (0.5)	4.7 (0.5)	45

* p<0.10, ** p<0.05, *** p<0.01

Figure 11. Summary of Fruit Splash's impact on kids' water consumption

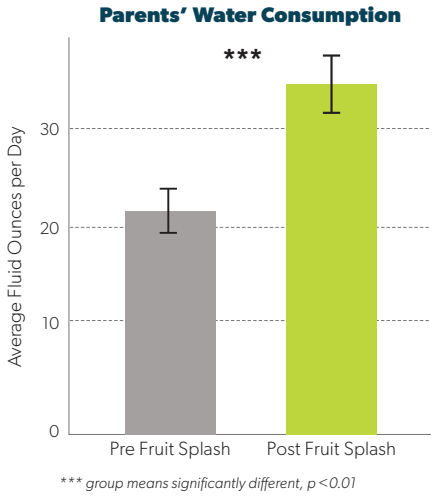


*** group means significantly different, p <0.01

Mean Pre-FS	17.6 fl oz/day
Mean Post-FS	34.9 fl oz/day
Percent change	98% increase
t-value	4.72
p-value	<0.001

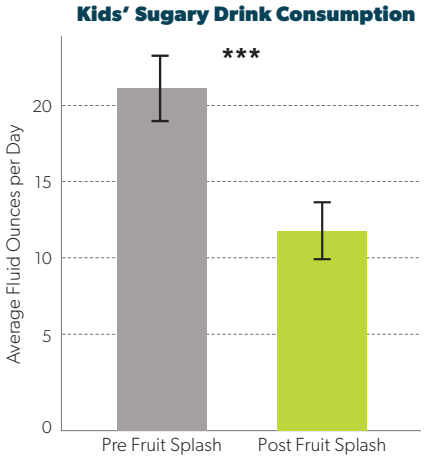
Note: average effect of interventions to increase water consumption among kids is increase of 2.6 fl oz/day (Vargas-Garcia et al. 2017)

Figure 12. Summary of Fruit Splash's impact on parents' water consumption



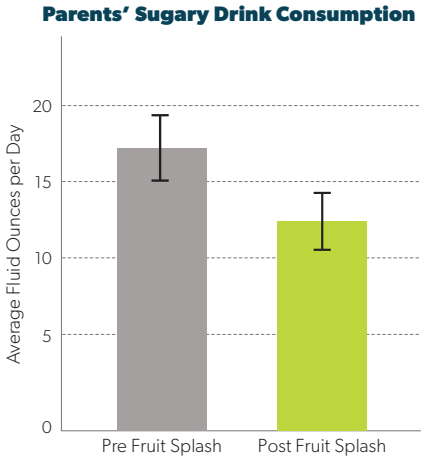
Mean Pre-FS	22.2 fl oz/day
Mean Post-FS	34.0 fl oz/day
Percent change	53% increase
t-value	4.25
p-value	<0.001

Figure 13. Summary of Fruit Splash's impact on kids' SSB consumption



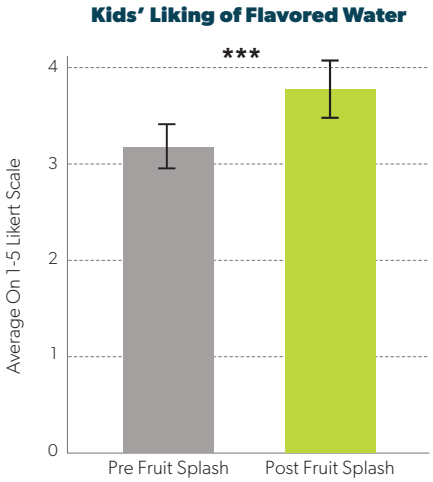
Mean Pre-FS	21.1 fl oz/day
Mean Post-FS	11.8 fl oz/day
Percent change	44% decrease
t-value	-2.98
p-value	0.005

Figure 14. Summary of Fruit Splash's impact on parents' SSB consumption



Mean Pre-FS	16.9 fl oz/day
Mean Post-FS	12.5 fl oz/day
Percent change	26% decrease
t-value	-0.87
p-value	0.39

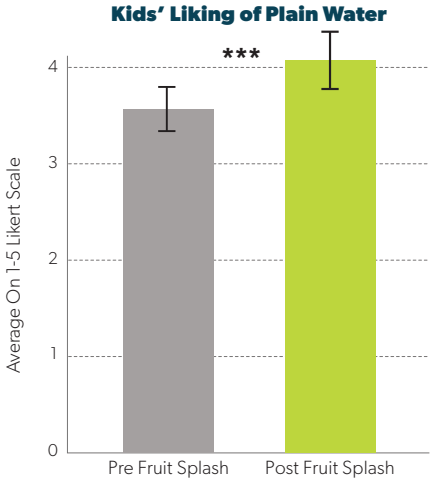
Figure 15. Summary of Fruit Splash's impact on kids' liking of flavored water



Mean Pre-FS	3.14 (out of 5)
Mean Post-FS	3.84 (out of 5)
Percent change	22% increase
t-value	4.56
p-value	<0.001

Percentage of kids who reported liking flavored water (rating it a 4 or 5) increased from 52% before to 76% after Fruit Splash

Figure 16. Summary of Fruit Splash's impact on kids' liking of plain water



Mean Pre-FS	3.60
Mean Post-FS	4.09
Percent change	14% increase
t-value	2.93
p-value	0.007

Percentage of kids who reported liking plain water (rating it a 4 or 5) increased from 71% before to 91% after Fruit Splash