



Research Article

Total Wellness: Using Technology to Integrate Physical Activity and Nutrition across the Curriculum

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Abstract

Background: Childhood obesity is associated with negative social, psychological, physical, and financial consequences. It is important to develop strategies to encourage maintenance of energy balance by addressing children's behaviors as well as the social and built environments within which they live. Schools are seen as important intervention settings given the large amount of time youth spend there. **Aim of the study:** The purpose of this study was to evaluate the implementation of Total Wellness, a primary school-based intervention conducted during the 2015-2016 academic year to enhance physical activity and nutrition through an integrated studies curriculum, using technology (fitness monitors and tablets) as tools to enhance learning while modifying the social and environmental supports for change. **Materials and Methods:** Total Wellness incorporated nutrition and physical activity into the existing curriculum, and used technological tools to assist with learning and motivational changes (fitness monitors, tablets). Teachers, staff and parents also engaged in aspects of the program. **Results:** Older students' survey data and fitness monitor tracking showed increased physical activity. Younger students showed increased physical activity when they had the trackers, but not self-reported activity. Younger students reported eating fewer sweets and sugar sweetened beverages and drank more water, while older students didn't have changes in nutrition behaviors.

Conclusions: By integrating nutrition and physical activity, using technology as a tool to enhance learning, and engaging teachers, staff and families Total Wellness was able to show significant improvements in behavior. Given the substantial consequences of childhood obesity, schools should be encouraged to explore ways to intervene in ways that fit within their values and mission.

Keywords: Nutrition and physical activity monitor; Youth

Introduction

Childhood obesity has been associated with negative social, psychological, physical, and financial consequences for youth and as such is one of the most significant concerns of the 21st century [1,2]. Given these significant implications, and that for many the negative consequences of being overweight or obese continues as they enter adulthood [3-8], it is important to develop strategies for prevention by working with youth in general not only those who are already overweight or obese [8,9]. These strategies need to encourage maintenance of energy balance (caloric intake and expenditures), addressing behaviors (i.e., nutrition and activity) as well as the social and built environments within which children live [3,10-13]. Schools have been seen as important intervention settings given the large amount of time youth spend in school [14-20]. As was recommended in a recent review [14], it is important for such school-based interventions to include educational and environmental strategies that increase physical activity, decrease sugar sweetened beverages, and increase fruit consumption. However, the approach of such school-based programs, and subsequent impact on behavior and obesity, has varied considerably [21-23].

Some have suggested that educational instruction should specifically focus on knowledge around the benefits of physical activity and nutrition, while others have included skill development and extended physical education within the school. Some have included changes to school policies and environments [14,24] such as changes to the types of food offered within the school. Given the challenges faced in fitting everything into the school day it has been suggested that it is beneficial to integrate information about nutrition and physical activity and opportunities for engaging in physical activity across the school day and within curricular topics being covered [25].

Given youth interest in technology, there has also been interest in incorporating the use of technological methods for self-monitoring activity to enhance behavioral change through the use of activity monitors [26-29]. Previous studies have found that this type of technology can be effectively used with youth, providing youth with motivation and the opportunity to self-monitor [28,30,31]. Fitness monitors are also seen as providing a more objective way to track changes in physical activity than self-reported survey data [30]. Most of these interventions have focused on the technology with less attention to other critical aspects of the social and built

environment within a youth's day and have shown mixed results. Some interventions indicate that providing fitness monitors in the absence of their use being integrated into the curriculum may actually decrease activity among primary school youth [30,32].

This previous work points to the benefits of a multilevel intervention namely, incorporating physical activity and nutrition throughout the curriculum along with the assistance of technology and modifications of the social and built environment. The purpose of this study was to evaluate the implementation of Total Wellness, a primary school-based intervention conducted during the 2015-2016 academic year to enhance physical activity and nutrition through an integrated studies curriculum, using technology (fitness monitors and tablets) as tools to enhance learning while modifying the social and environmental supports for change.

Materials and Methods

Sample population: Participants for this study were 81 male and female students (of a possible 84 students enrolled or 96% of the total student body at the school) aged 6-10 attending an urban elementary school. In terms of race, 27% percent of the students were white, 47% were racially diverse/more than one race, 12% were African American, 9% were Hispanic American, 2% were Asian American, and 1% were Native American. Thirty-six percent of the students qualify for federally reduced or free lunch. The household income of the zip codes where students lived ranged from \$104,539 to \$19,685 with a mean of \$44,008. The students were divided into two groups based on age. The younger students were from the kindergarten and first grade classes. The older students included grades 2 to 5. The average BMI values for all ages were generally within the normal range for all age groups [33].

All teachers, staff, students, and parents were informed about, and given the opportunity to discuss the Total Wellness program at a number of school assemblies. The connection between Total Wellness and the overall mission and vision of the school was emphasized, and efforts were made to address any potential concerns.

Ethical and administrative approval: The informed consent procedures were consistent with other activities engaged in by the school. The school distributed information about the program through newsletters and flyers sent home with students and asked the parents to return a form indicating if they wanted their child to take part by having a fitness monitor, if they wanted a fitness monitor, and if they wanted their children and themselves to be part of evaluating the project. All staff and teachers were also given the opportunity to opt in or out of wearing a fitness monitor. The university Institutional Review Board (IRB) reviewed these protocols and provided approval for faculty to engage in the project as evaluators of the data collected.

Intervention: Total Wellness incorporated nutrition and physical activity focused information and skill building into the existing curriculum, using technological tools (fitness

monitors, computer tablets) to assist with learning and motivational changes while modifying the social and environmental supports for change.

Nutrition

The culinary arts teacher engaged in activities in the classroom as well as during lunch preparation. The main message conveyed was that food is fuel for the body. The material covered included food groups (fruits and vegetables, proteins, fats, grains, carbohydrates, sugars), how to read nutrition labels, and portion size. Nutrition messages focused on decreasing sugar consumption by reducing the amount of foods and beverages with added sugar, particularly sugar-sweetened beverages, and replacing these foods with increased fruit consumption and water. The culinary arts teacher emphasized that added sugar is not something to feel guilty about, but is a "sometimes" food. The students used computer tablets to obtain information on different types of sugar, calculate the amount of sugar in foods/beverages, and the benefits of reducing added sugars.

During lunch preparation the culinary arts teacher and students jointly prepared family style meals for all students, teachers and staff at the school. For each menu they used the computer tablets to create a menu that listed the grams of added sugar that each item contributed. The computer tablets were also used to help students look up the answers to questions they had about food they were preparing, such as "Why is it called Caesar salad dressing?"

Physical activity

As part of the physical activity intervention, Total Wellness provided POLAR fitness monitors to staff, teachers, parents/caregivers and students. The 3rd, 4th and 5th graders plus parents/caregivers received their fitness monitors first. They wore them all year. There was also a set of monitors that rotated monthly among the younger students in kindergarten, first and second grade.

The initial emphasis was to increase student awareness of their activity levels. It was only after students had an opportunity to use the fitness monitors to observe their activity levels that the physical education (PE) teacher provided students with information regarding national guidelines for physical activity (i.e., that students their age should get 60 minutes of moderate to vigorous physical activity each day). [16]. Students were encouraged to move toward this goal as a school average rather than just an individual goal. The PE teacher emphasized the importance of not comparing results with classmates (whose "bar might be more or less full") because different students have different access to physical activities. For instance, one student might get all their activity at school, while another might have soccer practice or always go to a playground after school.

Cross-curricular integration

Staff and teachers were encouraged to integrate nutrition and physical activity across the curriculum in ways that were age specific and in line with core curriculum. As a result,

teachers were able to be intentional and responsive to natural “teachable moments.” For example, teachers incorporated physical activity as part of brain breaks (brief activities to help focus students) and as part of more academic exercises such as having students move around the classroom as part of problem solving and math. Teachers similarly incorporated information about nutrition into their history or geography lessons, for example discussing maple syrup (and its nutritional value) as a type of sugar when learning about Canada.

Data collection : Data was collected through a pre-post on-line survey, fitness monitor tracking, and qualitative interviews.

Survey

All students who were in attendance on the day the survey was administered took the survey using an on-line platform (71 of 84 or 85% of the total student body took both pre and post surveys). The survey was based on the Coordinated Approach to Child Health (CATCH) survey tools [34]. The survey asked students about their physical activity and nutrition knowledge, attitudes and behaviors, and support for healthy behaviors. The survey was given two times (fall, 2015 and spring, 2016) and analyzed in two groups, kindergarten/grade 1 (T1 n=29; T2 n=32) and grades 2, 3, 4, and 5 (T1 n=49; T2 n=45). All students were given student identification numbers (which corresponded with the fitness monitor they used). Data were aggregated to the group level and compared using McNemar’s test for non-parametric paired data to determine if there was a significant change in the variables of interest from time 1 to time 2.

Fitness monitors

Students, staff/teachers, and parents were provided the opportunity to wear fitness monitors. Eighteen parents, 18 teachers, and 42 students (6 kindergarten, 10 1st, 8 2nd, 8 3rd, 10 4th/5th graders) or 52% of students wore the fitness monitors. Data were uploaded from the watches initially after one month and then every two weeks. Times were also set up for parents to drop off their watches to have them uploaded. Once uploaded, the data were aggregated by class into 3 categories that reflected levels of achieving the recommended 60 minutes per day of moderate to vigorous physical activity (MVPA): those who had full (100-90% of the 60 minute activity goal), moderate (89-50% of the 60 minute activity goal), or low (49-0% of the 60 minute activity goal) achievement of the recommended levels.

Qualitative interviews

Qualitative interviews were conducted at the end of the project period with 9 students, 6 parents, and 13 teachers and/or administrative staff. All interviews included questions regarding the main messages conveyed/what was learned regarding nutrition and physical activity as well as what each perceived as the benefits and challenges of the various aspects

of the program. All interviews were audio recorded with permission of parents for children and then the children’s assent, and permission of parents, teachers, and staff. Audio recordings were transcribed verbatim. Transcripts were reviewed and coded using focused coding techniques.

Results

Nutrition

Statistical analysis : Table 1 reports results from the survey assessment of changes in nutrition. There was a significant increase in the older students’ perception of eating and drinking healthy foods and beverages ($p=0.05$) and recognition of the impact of high sugar consumption on memory ($p=0.01$), though a slight decline in the number of students who indicated parents ($p=0.05$) and teachers ($p=0.05$) tell them to drink water. Among the younger students there was an increase in fruit ($p=0.01$) and a significant decrease in those that had more than one sweet the previous day ($p=0.01$). There was also an increase in those that drank at least one bottle of water each day ($p=0.00$), and a decrease in parents telling students to drink water ($p=0.03$).

Qualitative interviews : When asked, students stated that they learned some important cooking skills and learned to try new foods.

If you're cooking, you can't rub your head or pick your nose or rub your eyes because if you have oil on your hands and you rub your eyes that could hurt your eyes. And also you're getting germs on your hands and then you have to go over and wash your hands and come back and go over and wash your hands.

Our nutrition teacher talked about, like she gave us this challenge this week of trying new fruit or something like that. So we've been talking about that and how you should try new fruit, or something.

Students also noted that they became more aware of and decreased their sugar consumption.

I did change a little bit of what I ate. I started just having dessert one day every week. So I didn't have it on the weekend.

I learned about how there can be healthy desserts like—there are—and how much sugar there is in soda. So I stopped drinking soda. I didn't want to drink Fanta anymore. I learned about tea, different types of tea. We tried tea before and it was sugarless tea and I kind of actually liked it. Normally I have sugar tea, but the sugarless tea was really good.

Parents indicated that they became more aware of nutrition as a result of their child’s inquiries or comments.

It has had a huge impact on his learning about what he's putting in his body to fuel it. So that was kind of a big component of it as well. Makes me more aware too, think about what stuff I'm giving him.

He was beginning to look at home and compare it with what he was learning in class. Well a lot of it was sugary stuff. He'd be like, “oh I'm only supposed to eat a little of that.”—I felt like it was more important for him to be aware of what he was eating as opposed to before where he would see something sweet and he'd just eat it.

Measure		Younger Students N=29			Older Students N=42		
		Time 1 N (%)	Time 2 N (%)	P-Value	Time 1 N (%)	Time 2 N (%)	P-Value
Fruit Consumption	0-3 Fruits	20 (68.97)	9 (31.03)	0.01	21 (50.00)	14 (34.15)	0.18
	4 or more Fruits	9 (31.03)	20 (68.97)		21 (50.00)	27 (65.85)	
Water Consumption	Less than 1 bottle	22 (75.86)	10 (34.48)	0.00	29 (69.05)	35 (83.37)	0.16
	1 bottle or more	7 (24.14)	19 (65.52)		13 (30.95)	7 (16.67)	
Fruit Juice Consumption	None	19 (65.52)	19 (65.52)	1.00	36 (85.71)	37 (88.10)	0.71
	1 bottle or more	10 (34.48)	10 (34.48)		6 (14.29)	5 (11.90)	
Soda Consumption	None	28 (96.55)	27 (93.10)	0.32	40 (95.24)	40 (95.24)	1.00
	1 bottle or more	1(3.45)	2 (6.90)		2 (4.76)	2 (4.76)	
Parents Encourage Drinking Water	Never or Sometimes	17 (41.38)	20 (68.97)	0.03	27 (64.29)	32 (80.00)	0.05
	Almost Always/Always	12 (58.62)	9 (31.03)		15 (35.71)	8 (20.00)	
Teachers Encourage Drinking Water	Never or Sometimes	0 (0.00)	3 (10.34)	No Variation	11(26.83)	12 (28.57)	0.05
	Almost Always/Always	29 (100.00)	26 (89.66)		30 (73.17)	30 (71.43)	
Sweets Consumption	1 or Fewer	14 (50.00)	24 (85.71)	0.01	31(73.81)	35 (83.37)	0.25
	More than 1	14 (50.00)	4 (14.29)		11(26.19)	7 (16.67)	
Too much sugar causes energy loss	Agree	21 (75.00)	22 (75.86)	1.00	33 (78.57)	33 (78.57)	1.00
	Disagree	7 (25.00)	7 (24.14)		9 (21.43)	9 (21.43)	
Too much sugar causes reduced memory	Agree	24 (85.71)	20 (68.97)	0.13	23 (54.76)	34 (80.95)	0.01
	Disagree	4 (14.29)	9 (31.03)		19 (45.24)	8 (19.05)	
Sugar causes teeth to rot	Agree	22 (78.57)	27 (93.10)	0.10	39 (92.86)	40 (95.24)	0.56
	Disagree	6 (21.43)	2 (6.90)		3 (7.14)	2 (4.76)	
Too much sugar can ruin your appetite	Agree	20 (71.43)	26 (89.66)	0.06	34 (82.93)	36 (87.80)	0.41
	Disagree	8(28.57)	3(10.34)		7(17.07)	5(12.20)	

Table 1: Pre-post measures of nutrition-related behaviors for younger and older students, Total Wellness Intervention.

Physical activity

Statistical analysis : Table 2 reports results from the survey assessment of changes in physical activity. For older students, there was a significant increase in those who had four or more days of vigorous and light activity. While the data indicated a non-significant increase in the amount of time they were active outside the

home (p=0.08), there was a decrease in the number of sports teams they played on (p=0.03) and the amount of time they were active with their parents (p=0.01). Younger students on the other hand showed no significant change in vigorous or light activity days, and a decline in those who indicated they had fun with friends when active (p=0.03). However, there was an increased involvement in sports teams (p=0.03).

Measure		Younger Students N=29			Older Students N=42		
		Time 1 N (%)	Time 2 N (%)	P-Value	Time 1 N (%)	Time 2 N (%)	P-Value
Vigorous Activity	Less than 4 days	6 (20.69)	4 (13.79)	0.41	17 (40.48)	6 (14.29)	0.01
	4 or more days	23 (79.31)	25 (86.21)		25 (59.52)	36 (85.71)	
Light Activity	Less than 4 days	3 (10.34)	1 (3.57)	0.16	18 (42.86)	1 (2.38)	<0.0001
	4 or more days	26 (89.66)	27 (96.43)		24 (57.14)	41 (97.62)	
Sports	0 teams	18 (62.07)	11(37.93)	0.03	15 (35.71)	22 (52.38)	0.03
	1 or more teams	11 (37.93)	18 (62.07)		27 (64.29)	20 (47.62)	
Active with parents	Never or Sometimes	21 (75.00)	24 (82.76)	0.41	30 (71.43)	39 (92.86)	0.01
	Almost Always/Always	7 (25.00)	5 (17.24)		12 (28.57)	3 (7.14)	
Active with friends	Never or Sometimes	4 (13.79)	7 (24.14)	0.26	15 (35.71)	17 (41.46)	0.47
	Almost Always/Always	25 (86.21)	22 (7.86)		27 (64.29)	24 (58.54)	
Fun with friends when active	Never or Sometimes	3 (10.34)	9 (31.03)	0.03	8 (19.05)	11 (26.19)	0.41
	Almost Always/Always	26 (89.66)	20 (68.97)		34 (80.95)	31 (73.81)	
Active outside at home	Never or Sometimes	19 (65.52)	19 (65.52)	1	33(78.57)	27 (64.29)	0.08
	Almost Always/Always	10 (34.48)	10 (34.48)		9 (21.43)	15 (35.71)	
Parents support physical activity	Never or Sometimes	11 (37.93)	9 (31.03)	0.53	19 (45.24)	21 (50.00)	0.64
	Almost Always/Always	18 (62.07)	20 (68.97)		23 (54.76)	21 (50.00)	
PE teacher	Never or Sometimes	14 (48.28)	16 (55.17)	0.56	21 (50.00)	22 (52.38)	0.82

affirms activity	Almost Always/Always	15 (51.72)	13 (44.83)		21 (50.00)	20 (47.62)	
Television	0-5 Episodes	10 (34.48)	10 (35.71)	0.74	20 (47.62)	18 (42.86)	0..59
	6+ Episodes	19 (65.52)	18 (64.29)		22 (52.38)	24 (57.14)	
	0-5 Games	19 (70.37)	18 (62.07)	0.41	26 (61.9)	30 (71.43)	0..32
	6+ Games	8 (29.63)	11(37.93)		16 (38.10)	12 (28.57)	
*p-values calculated using the Mc Nemar's test							

Table 2: Pre-post measures of physical activity-related behaviors for younger and older students, Total Wellness Intervention.

Fitness monitor data : The fitness monitor data was used to evaluate if there was a change, by class, in those who had full (100-90% of the 60 minute activity goal), moderate (89-50% of the 60 minute activity goal), or low (49-0% of the 60 minute activity goal) achievement of recommended levels of activity. Data indicated that there was an increase from the first to the last data point in those having full achievement (100-90% of the 60 minute activity goal) among the kindergarteners (from 36% to 54%), the first (46% to 71%), second (41% to 50%), and fourth/fifth (28% to 62%) grade classes. There was a decrease among third graders (58% to 42%). There was also a decline in the number of students in second (23% to 12%) and fourth/fifth grades (44% to 19%) who had low levels of achievement of the recommended levels of activity (49-0% of the 60 minute activity goal).

In looking at the adults who wore watches (teachers, staff, and parents) there was no change in those who fully met recommended levels of activity (46%) and a slight decline in those who had the lowest levels of achievement of recommended levels of activity (18% to 17%). Overall as a school, there was an increase in the percent who met the full level of recommended activity from 45% to 51%, and the percent of those who met the moderate level did not change (20%).

Qualitative data : Some students noticed they were more active during the school day than on weekends or during vacations. For other students it was the other way around with more activity during breaks and on the weekends.

We do. We have—every single person in the class and in the school actually has a goal for one hour of activity. I usually meet my goals, except I can't on the weekends. You're away from school and kind of like taking a break from working and P.E. and recess and all that, yeah. And plus you don't have to walk from different classes. Like we usually have to walk to rec room for strings, to lunch, to recess, and sometimes you have to walk over here.

And every time breaks happen most kids are sitting on the couch and relaxing....and On the weekends I get like 5 minutes of fitness. It's the other way with me. On the weekends, I get tons of fitness.

Some students noted that the fitness monitors helped them to be more aware of the amount of time they spent watching TV.

I kind of stopped watching as much TV as I used to. I used to sit there for a really long time and just watch TV after school. ... Because one of the places had how much time you're spending sitting down and standing up and using energy.

When asked, students, parents, teachers and staff all indicated that the fitness monitors made them more aware of when they were, and were not, being physically active. For some this served as a tangible cue to be more active. For others, it was just fun to see.

One student told me he had been reading on the couch for a while and realized he hadn't been active so he got up and rode his bike around the block.

But this had a more tangible effect on seeing themselves over time rather than trying to remember. Having something else that helped capture their experiences and give them back to them was the shift of, "oh I see that now.. The kids being able to monitor themselves...I got a picture of myself like this and now I can understand why—if maybe there's a gap of activity. It just brought a tangibility to it.

But it's really fun to wear it and to see how far you need to get to get your hour activity. And how much steps you get...It's really fun to look at.

Others found the watch itchy or uncomfortable, with a some students, teachers, staff, and parents getting rashes as a result of wearing them.

I don't really like wearing that much things, except rubber bands on my wrists. But I didn't like how it could be really tight and leave marks. And beneath I'd get a little itchy.

And I didn't, because when I was doing this with the band on it, it would catch my hair and so, and it was always, like, on my glasses. And it would catch my hair, and I'm like, "Ugh! This is so annoying." So I turned it in and didn't do it anymore, but then that caused the rash.

Some indicated that they were not sure if the monitor accurately reflected the actual amount of physical activity they got, and some felt that the monitor brought out a competitive edge in them or their children.

I didn't know if it was really accurate at times...was a little bit off-putting for me, because it was like, "is this thing really tracking it accurately?"

We did have to have a discussion about—he's very competitive—about him not teasing other kids who had not logged as many active minutes as he did. So we had to have a discussion about that, that you know, he and I could compare or he and his one friend could compare, but he needed to not harass anyone else about where they were.

Still others noted that while the monitors initially increased activity, it was hard to keep the momentum going after you got used to wearing it.

Initially I was really excited about wearing it. But then, a couple months in it was like, "Now what?" You forget it one day or two days.

Some indicated that they found the monitors distracting from the physical activity itself, or that the watches took away from engagement in other activities.

Whenever students received their monitors, they were exceptionally pre-occupied with them. They would shake their hands to see the person on it change activities. They would run in circles around the playground.

I told them (my teachers) I didn't feel like wearing (the monitor) anymore because it just got a little too distracting sometimes for me, so I didn't want to get distracted, so I didn't wear it anymore.

Some parents voiced concerns that they didn't want to be responsible for their child losing or breaking the monitor. Some felt that their children were not yet ready to fully understand the implications of sharing personal data through the monitors. Others indicated they thought it was important to have these conversations with youth while they were receptive to discussing these issues with adults.

We were concerned about (our son) losing it or breaking it.

We want him to learn to be a little bit careful about interacting with technology so that having things that automatically collect and send up data, you know, we wanted to have a talk about that with him when he's a little bit older before he starts enrolling in things and takes it for granted. Oh, giving up your data. It's—how to say it—we live in this environment where more and more things are connected to the cloud and everyone is trying to exploit records or data, to offer up consumers to businesses. And, I mean, I trust the school and I trust the program and I have no reservations about having his data collected for a program like this, but I want him to be aware enough to make those distinctions. And to get in—I want to get him in the habit of asking these questions, but I think he's a little young to understand what it means to have himself monitored automatically and the data collected somewhere.

So I think that's going to be a huge benefit as they go into middle school, and they're going to be presented with those kinds of experiences or encounters with technology. Whereas when you're in fourth and fifth grade there's a—they're still more receptive to the learning and what you have to say

Overarching programmatic responses

Parents and teachers noted that they and their children were proud of the Total Wellness program.

Because I was proud of it. I mean, I liked having it. I mean this was like, when I would go "this is my watch that our whole class is doing"—I liked that. This is part of one of the things that we're doing at the school, which is kind of one of those unique things that, that we do that I think is just, you know? That's pretty cool... And it was kind of one of those things that just seemed perfectly to fit in with what we were doing here.

Others highlighted that they appreciated that the fitness monitors brought parents, teachers and children together. In some ways they saw the watches, and the conversations they sparked, as community building.

Well, anytime that the teachers and the students can be in all that together, it's just another thing that brings you together. I liked the fact that the teachers and the students were doing it...just the fact that we're all doing it.

And it was an opportunity—just starting at the big level—it was an opportunity for us to connect it to having deep conversations. It was—I really took that as a, we need to within this opportunity, to learn about ourselves and connect these three realms that really help shift our mindset. We are shifting our mindset to be healthier members of a community that needs us to participate. So it became a real school message, not just the individual piece but it built a message around it that these tools are here for us to engage in conversation and practice what it feels like to be open about our choices and about the way we think about things.

While overall the Total Wellness program was enthusiastically received there were some challenges. For example, some teachers/staff were concerned about the role of the school in addressing the societal pressure to be a certain definition of healthy with regard to both food consumption and physical activity, and the associated feelings of self-consciousness and inadequacy. Families also voiced a desire to have more opportunities to engage in the program.

People get pretty defensive when you talk health, quite frankly, because it makes you feel self-conscious and inadequate and all of those things. And it exposes some of those.

It would have been good if the school could have done more to communicate about the program. Because it's a good program and it has parts other than just the wrist monitor. And for some they got the fitness monitor and talked about it, but didn't have much context for it. As they develop this program and continue with it, I would like to know more and have a better sense of what else they're doing and how the parts fit together and how it can interact with what we do at home beyond the monitor. So more parental involvement I think would be a good direction for the program if they do it again.

Discussion

In order to reduce childhood obesity and its negative effects, it is important for youth to reduce consumption of sugar sweetened beverages, increase consumption of fruits, and get 60 minutes or more of physical activity each day [35-37]. Our study aimed to enhance physical activity and nutrition through an integrated studies curriculum, using technology (fitness monitors and tablets) as tools to enhance learning while modifying the social and environmental supports for change. In our study older students' survey data and fitness monitor tracking showed increased physical activity, but no significant changes in nutrition behavior. Younger students on the other hand showed increased physical activity over the course of time that they had the trackers but not self-reported activity from the beginning of the year to the end. It is possible that this reflects the fact that they had only periodic access to the fitness monitors. Younger students also reported that they ate fewer sweets and sugar sweetened beverages and drank more water, while older students didn't appear to exhibit changes in nutrition

behaviors, underscoring the importance of developing healthy nutritional habits at an early age.

Recent studies show that fitness monitors may provide initial motivation for youth to become physically active, but that these results may not be maintained. [30, 38, 39]. Our findings support previous recommendations that using monitors as a tool to enhance self-monitoring while at the same time emphasizing integration of learning across the curriculum and engaging parents in the intervention can have a positive impact. Our findings also complement other work that identified challenges for youth in wearing fitness monitors such as discomfort in wearing the monitors overnight thus limiting their benefit in tracking sleep, and challenges in wearing the monitor during group sports [40].

Our findings also highlight that it is important to engage teachers and staff, as well as parents in wellness programming. Interviews highlighted that teachers and staff want to have the opportunity to voice their opinions about the role of schools in promoting health and to reflect on their own lifestyle as a model for these activities. Parents want to feel engaged in interventions that influence their children's behavior, recognizing that what happens inside the school influences behaviors and attitudes outside of the school as well.

Limitations

While all children had the opportunity to engage in Total Wellness activities, including wearing fitness monitors, not everyone wore the monitors for the same amount of time either because they didn't like them or because they interfered with other activities, thus potentially biasing the results. In addition, the programmatic results may not reflect a specific individual's change, thus individuals who may have most needed physical activity or improved nutrition the most may not have actually changed their behavior through this intervention. A further limitation is that the findings may not be generalizable because students in our sample started with more activity and better nutrition than the national norm (e.g., less than 10% of students in the study drank a bottle of soda day in comparison to 63% of youth nationally) [41]. This may have biased our results in that, for example, our sample may have a predisposition to engage in activity more than other youth.

Conclusions

By integrating nutrition and physical activity, using technology as a tool to enhance learning, and engaging teachers, staff and families Total Wellness was able to show significant improvements in behavior. Given the substantial immediate and long-term consequences of childhood obesity intervention, schools should be encouraged to explore ways to do so that fit within their values and mission.

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Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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