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RESEARCH ARTICLE

Characterization of Website use Associated with the WhyDairy? School-based Nutrition Education Intervention

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Abstract:

Background:

Despite the known health benefits of dairy products, their daily consumption continues to decline, particularly in pre-adolescents and adolescents. It is therefore of interest to develop effective strategies to increase dairy intake and education in this population.

Objective:

The objective of this study was to evaluate the use of the web-based component of a school-based dairy nutrition intervention called WhyDairy?. Through analysis of popular website content, traversal paths and timing of website access, we aimed to investigate how students used this website and to identify areas of improvement for future research.

Method:

Grade 7 students (n=115) in 10 Southwestern Ontario schools received the WhyDairy? intervention, which included three classroom visits and a website that could be voluntarily accessed. Website use data was collected using Google Analytics. The intervention delivered to control schools did not have a website component and is therefore not described in this report.

Results:

The website was voluntarily accessed by 33.6% of students participating in the intervention. Almost 70% of website visits occurred within two days following a classroom visit. Popular content included games and interactive pages. While there was moderate engagement with the website during the intervention period, there was poor engagement during the follow-up period.

Conclusion:

The utilization of the WhyDairy? website represents students' interest in independently furthering their knowledge and student engagement with a web-based component of a dairy nutrition intervention. Future work should investigate students' motivations for accessing the website and how to encourage prolonged website use.

Keywords: Adolescent, Pre-adolescent, Milk, Schools, Health education, Vitamins, Minerals.

1. INTRODUCTION

Dairy products are a convenient source of vitamins, minerals, and protein necessary in the diets or pre-adolescents and adolescents [1, 2]. However, despite the known health benefits of dairy products, their daily consumption continues to decline in many populations, particularly in pre-adolescents and adolescents. As dairy products are foods that promote health and prevent disease later in life, their low consumption is a concern for children and adolescents who

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are developing eating habits that will carry into adulthood. Therefore, it is of interest to investigate interventions and strategies to increase the knowledge and consumption of dairy products among pre-adolescents and adolescents.

Previous research has highlighted components and characteristics of nutrition interventions, including dairy, that are likely to be effective [3 - 5]. Schools are recognized as an appropriate setting and location to implement dietary interventions as they provide a place in which consistent and reliable information is delivered to students [6]. In addition, school-based interventions may be enhanced through the use of strategies that reach beyond the classroom, such as specialized web-based programs [7, 8]. Nutrition sessions can be taught to all students in the classroom, and then students can be directed to web-based programs that they can access from home or other locations. These programs could be designed to supplement the material taught in class, using content that appeals to youth including games and other engagement strategies [9]. Web-based programs may be especially appropriate for use in interventions targeting youth, as 93% of adolescents use the internet [10]. It has also been widely reported that adolescents are more comfortable with technologies like the Internet and perceive them as more helpful than do adults [11]. Supplementing a school-based nutrition intervention with a web-based program allows students to access the information at any time, and therefore increases potential exposure to the intervention content, which may facilitate changes in behaviour. In addition, the use of technology can allow further reach into the home environment through use of the web-based program at home and promotion of the technology through email correspondence with parents. However, there is a limited amount of literature evaluating websites or other technologies as supportive components of health or nutrition interventions, as the majority of these interventions are either strictly web-based or school-based.

Therefore, this study aimed to evaluate the voluntary use of the web-based component of the school-based WhyDairy? intervention. The primary objective of the WhyDairy intervention was to evaluate effectiveness related to knowledge and dairy intake behaviour, and is not reported here. The website component of the intervention provided an online, interactive learning environment to complement four informative in-school visits. We hypothesized that the novel school-based intervention would result in consistent use of the website and would be voluntarily accessed by a majority of students.

2. MATERIAL AND METHODS

2.1. Subjects

Subjects were recruited from grade seven classrooms at elementary schools in Southwestern Ontario. Racial/ethnic breakdown of the participants was not determined. The study was approved by the Research Ethics Board at the University of Guelph (REB # 14NV037).

2.2. Study Design Cluster

This study was a school-based cluster Randomized Controlled Trial (RCT). The intervention was first piloted in a local private school (n=1) to assess feasibility of the intervention delivery and success of planned activities. For the RCT schools, nine elementary schools in Southern Ontario were block randomized (using blinded envelopes) based on school board into intervention schools with no follow-up email contact (INT n=3), intervention schools with follow-up email contact from June to October 2016 (INT+FU n=3), or control treatment (CON n=3) by the lead researcher. Data was collected from the pilot school and combined with the three INT schools that did not receive follow up, for a total of n=4 schools for the INT group. Researchers delivered the intervention and were therefore not blinded to allocation of the schools; however, students were unaware of their allocation or the purpose of the study.

2.3. Intervention Website

The intervention schools (including INT n=4 and INT+FU n=3, total n=7 schools) received the WhyDairy? intervention, which was developed by the researchers. WhyDairy? was developed as a web-based program, and the intervention included both school-based visits (delivered in class to all students and which used the web program as a teaching tool), as well as additional web-based material that students could access voluntarily on their own. The intervention material was taught over three 20 to 40-minute school visits across six to eight weeks. Visits were both didactic and interactive, with researchers engaging students throughout each visit using the same website to which they had voluntary access to outside of class. Following cessation of the school visits, half of the intervention schools received a follow-up email campaign that consisted of emails (five in total) sent once a month to parents during the months between post-invention measurements and the final follow-up measurement visit. The emails contained general

information about the intervention and directed parents to different parts of the intervention website in an effort to involve parents as well as students when there was no direct contact with researchers. The remaining half of the intervention schools did not receive any email communication during the follow-up period but still had access to the intervention website during this time.

During school visits, researchers navigated the website content (including games) and students were encouraged to voluntarily access the website outside of class time and at home. Sections of the website within the "Student Corner" (Table **1**) were opened as researchers completed the visit for that school to encourage the students to explore new material on the website after visits and to control the access of information by students. Use of a web-based format for WhyDairy? was designed to make the information taught during the school-based sessions interactive, fun, easy-to-use, and accessible to the students after visits were complete. The goal was to create prolonged contact with the intervention of information beyond the in-class visits and to extend the intervention reach to the parents and home environment.

Table 1. Description of intervention visits, material taught, and corresponding web pages.

Visit #	Visit Theme	Visit Details	Website Sections (Content and Pages)
1	What Are Dairy Products and Alternatives?	- Introduction to researchers - Definition of a dairy product and/or alternative - Interactive game with sample dairy products and alternatives, common misconceptions - Serving sizes of dairy products and alternatives - "Guess the Serving Size" Gameshow - "Build your own meal" interactive game to build meals containing different dairy products and alternatives - "S.M.A.R.T" goal setting	Home Page Student Corner → What are Dairy & Alternatives Student Corner → Gameshow Student Corner → Build Your Own Meal
2	What is in Dairy Products and Alternatives?	- Small group "think, pair, share" activity comparing Nutrition Facts Table (NFT) of various dairy products, alternatives and other food choices - Several interactive versions of NFT were available on the webpage - Activity was used to lead discussions on carbohydrates, protein, fats, cholesterol, vitamins and minerals - "S.M.A.R.T" goal setting	Student Corner → What is in Dairy & Alternatives Student Corner → Playing with Food!
3	Why eat Dairy and Alternatives?	- Discussion of how the nutrients in dairy products and alternatives can positively impact different health effects - Bone health, body weight and composition, and sports performance and recovery were discussed - "S.M.A.R.T" goal setting	Student Corner → Why Dairy & Alternatives Student Corner → Explore the Human Body

The website also contained sections not discussed in the intervention visits, including a Parent Corner, Kitchen Corner, and Contact Us page.

- *Parent Corner:* Contained information related to the researcher team, the intervention message and goal, quick tips on incorporating dairy and alternatives into meals, serving sizes of dairy products and alternatives, common misconceptions with scientifically supported answers, and frequently asked questions.
- *Kitchen Corner:* Contained family-friendly recipes for breakfast, lunch, dinner and snacks with a link to further recipes.
- *Contact Us:* Lead researcher contact information

Throughout the website, "Fun Facts" were placed as a hover-over pop-up box for students to find and explore while navigating through the website pages. All of the same material was available on the intervention website during the follow-up period.

The control schools received a standard industry-based education program, which did not have a website component; website data were therefore not collected from control schools and only data from the INT schools are presented in this analysis.

2.4. Data Collection and Analysis

Voluntary use of the WhyDairy? website, outside of classroom visits, was tracked throughout the entire intervention using multiple components of Google Analytics software. Each school was assigned a unique acronym that needed to be included in the web address to gain access to the website. This allowed Google Analytics to distinguish each

school's activity via the specific web address anonymously by user. Data were tracked through the six to eight-week intervention period as well as the five-month follow-up period.

The "Audience" tool was used to track the number of website sessions and the specific date on which they occurred as well as to distinguish new users versus returning users. The "Acquisition" tool provided data on how students accessed the website; examples of sources include social media and direct web address input. The "Behaviour" tool showed statistics specific to each page, allowed for tracking of content use and tracked the order that pages were visited during each session (behaviour flow).

In order to facilitate data analysis, each website page was assigned to a specific category to describe its content. "Knowledge" pages contained mostly textual information about the importance of dairy and alternatives and their nutritive components. "Interactive" pages contained activities and games to facilitate learning about dairy and alternatives. For example, the "Plate" page permitted users to select breakfast, lunch or dinner, and build their meal while being encouraged to include the proper number of servings of dairy and alternatives. Finally, the "Kitchen & Recipe" category included website pages that provided students with recipes for breakfast, lunch, dinner, dessert and snacks that highlighted dairy ingredients.

It should be noted that it is possible that the school-specific websites may have been accessed by third-party users via Google search or ad buttons. Any Google Analytics data that appeared to originate from these third-party users were excluded from data analysis. This was defined as an acquisition to the webpage from a "social" page (such as Facebook or WordPress) and reaching the website from an ad button (such as "free-share-buttons-fff.xyz").

3. RESULTS

3.1. Study Population

The study population consisted of 83 males and 92 females. Mean age ± standard deviation was 12.32 ± 0.47 years. Due to the anonymity of Google Analytics, we were unable to distinguish which students used the website relative to our subject pool.

3.2. Website Use During the Intervention Period

Website data during the six to eight-week intervention period were tracked for all schools who received the intervention (Table **2**). Overall, the WhyDairy? website was used by 37.3% (n=43) of students participating in the intervention (n=115) for a total of 79 sessions. Google Analytics showed that of the 79 sessions, 49% (n=39) were initiated by returning students who had already visited the website at least once.

Table 2. Summary table of all website sessions conducted by students during the WhyDairy? intervention period.

	Total Sessions	Total Users	Total Pageviews	Avg Pages per Session	Avg Session Duration (mm:ss)	Avg Bounce Rate	Avg % New Sessions
Total (all intervention schools)	79	43	492	6.32	0:06:56	19.17%	51.93%

Sessions = a group of website interactions that takes place within a 30min time frame by a single user□Users = individual viewing website□Pageviews = each view of any page on the website□Pages per session = number of pages viewed during a single session□Average session duration = length of time user interacted with website□Bounce rate = percentage of single-page sessions (ie. Sessions in which the person left site from the entrance page without interacting with the page or website)□% New Sessions = percentage of first-time viewers

As can be seen in Table **3**, the Kitchen/Recipe section of the website recorded the highest amount of views per page (11), but the shortest average time per page (19s). However, these pages also had the lowest average of website exits, meaning the last page viewed before exiting the website (8.02%). The Interactive pages had the second highest count of page views per page and the most time was spent on these pages, with an average time of 0:01:47. The least popular sections were pages containing Knowledge content, which attracted 8.62 page views per page with an average viewing time of 34s per page. This section had the second lowest average website exits (10.26%).

Table 3. Interaction with WhyDairy? website pages, with all web pages categorized into Knowledge, Interactive or Kitchen & Recipe categories, by students during the intervention period.

Category	Sample Content	Total Page Views	Views Per Page	Average Time on Page (mm:ss)	Average % Exit
Knowledge	What are dairy & alternatives and why are they important	112	8.62	00:34	10.26%
Interactive	Games including; Explore the human body, build your own plate	96	8.73	01:47	18.84%
Kitchen/Recipes	Breakfast, lunch, dinner, dessert & snack recipes	55	11.00	00:19	8.02%

Fig. (**1**) provides an overview of how study participants navigated through the WhyDairy? website with pages categorized as Knowledge, Interactive, or Kitchen/Recipe. Of the 79 unique sessions, 47 website sessions started from the homepage. As this analysis was meant to describe the student's flow through the whole website, sessions must have originated from the homepage to be included in this figure.

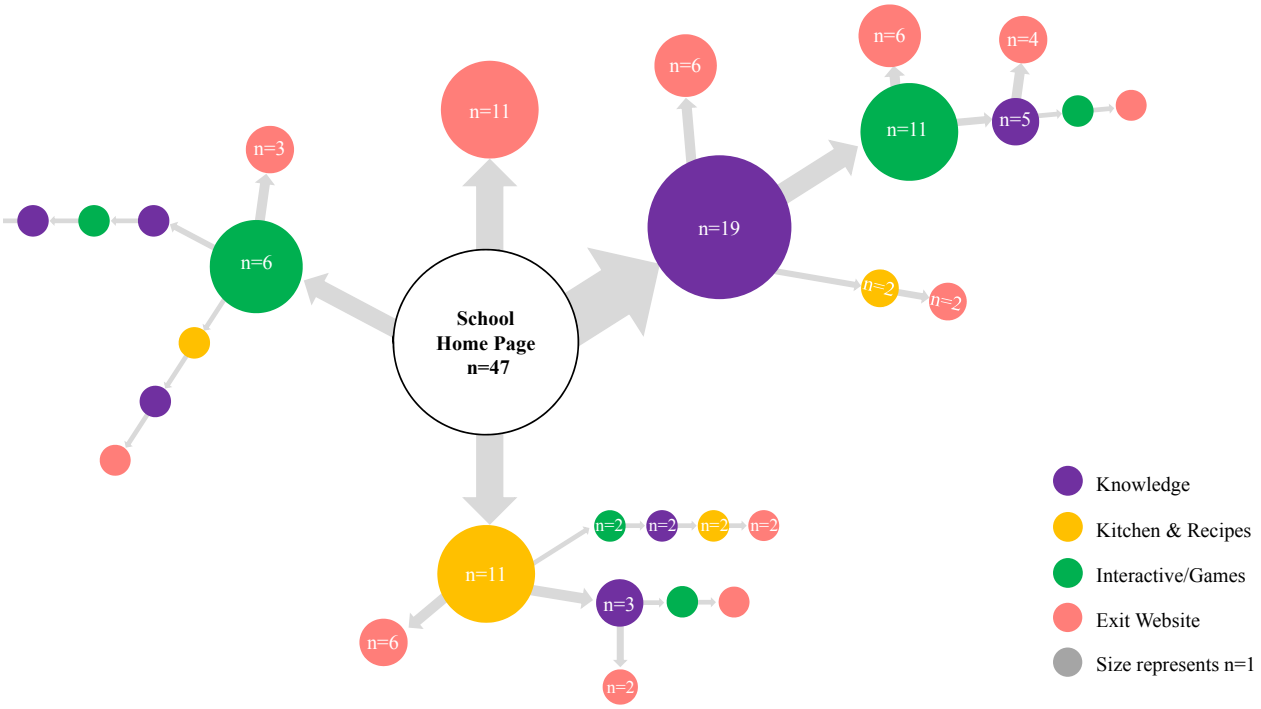

Fig. (1). Traversal paths through the WhyDairy? website, taken by a sample of students during the intervention period that began at the home page for their school. Shape sizes are variable depending on the size of the subject pool in each.

From the school homepage, 40% (n=19) visited a Knowledge page for their first interaction, 13% (n=6) visited an Interactive and 23% (n=11) visited a Kitchen/Recipe page. The remaining 24% of students exited the website from the home page without any further interactions. Of the 17 students that initially visited a Knowledge page, six exited while two proceeded to a Kitchen/Recipe page. The remaining 11 students proceeded to an Interactive page, five of which visited another Knowledge page before exiting. Alternatively, of the five students that visited an Interactive page for their first interaction, 50% (n=3) exited the website from this page category, while the remaining three students engaged in further interactions. After initially visiting a Kitchen/Recipe page, five of the 11 students visited a page in at least one other category before exiting the website, and six students exited directly from a Kitchen/Recipe page.

Fig. (**1**) highlights the exploration of all three categories of the website, as 58% (n=21) of students in this sample who did not leave the website directly from the home page proceed to visit website pages in more than one category of content.

Fig. (**2**) captures the date of access of WhyDairy?.com in relation to the date of intervention education visits one, two, and three, which is when the students were encouraged to visit the website. Although there were four classroom visits in total during the intervention period, the fourth visit was strictly for post-intervention survey completion and therefore did not include promotion of website content. Thus, it was not included in this evaluation. As well, "other" denotes a website visit not within two days following a classroom visit. On average, across the seven schools who received the Why Dairy intervention, 67.5% of website sessions occurred within the two days following classroom visits one to three. Approximately one-quarter (25.6%) of the sessions occurred within two days following Visit 1, while 16% of the sessions occurred within two days following Visit 2, and 25.9% of the sessions occurred within two days following Visit 3.

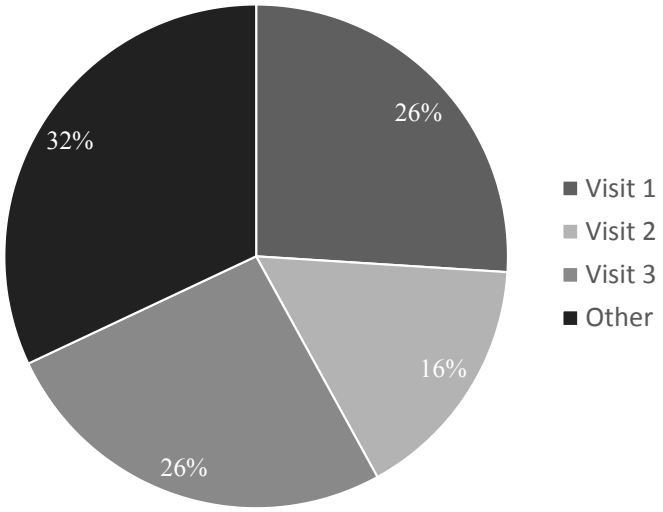

Fig. (2). Average percent of website sessions on WhyDairy?.com that occurred within the two days following a classroom visit for the intervention schools (n=7).

3.3. Website Use During the Follow-up Period

Regarding the parent follow-up email campaign, out of a total 52 consenters, 50 parents provided correct email addresses. The average percentage of email opens was 43%. Despite the number of opened emails, only five total clicks to visit a website page were recorded throughout the entire follow-up period (Table **4**). During the follow-up period, there was low activity on the WhyDairy? website. In schools that were part of the parental email campaign, eight total website sessions were initiated during the five-month follow-up period and these sessions all originated from the five email clicks. In comparison, the INT schools (with no parental emails) engaged in only five website sessions across the follow-up period.

Table 4. Parent email campaign subscribers, email opens and email clicks across the five-month email campaign.

Follow-up Email #	Subscribers	Opens (% of Subscribers)	Clicks
1	50	50%	3
2	50	44%	-
3	48	44%	2
4	46	33%	-
5	46	43%	-

Subscribers = parents who remained subscribed to receive emails Opens = emails opened from inbox
Clicks = engagement with the email through clicking one of the WhyDairy? links provided in the email

4. DISCUSSION

The purpose of this paper was to investigate the use of the WhyDairy? web-based component by students during the intervention and subsequent follow-up period. The timing of website sessions in comparison to classroom visits, popular website content and traversal paths through web pages were all topics of interest. Overall, participants

demonstrated some voluntary use of the website, mostly during a two-day period following intervention education visits; however, voluntary engagement with the website during the intervention period was limited overall, and there was an almost total lack of engagement with the website during the follow-up period.

The amount of time spent on a website has been shown to be a significant indicator of behaviour change outcomes in health interventions [12]. One-third of our intervention study population voluntarily used the website during the eight-week intervention period, but activity almost exclusively occurred within two-days following a research visit. This may suggest that repeated between visit prompts or personalized sections of the website, such as recommended by DeBar et al. (2009), are warranted to encourage the sustained use of a supplementary web-based component of a school-based nutrition intervention. Of those who viewed the website, almost half were returning users which could indicate that these students found the website to be of interest and therefore chose to revisit. Although data regarding dietary intake are not reported here, it should be noted that when dairy intake was analyzed as an outcome of intervention effectiveness, there was no difference between the control and intervention groups, with neither group showing an increase in intake. The limited voluntary interaction with the WhyDairy? website outside of the classroom visits is consistent with the failure to change behaviour, as described by Couper et al. (2010). Due to the design of the present study, we were unable to explore the reasons for return visits, as Google Analytics provided us with anonymous usage of the website. As well, we were also unable to determine whether dairy intake on an individual level was positively associated with website use. These would certainly be topics to explore in future research, as it would be of value to determine whether website use predicted behavior in individuals, the characteristics of the returning users compared to those who did not return, their motivations to return to the webpage, and the specific website components that appealed most to users.

Using the WhyDairy? website as a supplementary, technological component to the school-based intervention had the added benefit that website content could be specifically matched to the content of the research visits. As well, the website was updated with new content prior to each research visit; that is, the sections of the website that were used as part of each classroom visit were not released to students in advance, but rather were released on the day of the visit. Previous research has demonstrated that users preferred having new, updated content throughout an intervention period and this encourages return visits to see the new content [13]. The influence of face-to-face encouragement of using the website and the release of new content may have been related to a high number of visits within two days following a classroom visit and the relatively high number of returning users. However, we only successfully motivated one-third of students to visit the website, which means that the majority of students did not access the website on their own and may suggest that face-to-face encouragement, at least at a biweekly frequency, is not a sufficient engagement strategy.

In addition to visual appeal, the content and layout of a website can greatly influence which pages are visited. The high number of page views in the Interactive content category is consistent with previous research showing that children and adolescents enjoy games and interactive components of health and nutrition websites [14, 15]. While the Kitchen/Recipe category had the second highest views, we are limited in not knowing if a student printed or recorded the recipe. The layout of the website may also promote page views for specific content categories. For example, one interactive feature in the WhyDairy? website involved exploration of the human body to learn how dairy and alternatives affect various body parts and bodily functions. Users were able to click on different parts for further information. Therefore, this feature promoted additional page views of the Interactive category as users explored many body parts. In contrast, most knowledge pages contained only information presented in text without links to additional knowledge pages. This is a caveat to consider when relying on categorical page view data to conclude about popular content and further support the need for qualitative research.

In an attempt to gather a more holistic view of how students navigated through the site, researchers utilized the Behaviour Flow tool of Google Analytics. This tool provided valuable insight towards how students navigated through the website, specifically the order by which they viewed different types of content and the pages from which they exited the website. This analysis is an example of combining the quantitative data collected by Google Analytics with objective interpretation to gain a more in-depth understanding of user behaviours. Our observations support the progression towards higher order learning during a website session. Bloom's taxonomy outlines progression in thinking where a foundation of understanding developed in lower-order thinking is necessary to progress to higher order thinking [16]. Levels of thinking progress in the following order: Remembering, Understanding, Applying, Analysing, Evaluating and Creating [16]. When comparing the three content categories of the WhyDairy? website to Bloom's Taxonomy levels, pages in the Knowledge category would fall under "Understanding" and Interactive pages would fall under "Applying". Kitchen/Recipe pages would fall under "Creating", as these pages provided recipes that students and

their families could use to create meals or snacks. Here, students would have the opportunity to integrate their knowledge of dairy nutrition, such as nutritional benefits or serving sizes. Analysis of the traversal paths support the idea that users progressed in a pattern corresponding to Bloom's Taxonomy levels, by building a foundation at the "Understanding" level before progressing to "Applying" or "Creating" levels. Researchers developing websites to assist in their intervention efforts may consider developing the pages to flow in the same order as Bloom's Taxonomy in order to capitalize on student's natural progression through the site and development of knowledge.

Another area of data that holds potential applications for website improvement is the section of the website from which students ended their session. While we were able to elicit a general percent exit rate based on content category (Table **5**), we were also able to use the Behaviour Flow too to provide a more detailed view of website exits, by highlighting the depth of their website session when the student exited. Although the measurement of exit percentage provides information on the last page visited before exiting the website, we are not informed on the motivation behind the user exiting the website; they could have exited because they were satisfied with the content and information that they viewed, or because they were unsatisfied and exited the website to search for information elsewhere [17]. The latter reason highlights the importance of first impressions of the website pages. A study conducted by Lindgaard et. al. [18] established that it takes a website user 50ms to assess visual appeal, suggesting that the desire to exit the website may be influenced by first impressions based on page layout and design. This is an area of investigation that would benefit from further qualitative research, as focus groups or user interviews would assist in developing a more in-depth understanding of the exit percentage measurements.

Table 5. Summary of findings: Effectiveness of the WhyDairy? intervention and the associated website and parent email components.

• One-third of students voluntarily accessed the WhyDairy? website and timing of these visits corresponded closely with school visits
• Interactive game pages were the most popular pages, followed by Kitchen/Recipe and Knowledge pages
• Targeting parents during the post-intervention period with an email campaign resulted in 30-50% of parents opening the email, but virtually none of the parents clicked on the links within the email to access the intervention website

It has been suggested that interventions aimed at improving adolescents' consumption of dairy products may be enhanced by including a parental component [6, 19]. The WhyDairy? intervention attempted to engage parents by including a parental email campaign as part of the intervention, although parents were only engaged following the completion of the school visits and not during the school visit period, and it should be noted that the parental email campaign took place in part over summer holidays, during which some families may have been away on vacation with limited Internet access. Nonetheless, it is evident that the parental email campaign during the follow-up period in this study was not effective at engaging the parents or children through the website, as evidenced by the extremely low number of website visits during the follow-up period by either INT or INT+FU groups. It is possible that more intensive engagement of parents during the intervention period, in addition to the follow-up period, would have been more effective. In contrast to website engagement, the follow-up email campaign was more successful at engaging parents to open the sent emails. Emails contained rich content related to dairy products and health, and while each contained links to the website, it is possible that the information contained within the email was deemed sufficient. Future research that incorporates parents as a target of web-based interventions should focus on actively engaging the parents, since changing the home food environment and utilizing parents to model healthy behaviours are predictors of behavior change [6, 19, 20].

This study has several limitations. Firstly, the intervention program and time with the students were limited due to school board and individual school restrictions. This limited the length, depth, and intensity of the intervention, which have been suggested as important components for the success of changing adolescent behaviour [4, 5]. Secondly, Google Analytics was configured to distinguish each school's activity via this specific web address; however, it did not allow us to identify specific website users and it is possible that the website may have been accessed by third-party users via Google search or ad buttons. In order to mitigate this, any Google Analytics data that appeared to originate from these third-party users were excluded from data analysis. We acknowledge the fact that those voluntarily accessing the intervention website represent a subset of the entire population and were likely more engaged students. Lastly, as already described, the anonymous nature of data collection through Google Analytics, which meant that analysis on an individual level to link website use with behaviour change was not possible.

CONCLUSION

Overall, the results of this study provide supportive evidence that incorporation of a voluntary web-based component with a school-based nutrition intervention can engage students, especially during the intervention period, although it is clear that not all students were motivated to explore the website on their own. Students were especially motivated to explore the website in the two days following a research visit. This engagement did not continue through the follow-up period, which included the summer break and a potential change in routine or access to internet. Finally, while parents were receptive to receiving emails as a follow-up strategy, the vast majority of parents did not engage with the email by clicking on any links or resources provided within the email text. Future research should consider the school environment as an effective location to educate students about foods for health and could supplement the lessons with web-based components. In addition, researchers should investigate motivations for using websites and how to encourage prolonged website use when developing these supportive intervention components. Parents have been shown to be an effective supplement to school-based interventions, and more targeted approaches that actively engage parents to engage with an intervention website may result in changes amongst students in future research.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

The study was approved by the Research Ethics Board at the University of Guelph (REB # 14NV037).

HUMAN AND ANIMAL RIGHTS

Animals did not participate in this research. All human research procedures followed were in accordance with the ethical standards of the committee responsible for human experimentation (institutional and national), and with the Helsinki Declaration of 1975, as revised in 2008.

CONSENT FOR PUBLICATION

All subjects provided written informed consent prior to undergoing any of the tests related to this study.

CONFLICT OF INTEREST

This study was supported by funding from the Dairy Farmers of Ontario (DFO). M. Racey was supported by a Highly Qualified Personnel award from the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). DFO and OMAFRA had no role in the design, analysis or writing of this article. The authors declare no potential conflicts of interest.

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