

An Investigation into the Effects of Text-Message Intervention on Teenagers' Added Sugar Intake

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The average teenager consumes 75 grams of added sugar daily — three times the American Heart Association recommendation of 25 grams. Reducing sugar intake from a young age could help prevent health conditions such as type 2 diabetes, cardiovascular disease, obesity, and cancer, which research has linked to excessive sugar intake. This study explored whether text message intervention over a five-day period could influence teenagers to reduce their added sugar intake. All participants initially read articles on the negatives of added sugar before beginning the text intervention period, during which half the participants received texts while the other half did not. Surveys were used to record information on pre/post-research knowledge/consumption levels, day-by-day sugar intake changes, and intervention effectiveness. All participants reported increased knowledge, awareness, and/or desire to reduce their added sugar intake due to the articles or texts. The text messages impacted 60% of the text intervention group, while the articles' effect was very pronounced across both groups. The findings offer insight into teenagers' motivations regarding added sugar reduction and identify factors to consider in developing future interventions targeting teenagers. For instance, sugar intake sometimes decreases due to less overall food consumption. Interventions must take measures to counter the added sugar reduction barriers identified in the qualitative data collected in this study. In addition, the significant effect of the surveys and initial articles across both article-only and article-text groups should also be considered when designing methods for future programs. Keywords: added sugar, sugar-sweetened beverages, sugar reduction, teenagers, text messages, sugar intervention.

Introduction

Background and Context

Added sugar has been shown to increase fasting insulin levels and lead to insulin resistance, prediabetes, and type 2 diabetes (T2D) over time¹. According to the Centers for Disease Control and Prevention, diabetes is the most expensive chronic condition in the United States. \$1 out of every \$4 spent in healthcare is spent on diabetes, and in 2022 the total amount spent on people with diabetes in the U.S. was approximately \$412.9 billion². Of the approximately 38 million people with diabetes, 90-95% percent have T2D³.

High consumption of added sugars leads to obesity^{2, 4, 5}, which is also a factor for cardiovascular disease⁶. Added sugars have been shown by multiple studies to increase the risk of cardiovascular disease mortality^{7, 8}. In a 2011 American Heart Association (AHA) study, researchers found that added sugar consumption can lead to a rise in low-density lipoprotein (also known as bad cholesterol)⁹, which causes atherosclerosis, or plaque buildup in arteries over time¹⁰, and could eventually trigger a heart attack. In the U.S., one person dies every 33 seconds from cardiovascular disease¹¹.

According to the AHA, the recommended maximum amount of added sugar that should be consumed daily is 25 grams for women and 36 grams for men^{12, 13}. However, the aver-

age teenager (11-18 years old) consumes 75 grams of added sugar per day¹⁴. Due to the plethora of health risks that result from too much added sugar, researchers have conducted different interventions to lower this consumption. Environmental intervention methods such as traffic light labeling (the use of red/yellow/green labels to indicate the healthiness of an item), price increases, supermarket promotions, and at-home availability of lower-calorie options were found to be moderately effective in decreasing sugar-sweetened beverage (SSB) intake¹⁵. In an online fact intervention study, Chen et al. taught Taiwanese mothers to effectively interpret nutrition labels, enabling them to make informed decisions when purchasing food for their children¹⁶. Bradley et al. conducted a successful health-marketing campaign for children 5-11 years old and their parents, showing that a majority of participants were able to consume fewer SSBs as a result¹⁷. In addition, Wang et al. used a community-setting educational program titled H2GO! for helping youth and families to decrease SSB consumption and promote water intake¹⁸. Furthermore, Hoppu et al. conducted an in-school intervention, providing nutrition education and improving the health quality of foods available at a secondary school¹⁹. This resulted in increased consumption of rye bread over sweet snacks, and a fall in sucrose intake among students.

Review of Text Message Intervention

Texts are a popular option for reaching a wide young audience given the prevalence of mobile devices among teenagers and other age groups. As of October 2023, 95% of U.S. teens (aged 13-17) own a smartphone²⁰, and teens average 8.5 hours of overall daily screen time, so they are likely to see the texts they receive²¹. Text messages are easier to read and digest than long articles, and thus more likely to be read²². In addition, a standard text message costs about \$0.01 to send in the U.S., making this method relatively inexpensive to employ²³. Thus, texts are a generally well-accepted way to deliver health care²⁴.

In particular, texts have been used to positively impact diabetes care management^{25, 26, 27}, and were found to be more effective in situations with increased participant engagement^{6, 28}. Two-way SMS reminders were shown to initially aid with glucose management for teenagers with type 1 diabetes who responded to text messages; these two-way reminders were shown to have higher effectiveness among participant groups who were more responsive²⁶.

One study aimed to understand diabetic teens' perspectives, factors and barriers associated with their use of digital support²⁷. The researchers hypothesized that teens with positive perceptions about text reminders would show greater engagement in the intervention and have lower HbA1c over time than those who had negative perceptions. However, they saw no significant changes in either group's measurement of HbA1c (average blood sugar over the past 2-3 months) compared with 18 months prior. Nonetheless, 71% of participants said that texts reminded them to check their blood glucose. Markowitz et al. also examined the feasibility of a text messaging program to increase self-efficacy and goal-setting for teenagers and young adults with diabetes²⁵. Although there was no significant change in self-efficacy, BMI, and glycemic index over the short 1-month initial period, the researchers found that daily text messages could be effective for small nutritional/physical activity goal changes. Text intervention is also employed in adolescent weight management/obesity prevention^{18, 29, 30}. For adolescents who were overweight or obese, there is limited evidence that text messages are an effective tool to deliver weight management interventions²⁹. Another study conducted by researchers at Wayne State used texts as well, aiming to reduce preschoolers' SSB intake to combat pediatric obesity³¹. Similarly, Danish researchers explored the use of an SMS chatbot to provide digital education and increase healthy eating behaviors in adolescents; the researchers were able to see modest improvements in weight from over half the participants³².

In a study where text-interventions were used to promote drinking water instead of SSBs, the overall reaction was positive, and the majority of participants consumed fewer sugary drinks due to the texts³³. Brock et al. targeted middle school caretakers and found text messages to be a promising intervention method

for reducing SSB intake of both caretakers and middle schoolers, as self-reported intake significantly declined during the study³⁴. Similarly, Yuhas et al. conducted a mixed methods study targeting rural caregivers and adolescents with text messages³⁵; however, that particular study also only focused on SSB intake. Another text message intervention study conducted by Baidal et al. targeted the SSB consumption of pregnant women and mothers of infants³⁶. Shapiro et al. conducted a pilot study using text messages to manage SSB intake and found it to be a potentially useful method for self-monitoring consumption³⁷.

Objective

Despite the existence of different studies on reducing sugar consumption, there is a current lack of intervention studies specifically targeting teenagers' overall added sugar intake, as most existing studies solely consider SSB consumption and/or target other age groups. As seen above, most interventions directly targeting sugar intake focused only on SSBs. A review by Ezike and Da Silva of technology-based interventions for adolescent SSB intake analyzed seven other articles; however, these only concerned SSBs as well³⁸. As a result, the researcher decided to expand the scope of this study to include all added sugars, despite the additional difficulty that this could pose when recording sugar content in unlabeled food items.

This study addressed the question of whether text-message intervention can influence teenagers to reduce general added sugar intake in their diet. The researcher aimed to educate participants about the dangers of added sugars and encourage them to limit excessive added sugar consumption. Participants were divided into two groups; both read two initial/pre-research articles, and one group received daily text messages over a five-day period. The researcher hypothesized that teens from the text-message group would cut down more on their added sugar as the messages reminded them of the health impacts of consuming excessive added sugar.

It is important to conduct a study that focuses on mechanisms to reduce teens' added sugar intake because T2D, obesity, and cardiovascular disease are increasingly affecting younger populations. Between 1990 and 2019, 56% more adolescents and young adults (ages 15-39) developed T2D³⁹. Thus, it is crucial that teenagers become conscious of their sugar intake to lower their chances of developing T2D in the future.

Results

Participants generally seemed aware that they were consuming too much added sugar, and 80% of participants from both groups indicated they had considered cutting their sugar intake, with varying levels of intensity and effectiveness (Tables 1 and 2). For example, AMIRC said she "cut out all desserts with added

sugars for a while last year,” while IJLLE said, “I have [considered reducing sugar intake], but I tell myself that after I have already consumed sugar, so it’s not really helping.” Only three out of 10 total participants (AMIRC, MARIS, and OHLLA) gave pre-research added sugar consumption estimates within the American Heart Association guidelines. Five participants consumed more than 60 grams, one reported 200 grams, and another reported a range of 167-209 grams. Two participants provided no numerical estimate but wrote that they consumed “too much” sugar. Although the pre-research self-reported sugar intake estimates are not verifiable, this demonstrated participants’ general awareness of the excessive amounts they consumed.

In addition, there was a difference in the two groups’ pre-research knowledge levels. As shown in Table 1, all participants in the article-only group acknowledged the articles’ effect on their knowledge level and/or awareness: EZLHC became “more aware of the effects of sugar” and different approaches to avoid it. MARIS wrote, “The articles helped and encouraged me to reduce my added sugar.” In comparison, two participants in the article-text group said that the articles affected them less and provided information that they already knew: IJLLE said she “already knew the drawbacks of sugar”, and UGNNA said “I already knew most of the effects but they helped me stay more alert.”

Table 2 contains an additional column displaying the text messages’ effect on the text intervention group’s sugar consumption. Three out of five participants (OHLLA, UGNNA, and AWMAJ) from the text intervention group said the messages were a good reminder to watch their sugar intake; for instance, AWMAJ wrote that “Having a reminder about sugar and the effects definitely kind of reminded me of all of the things that I read before.” Meanwhile, the messages were less effective for the other two participants. AGGIZ attributed it to his lack of overall food intake: “I don’t think receiving the messages helped me much solely because the past week I just haven’t eaten much.”

During the five-day research period, four out of five participants in the article-only group consciously attempted to reduce added sugar intake on at least one occasion. Three (EZLHC, AMIRC, MARIS) were due to the articles/texts and one (DOAZO) was due to other reasons. AMIRC, who reduced her intake twice during the survey period, wrote on Day 2, “Yes, I tried to reduce it, because I read those articles about the dangers of sugar/sugar cravings.” On Day 2, DOAZO wrote that he had “eaten a lot yesterday so [he] was taking it easier.”

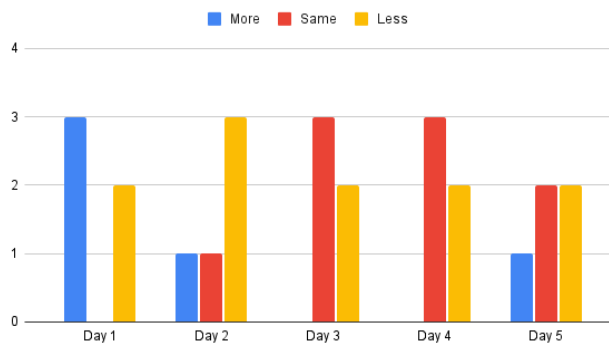
In the text intervention group, four out of five participants attempted to reduce added sugar at least once during the five-day intervention period. AWMAJ acknowledged the effects of the text messages/articles on Day 2, writing that “learning about how much sugar is in daily things has opened my eyes a little bit but I didn’t restrain more or less I just tried to not up my intake”; he finally reduced on Day 5 because he “didn’t want to

Table 1: Sugar Reduction (Article-Only Group)

ID	Considered cutting sugar (pre-research survey)	Effect of articles on sugar consumption (post-research survey)
EZLHC	I have considered it and am trying to but I am not disciplined so I still consume a lot of sugar	Yes it made me more aware of the effects of sugar and different ways I could avoid it. I did try to use a couple of the methods suggested by one of the article.
AMIRC	Yes, I cut out all desserts with added sugars for a while last year.	I was shocked by the fact that added sugar is not only in dessert foods, but also bread. I did want to limit my added sugar intake by cutting out desserts, that way I could control it as much as possible without having to cut out more everyday foods like bread, ketchup, etc.
ESVAN	Yes I have before but I am currently not trying to do that.	The articles definitely opened my eyes to some more of the negative effects of eating too much added sugar.
DOAZO	yes; yes	I think more about everything that I consume. I did want to lower my intake, but I was already eating very little so I stayed roughly the same.
MARIS	Yes, I have. I’m currently trying to reduce my sugar intake for my own health.	The articles helped and encouraged me to reduce my added sugar.

ID	Considered cutting sugar (pre-research survey)	Effect of articles on sugar consumption (post-research survey)	Effect of messages on sugar consumption (post-research survey, intervention group only)
OHLLA	I have considered trying to eat more healthy snacks such as fruit and whole grain foods instead of highly processed things, but I am not currently trying to do that specifically. Right now, I am just trying to be healthy in general and have sugar in moderation.	Reading the articles helped me by providing tips on how to limit my added sugar consumption. I wanted to try the tips after I read about them.	Receiving the text messages was a great reminder when I was forgetting about trying to limit added sugar. I wanted to try to think more about their information, but I ended up being busy most days and just eating what I usually eat. I was definitely more aware, though.
UGNNA	yes	not really because I already knew most of the effects but they reminded me stay more alert.	they didn't really make me want to change anything but they reminded me to stay conscious!
IJLLE	I have, but I tell myself that after I have already consumed sugar, so it's not really helping.	They didn't really effect me, because I already knew the drawbacks of sugar.	They didn't really help. I felt more guilty but the alternative methods just felt like too much work. It's like making a reminder for myself and knowing I wrote one but then I forget about it when I need it.
AWMAJ	No	I learned a lot of tricks to lower my sugar intake and I also learned a lot on why you should.	Having a reminder about sugar and the effects definitely kind of reminded me of all of the things that I read before
AGGIZ	Not really, I haven't been in a health-focused arc in a while The closest thing to that for me is straight up not eating for periods of time	Reading the articles taught me a decent amount of more concrete facts about the effects of too much sugar instead of just basic "sugar bad for heart," etc	I don't think receiving the messages helped me much solely because the past week I just haven't eaten much

Figure 1: Article Only



feel bad today.”

Both groups saw 80% of participants make sugar reduction attempts. This is generally attributed to the overall increase in knowledge, and not necessarily just the text messages, as well as external factors. For example, AMIRC directly cited the articles as a motivation for reduction, while OHLLA cited both the articles and texts.

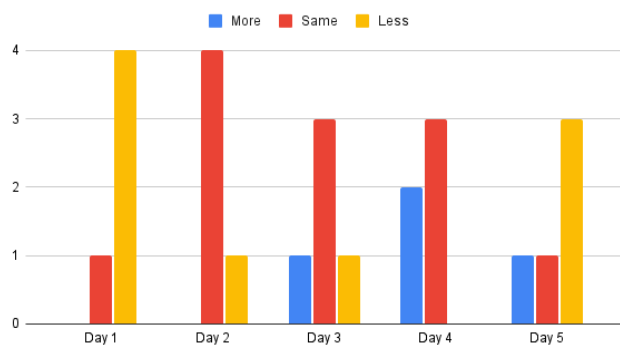
Table 3: Daily Surveys Changes in Added Sugar Intake

	1	2	3	4	5
Articles only					
EZLHC	L-RO	M	L-CR/RO	S	L-CR
AMIRC	M	L-CR	L-RO	L-CR	L-RO
ESVAN	L-RO	S	S	S	S
DOAZO	M	L-RO	S	S	S
MARIS	M	L-RO	S-CR	L-CR	M
Articles + text					
OHLLA	S	S	S	S	L-CR
UGNNA	L-CR	L-RO	S	S	L-RO
IJLLE	L-CR/RO	S-CR	L-CR/RO	M-CR	M-CR
AWMAJ	L-RO	S-CR	M	S	L-CR
AGGIZ	L-RO	S	S	M	S
Coding Key:					
L: less					
M: more					
S: same					
RO: reduced due to reasons other than articles/texts					
CR: consciously made attempts to reduce due to articles/texts					

The day-by-day frequencies of more/less/same sugar intake compared to the previous day were compiled into a bar chart for each group (Figures 1 and 2). Only counting the number of occurrences of ‘less’ per group across the five-day period, the article-only group has 11 instances, while the article-text group has 9. This gives the impression that the article-only group experienced a greater impact from this study. However, this is because the more/less/same response reflects any events/situations that participants experienced each day, not only a participant’s attempt or lack thereof to reduce their added sugar intake.

In Table 3, attempts at reduction due to the articles/text inter-

Figure 2: Article + Text



vention were coded as ‘CR’. This excludes other reasons (RO) for conscious reduction that did not involve articles/texts. In the article-only group, out of 11 instances of L (less), only five were related to the articles (L-CR) and seven were due to other situations (L-RO) like simply eating less due to being busy (ESVAN, Day 1). One instance (EZLHC, Day 3) was due to both articles and external factors, as she desired to reduce her intake and had fewer opportunities to consume sugar that day.

However, not every attempt succeeded in reducing sugar intake. For example, IJLLE initially tried to consume less sugar on Day 4, but ended up getting an iced tea from the vending machine because she was tired; this was coded M-CR. Nevertheless, while there were nine total instances of CR among the text group, only five of them were L-CR, and the article-text group had the same number of L-CR occurrences.

One must also account for other intervening factors to accurately observe the effects of this study and analyze the impact of the articles/texts on participants’ day-by-day sugar intake. Although all participants acknowledged in the post-research survey that they learned more and/or became more aware of their sugar intake, not everyone made daily reductions. The following section provides an in-depth discussion of different situations that may affect participants’ willingness and ability to reduce added sugar.

Sugar Intake as a Result of Total Food Quantity Consumed

Total sugar consumption is affected not only by the types of foods participants eat but also by the quantity of food consumed. Therefore, the day-to-day trends of more/less/same added sugar intake can be skewed by the overall amount of food consumed.

Being busy was an often-cited reason for consuming less food or not changing eating patterns. Two participants (OHLLA and ESVAN) gave this reason for keeping their sugar intake the same; for example, OHLLA wrote on Day 1, “I did think about it and consider the tips from the article, but I was also busy today and just ended up eating what I normally do.” Four people (AMIRC, ESVAN, MARIS, and UGNNA) ate less overall. ESVAN wrote

on Day 1 that she “had a very busy day and did not bring any food.” AMIRC wrote on Day 3 that she “was just busy and didn’t have any time for dessert.” UGNNA wrote on Day 5 that she “had a lot of homework and no time when [she] got home.”

Among the participants, two were already eating very little in general. AGGIZ (article-text group) indicated he did not attempt to reduce added sugar intake, stating that “it’s hard to reduce sugar intake from basically not eating much at all” (Day 4). In addition, DOAZO stated in the post-research survey that he “was already eating very little so [he] stayed roughly the same.”

Simply consuming less food for other reasons affected two people (EZLHC and UGNNA). On Day 2, UGNNA consumed less sugar because she did not eat due to an event, while EZLHC unintentionally happened to eat fewer snacks on Day 1.

Special Occasions

High Energy Events

At times, sugar can provide a quick burst of energy. AWMAJ chose not to reduce his sugar intake on Day 3, stating “I had two flights today and needed some energy and ended up having some ice cream.” In this case, the participant temporarily prioritized his need for energy during travel over his long-term healthy eating goals.

For athletes, reducing added sugar may be initially more difficult due to a need for enough energy to play their sport(s). UGNNA (article-text) was an athlete and did not reduce her sugar intake on Day 4 because she had practice; additionally, she made no change to her intake on Day 3 due to an event.

Eating Out

Another trend noticed among responses was that participants made exceptions to their usual added sugar restrictions for special occasions where it is customary to consume sweeter foods. For instance, EZLHC did not reduce her sugar intake on Day 2 “because I went to a party and ate a lot of dessert.” Similarly, on Day 1, AMIRC had dessert while eating at a restaurant. On Day 2, IJLLE “went to a family friend’s house for Chinese New Year, and there was a really tasty mochi roll thing that was really sweet.” This affected five participants in total (EZLHC, AMIRC, DOAZO, UGNNA, and IJLLE) at least once over the five days.

However, if one believes they are already healthy, they may not further reduce sugar intake. For example, ESVAN (article-only) stated “I did not try to reduce my added sugar intake because it was a normal day for me where all of my meals were home-cooked.” Additionally, she wrote that she “[didn’t] usually consume too much added sugar during the school days” in the post-research survey.

Available Options

Finally, added sugar intake is influenced by which foods are readily available. For instance, it is easier to choose fruits over dessert when both are equally simple to acquire; however, at a vending machine that mainly offers SSBs and candy, more

time and effort is required to purchase a healthier snack from a different location. For example, UGNNA consumed less sugar on Day 1 “because I’m home so I have choices.” It is also easier to reduce added sugar intake successfully when sweeter options are absent. On Day 3, IJLLE reduced her intake because she “didn’t bring any candy to school (where [she] spent most of [the] day).”

Discussion

Based on only the number of conscious attempts/intents to reduce sugar as a result of the articles and/or texts, the article-text group seemed to experience a greater impact. This may be because the messages motivated participants to try to reduce their intake on a daily basis, whereas the article-only group retained the information and awareness from the initial articles but did not receive the reminders. Nevertheless, while the article-text group had nine total attempts (CR), only five of them led to successful reduction (L-CR); this was the same number as the occurrences in the article-only group.

Although it was expected that the text intervention group would have a higher rate of sugar reduction, the articles seemed to leave an important impression on participants as well. The article-text group had five successful attempts at reducing added sugar intake (L-CR); the article-only group had the same number as the occurrences.

This may be due to the short five-day research period: participants who read the articles still had the information fresh in their minds, as much more information was contained in the articles compared to the two-to-three-line text messages, which mainly served as reminders. Additionally, participants from both groups wrote in their post-research surveys that they had learned something from the articles. However, three out of five participants from the text message group also noted that the texts reminded them to reduce their added sugar intake. Differences between the groups may have been more pronounced if the research was conducted over an extended period, as the impact of the articles may have waned over time for the article-only group.

The results of this study are consistent with the results from two prior studies in which text-message intervention also yielded a lack of conclusive results. In the text-intervention study by Chen et al., the researchers found no significant difference in HbA1c/average blood sugar measurements between participants who perceived the intervention messages more positively compared to those with more negative attitudes²⁷. However, the majority of participants in that study stated that the texts were helpful in reminding them to check their blood glucose. Baidal et al. saw an overall decrease in consumption for not only the intervention groups, but also the attention control group, which received messaging about infant safety irrelevant to health/sugar³⁶. This may be attributable to the fact that participants were recruited from a supplemental nutrition program and an ambulatory care

network. As a result, their knowledge level and motivation to reduce SSB intake was likely greater to begin with, suggesting that greater initial knowledge has an effect on subsequent sugar reduction across all groups. This was seen in the closeness between the article/article-text groups’ reduction in this current study.

This current study also demonstrates that reading about the adverse effects of sugar on health — whether daily (texts) or only at the start of the research period (articles) left an impression. Most teenagers were influenced to reduce or become more conscious of their sugar intake after learning more about the negative effects from the articles/texts — over the five-day research period, 90% of participants consciously made at least one attempt to cut their added sugar intake. All 10 participants said in the post-research survey that they learned something about added sugar and its detrimental effects and/or became more aware of their intake.

Other takeaways were that sugar intake/reduction choices often depend upon the situation, environment, and immediate availability. Despite changes in knowledge of added sugar effects and overall increases in awareness, participants do not necessarily reduce their sugar intake every day due to special occasions, personal circumstances, and lack of available options. In environments such as parties, where less healthy eating is allowed and even expected, usually-conscious participants may make exceptions. When participants are busy with limited time to eat, they may choose convenience over healthier but more time-consuming options. Even when time is not a constraint, some may select a sweeter option because it exists in the immediate vicinity. The factors identified in this study are supported by findings from a health marketing campaign on sugar intake by Bradley et al., where parents reported that busy lifestyles and time constraints for food preparation, and easy availability of sweet foods, were barriers to dietary change for their children¹⁷. Any exposure to the information about the adverse effects of added sugar can raise teenagers’ awareness and influence them to reduce their added sugar intake. Because teenagers consume far too much added sugar in their youth, they are at higher risk of diseases as they grow older.

Limitations and Future Research

The researcher acknowledges that this study has several limitations, which will be addressed in future research redesigns. The small sample size (n=10) and use of convenience sampling meant that the research may not represent the greater population’s motivations, health knowledge, or socioeconomic status; thus, the results are not necessarily generalizable to all teenagers. In addition, participants self-estimated their pre-research added sugar consumption, and the numerical accuracy of these estimations was not verified. The daily surveys, while only intended to track changes in participants’ sugar consump-

tion, unexpectedly raised participants' awareness of their daily sugar intake. EHLZC and AMIRC (article-only group) said the surveys helped remind them to watch their added sugar intake. To minimize this, future studies could survey for long-answer responses once every two days (or an even greater interval), while increasing regular reliance on food diaries, blood glucose measurements, or nutritional apps to track any changes in sugar intake. These measures would be more accurate and objective, allowing the researcher to better determine the effectiveness of the text messages alone.

In addition, the research could not capture any potential long-term effects of the intervention due to the short five-day period. Subsequent studies should be conducted over a longer time period (at least two months) with a larger participant pool to determine whether text message intervention would be more effective than the articles alone as more time passes.

Conclusion

The study found no significant difference between sugar reduction results in the article-only and intervention groups, despite an overall increase in awareness of sugar's negative effects. External intervening factors played a role in preventing participants from limiting sugar intake; busyness, special occasions/celebrations, and availability were identified as frequently cited reasons for sugar intake increasing or staying the same. Future research designs should minimize the effect of these situations to determine if there are long-term benefits to text-message intervention. A follow-up should also be conducted to create effective methods of combating these factors, to improve the ease with which one limits added sugar intake.

Overconsumption of added sugar is linked to type 2 diabetes, obesity, cardiovascular disease, cancer, and even worsened mental health. Because teenagers consume over 119 grams of sugar each day, they are at higher risk for these conditions later in life. Cutting the amount of added sugar Americans consume daily can have profound and far-reaching effects. Reducing the rate of diabetes by even 1% would save the United States over \$3 billion and lessen for many the pain and financial strain of treating diabetes and other conditions associated with added sugar. Thus, this type of research and intervention is beneficial and necessary. Not only does this help teenagers currently, but it could also have far-reaching impacts on the future of society's health.

Methods

Given the shortage of intervention-based research on teenagers' overall added sugar intake, the researcher conducted an exploratory qualitative study using surveys to assess the impact of articles and text messages. Then, the researcher used qualitative data analysis procedures to induce themes from survey

data^{40, 41}.

Sample Selection/Participants

The researcher first identified teenagers as the group of concern for the study. This decision was made based on the knowledge that the average teen consumes almost three times the American Heart Association's recommended amount of added sugar, as well as an observed lack of studies on added sugar intervention targeting teenagers.

Due to restrictions on public recruitment for projects at the researcher's high school, convenience sampling was the only possible method to use for recruiting participants. Inclusion criteria were (1) ages 11-18, (2) possession/ownership of a phone with text message receiving capabilities, (3) fluency in English, and (4) ability to attain parental permission and return a completed Parental Consent and Minor Assent form.

Although 20 students agreed to participate, only 10 teenagers returned timely parental consent and ultimately took part in the study. Of those 10, three participants (30%) were male and seven (70%) were female. All participants were within the age range of 14 to 17 years old. Two were in 9th grade, seven were in 10th grade, and one was in 11th grade.

Table 4: Participant Demographics

ID	Grade	Biological Sex	Estimated Sugar Consumption
Non-text-message (non-intervention) group			
EZLHC	11	F	167-209 g
AMIRC	10	F	20 g
ESVAN	10	F	130 g
DOAZO	10	M	65 g
MARIS	10	F	10 g
Text-message (intervention) group			
OHLA	10	F	20 g
UGNNA	10	F	too much
IJLLE	10	F	Probably too much
AWMAJ	9	M	200 g
AGGIZ	10	M	75 - 100 g

Data Collection

Three surveys were used to collect data on all participants: the pre-research survey contained free-response questions and recorded participants' pre-existing knowledge of sugar, their self-estimated added sugar consumption, whether they previously tried to reduce their sugar intake, and other information about their consumption habits. The daily surveys, sent to participants each night, tracked day-by-day changes in participants' sugar intake for a period of five days. In the daily surveys, participants indicated whether they consumed more, less, or the same amount of sugar as the day before. To validate this

response, they explained why they chose whether or not to reduce intake, as well as any causes/specifics for their daily intake. The post-research survey collected information on how reading articles/receiving text messages affected the participants, what they learned, and changes in their perception of added sugar.

Variables and Measurements

The controlled variables are the articles, which all participants read before the five-day survey period, and the daily surveys. The independent variable was the text messages, which were only sent to one group. The dependent variable is the perceived effectiveness of the text messages. The researcher counted the number of days that participants had less sugar than the day before and interpreted explanations to determine if the decreased consumption could be attributed to the articles/text messages. The researcher also used feedback from the post-research survey to determine whether participants deemed text messages to be effective.

Text message design followed results from three studies. In a study on message delivery for adolescents, Hingle et al. found that teens placed importance in the message tone, preferring messages that were written in active voice, included personal pronouns, and did not contain authoritarian phrases like “never”, “always”, or “you need to”⁴¹. One finding by Yuhas et al., who researched SSB text intervention for rural caretakers was to include more specific/actionable suggestions³⁵; this was also supported by Hingle et al.⁴¹. In addition, participant recommendations from the Wayne State study suggested real-time reminders (around mealtimes)³¹. This was taken into account when developing messages for this study. Each text message was designed with two parts: “Impact of too much added sugar” and “What you can do”. The first section contained one or more facts related to a specific health effect of excessive added sugar, while the second section contained actionable suggestions/substitutions that the participant could try. All website sources were cited within the text, and original hyperlinks provided so that participants could click and learn more if they wished.

Procedure

Before starting the five-day text intervention period, all participants recorded their prior knowledge and sugar consumption habits in a pre-research Google Form. Then, they read two articles: “13 Ways to Fight Sugar Cravings” and “The Sweet Danger of Sugar”^{42, 43}.

The researcher randomly split participants into two groups for the five-day intervention period. Around lunchtime, one group received daily text messages containing one health impact of excessive added sugar and methods to reduce intake. The other group did not receive these intervention messages.

In the evenings, the researcher sent daily surveys to both groups. The surveys tracked whether participants’ sugar consumption was ‘more,’ ‘less,’ or ‘same’ as the previous day and required participants to answer the questions “Did you try to reduce your added sugar intake today? Why or why not?”

After the five-day text intervention period, all participants completed a post-research survey, which asked about changes in their knowledge/views of added sugar and how they were affected by the texts (if applicable) and articles. All surveys were sent as Google Forms.

For a list of the text messages used or the full list of questions asked in each survey, contact the researcher.

Data Analysis

Each participant was given a specific 5-letter label (AMIRC, IJLLE, etc.), used during coding and presentation of results. Responses to daily surveys were compiled into a spreadsheet and color-coded by the researcher into categories based on reasons given for that day’s sugar consumption compared to the previous day. Responses were also analyzed on a case-by-case basis for participant-specific trends.

In addition, participants’ responses to the pre/post-research surveys were compiled into spreadsheets and tables. Based on this data, the researcher analyzed changes in pre/post-research knowledge levels and analyzed the effects of the articles/texts based on pre/post-research survey and daily survey responses.

Ethical Considerations

An Institutional Review Board approved this study. This was considered low-risk because participants were only asked to answer survey questions about sugar intake. All participants filled out informed parental consent forms. Sex, age, and grade of participants were recorded; race/ethnicity was not recorded. The researcher maintained the confidentiality of all participants’ names/contact information.

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