

H2O to Go – Staying Hydrated Safely: A Reusable Water Bottle Safety Education and Research Project

The use of reusable water bottles has increased significantly over the past two decades and research suggests a need for increased education on the proper use and care of such bottles. The University of Idaho Educators developed a project to study the use and care of reusable water bottles by middle-school-age youth. The goal of the project was to study and increase the student's knowledge of food safety practices when reusing water bottles. This was done by using pre-and post-surveys in control and intervention groups, to assess students' knowledge of correct care and use of reusable water bottles.

RESEARCH

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Drinking water is needed for life and consuming the recommended amount daily is an important health message supported by the Center for Disease Control (CDC, 2020) and the Mayo Clinic (2017). To meet this recommendation, it is common practice for persons to carry a reusable water bottle. In a school setting, students are encouraged to bring reusable water bottles. However, reusable water bottles provide optimal growth conditions for microorganisms. Water bottles may become contaminated by sharing, setting them on contaminated surfaces, opening or filling the bottle with hands that are not clean, and contact by user's mouth that may possess microorganisms. A water bottle in

a school setting, carried from classroom to classroom, is exposed to hundreds of students throughout the school day and may also be exposed to extracurricular activities. Once a water bottle is contaminated and contains potable water, the water supports microbial growth and becomes unsafe to drink (Lui & Lui, 2017).

REVIEW OF LITERATURE

According to market research, the adoption and use of reusable bottles for drinking water and other beverages have increased greatly in the United States and

other countries over the last decade (Grandview, 2021). Due to this change in consumer behavior, there have been several studies conducted looking at the potential for microbial contamination and growth in reusable drinking water bottles. Lui & Lui (2017), examined reusable bottles used by adults and children and found the bacterial content is high and can increase rapidly, 1 – 2 million counts/ml in one day. In another study Sun, S. et al. (2017) found high bacterial content in reusable water bottles, and whether individuals washed/rinsed their bottles or not significantly affected contamination level. Research by Hubbard, et al. (2019) discovered the presence of an antimicrobial-resistant, biofilm-forming bacteria in their study of reusable water bottles. The research also pointed to a need for the development and promotion of proper cleaning procedures for reusable water bottles. Reusable water bottles were tested, and bacteria counts were higher when compared to samples taken from a toilet seat (Ballweg, et al.). A Canadian study of youth water bottles revealed total coliform in 13.3% of 75 samples and fecal coliform and total heterotrophic criteria for The Canadian Drinking Water Quality Guidelines (CWQG) criterion were exceeded in 8.9% (of 68 samples) and 64.4% (of 76 samples) respectively (Oliphant et al).

The objective of this literature review was to examine current research, findings, and recommendations on the use of reusable water bottles. It is evident from the research reviewed there have been significant findings of bacterial contamination and rapid bacterial growth, especially in bottles that are not cleaned and sanitized. The research has also demonstrated a need for the promotion of proper cleaning and sanitizing procedures for reusable water bottles.

PURPOSE

Based on a review of the literature, Family Consumer Science Educators found it relevant to develop and study the implementation of a reusable water bottle cleaning protocol to educate middle school children in intervention sites to compare with control sites where education was done retrospectively. The desired short-term impact was to increase the use of properly cleaned reusable water bottles, and to teach about water consumption through the educational materials developed. The youth and teachers that participated increased their knowledge of food safety practices when reusing water bottles by demonstrating correct washing techniques and handling.

An anticipated long-term impact was to influence water bottle use school policies by sharing study results with teachers and school administrators. By conducting water bottle food safety research in schools, faculty developed collaborative research to disseminate to schools, health departments and write for peer-reviewed publications. In this project faculty collected, evaluated, and transferred new knowledge to community members. The faculty have continued to transfer this information through the development of an Extension Bulletin, Infographic, and other publications.

METHODS

A convenience sample was used of sixth through eighth-grade classrooms in four different towns/cities in Idaho. There were 28 male and 33 female students, with an average age of 11.86 years. Surveys were used to assess students' understanding of proper water bottle use. Parents/guardians and principals were given an information sheet about the study. Consent forms were signed by parents/guardians for their children to participate, and youth signed assent forms. The study was approved by The University of Idaho Institutional Review Board, IRB #18-210. The researchers provided students new reusable water bottles. Teachers were asked to reinforce the retention of the water bottles by students. The water bottle study occurred in April 2019, and October-November 2019.

All water bottles were collected after at least thirty days of student use to run microbiological testing. The estimated microbiological counts, on the surface of the water bottles, were compared between the control and intervention groups. Water bottle food safety practices

were taught at the intervention schools before the students used the water bottles. The students in the intervention group received an infographic with water bottle food safety practices and instruction in class. The two control groups received the infographic and instruction after they had used and returned the water bottles. All students received a new water bottle after returning the water bottle they had used for at least 30 days.

A post-survey was given to the control group and students ranked their level of understanding using a Likert scale ranging from 1-5 (1 = no knowledge to 5= a lot of knowledge). A Likert scale was also used to indicate how often students reported washing their water bottles before and after the intervention (1 = never more than a quick rinse to 5 = washing the water bottle every day). Students also reported the number of bottles of water they consumed every day with the option of 1-5 or more. A retrospective pre-post survey was given to the intervention group with the same questions as the control post-survey. A two-tailed paired t-test was used to compare the average of pre and post responses.

FINDINGS

The average post-survey ranking for each statement was higher than pre-survey ranking. This indicates a significant increase in knowledge on how to correctly clean and sanitize a reusable water bottle and avoid spreading germs with a reusable water bottle after the intervention. A two-sample paired t-test was used to compare the average of the intervention and the control post-survey responses (See Table 1).

The average intervention post-survey ranking for each statement was higher than the control post-survey ranking. This indicates that after the study students in the intervention group reported significantly greater knowledge in how to correctly clean and sanitize a reusable water bottle and avoid spreading germs with a reusable water bottle than students in the control group. Students in the intervention reported washing their water bottles significantly ($p < 0.05$) more often after the study than students in the control group. Students in the intervention group also indicated drinking more water after the study than students in the control group, but it was not significantly different.

DISCUSSION

Intervention youth reported increased knowledge of correct washing techniques, sanitizing, and handling of bottles. The survey findings show the average intervention post-survey ranking for each statement was higher than both intervention pre-survey and the control post-survey ranking. This may suggest that receiving education before using a reusable bottle resulted in youth being more likely to clean and sanitize a reusable water bottle and avoid spreading germs. The survey results also suggest that using classroom instruction and educational tools, like an infographic, were successful methods to teach proper cleaning and use of reusable drinking water bottles. Further research and studies are needed to discover the effects of this type of education on knowledge gain and behavior change in youth's cleaning and care of reusable drinking water bottles.



You may click here to access the references, tables, and graphs for this article.



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WATER BOTTLE CLEANING TIPS



Reusable water bottles are a great way to stay hydrated on-the-go. Avoid contamination by thoroughly cleaning and sanitizing your water bottles on a regular basis.

Follow these tips to keep your bottle clean!

HAND WASH EVERYDAY



Wash with soapy water and scrub inside of bottle and lid with clean brush everyday.

SANITIZE ONCE A WEEK



Soak water bottle parts in the sanitizing solution for two minutes, then rinse.

Sanitizing Solution:

- 1/2 teaspoon of 8.25% bleach
- 4 cups of water

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Table 1.*Differences in Mean Scores for Student Water Bottle Skills and Behaviors*

Skill/Behavior	Intervention Group			Post Survey		
	Pre-Survey	Post-Survey	P	Control Group	Intervention Group	P
I can teach someone how to correctly clean a reusable water bottle	2.83	4.08	0.00003	3.76	4.2	0.08076
I can explain to someone how to avoid spreading germs while using a reusable water bottle	3.13	4.30	0.00089	3.95	4.44	0.01992
I can demonstrate the practice of correctly cleaning a reusable water bottle.	2.83	4.17	0.00002	3.86	4.32	0.10603
I can list the ingredients to mix a sanitizing solution for my reusable water bottle.	1.74	3.23	0.01450	2.42	3.32	0.01293

Note. Two-tailed paired t-test compared mean middle school student water bottle skills and behaviors of the intervention (n=26) retrospective pre/post survey responses. A two-sample t-test (two-tails, unequal variances) compared the post-intervention (n=26) and control (n=39) mean responses. A Likert scale ranging from 1-5 ranked knowledge of topic addressed in the statement (1 = no knowledge to 5= a lot of knowledge).