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Research Article

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Findings from a Pilot-Study: Nutrition Education Tele-Visits to Promote Healthy Dietary Habits among Adolescents

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Abstract

Objectives: The purpose of this project was to assess dietary changes in fruit, vegetable, sugary beverage, and caffeinated beverage intakes among adolescents attending rural public schools who received nutrition education intervention via tele-visits.

Methods: Students 5th-8th grade from six public schools in rural areas of Arkansas voluntarily participated in a tele-visit nutrition education intervention. Students could have participated in up to seven tele-visit sessions over 6-months. Tele-visits consisted of a 20-minute one-on-one session addressing a specific nutrition-related topic. A 16-item retrospective questionnaire assessed dietary behaviors after then before intervention. Wilcoxon signed-rank and exact sign tests assessed for significant differences in number of days per week fruits, vegetables, sugary beverages, caffeinated beverages, milk, and water were consumed before and after intervention.

Results: Data from 29 participants revealed a statistically significant ($p = 0.03$) median increase (+1.00 day/week) in drinking eight glasses of water per day after completion of the intervention (4.00 days/week) compared to before (3.00 days/week). While not statistically significant ($p > 0.05$), other results indicated participants experienced positive changes in dietary habits, including decreased frequency of soda (41% of participants), and sweet tea (41% of participants) consumption, and increased frequency of fruit (41% of participants) and vegetable (28% of participants) consumption.

Conclusion: While majority of results were not statistically significant, they demonstrated practical relevance among participants through positive changes in dietary habits. Use of tele-visits to reach adolescent populations in rural areas is worth further exploration, as positive changes during this age may have potential to carry-over into adulthood.

Keywords

Pediatric health, Childhood obesity, Nutrition education, Tele-health, Behavior change

List of Abbreviations

BMI: Body Mass Index; Kg: kilogram; m^2: meters squared; SES: Socioeconomic Status; T2D: Type 2 Diabetes; DXA: Dual-energy x-ray absorptiometry; PCP: Primary Care Physician; US: United States; FDA- Food

and Drug Administration; NHANES: National Health and Nutritional Examination Survey AAP: American Academy of Pediatrics; RD: Registered Dietitian; ATLAS: Active Teen Leaders Avoiding Screen Time; PI: Principal Investigator; STAR: School Telemedicine in Arkansas; IRB: Institutional Review Board; ADE: Arkansas Department of Education; CDH: Center for Distance Health

Introduction

Obesity evolves from a multitude of factors leading to an excess of body fat. Body Mass Index (BMI), calculated by taking weight in kilograms (kg) and dividing by height in meters squared (m^2), is used to diagnose obesity. A BMI that is greater than or equal to the 95th percentile for children and adolescents (of the same age and gender), or a BMI greater than or equal to 30 kg/m^2 for females ages 17.5 to 20 years old, is classified as obese [1, 2]. Children with obesity are at a greater risk for developing chronic diseases and remaining obese into adulthood [3]. Quality of life may also be affected due to weight status, potentially leading to depression, social isolation, anxiety, bullying, low self-esteem, and poor academic achievement [3, 4]. Because obesity stems from numerous contributing factors, interventions should incorporate a variety of strategies that ultimately prepare children and adolescents with their families to make permanent lifestyle and behavior changes that will have a positive effect on weight and overall health [3].

BMI has been a primary measurement to assess weight status or serve as an outcome measure in various studies [5-11]; however, a lack of agreement regarding a clinically significant reduction in BMI persists [12]. Another perspective to be considered is outcome measures not associated with weight, such as dietary changes. One study by Thompson et al. [13] concluded that an increase in fruit and vegetable consumption positively affected dietary quality through increased intake of key nutrients associated with fruits and vegetables and decreased consumption of energy-dense and nutrient-poor foods. Implications of another study by Smith et al. [14], which explored similar outcomes, highlighted the need to assess adherence to targeted behavior changes; otherwise, positive health outcomes and favorable weight changes may not be plausible since an intervention should be at least six months (short-term), but preferably 12 months (long-term) in length [15].

A review by Pem & Jeewon [16] emphasized the importance of an individualized, or tailored, nutrition component to intervention programs, while another by Contento [17] discussed the need for nutrition educations that address food preferences, personal beliefs, attitudes, perceptions, social norms and environmental factors. Overall, focusing on desired behaviors as opposed to undesirable behaviors can lead to far better outcomes in terms of individuals making positive lifestyle changes [16]. Fleischman et al. concluded in their study [10] that tele-visits, which are often individualized sessions, provide an effective strategy for obesity treatment and help to reduce barriers due to convenience. The purpose of this current pilot project was to assess dietary changes related to fruit, vegetable intake, sugary beverage and caffeinated beverage intake among adolescents who received individualized nutrition education intervention via tele-visits as part of the School Telemedicine in Arkansas (STAR) HealthyNOW! program.

Methods

Study population

The project population consisted of 5th-8th grade students from six, rural public schools located in Central, Western, and Northwestern areas of Arkansas participating in the STAR HealthyNOW! Tier 2 program. Inclusion criteria consisted of the following: BMI greater than or equal to the 95th percentile (Tier 2), students enrolled in grades 5-8, parental consent (granted before the STAR program), primary care physician (PCP) approval (granted before the STAR program) and having had at least one nutrition tele-visit session prior to administration of the questionnaire.

Intervention

The STAR program is a grant project under the Arkansas Department of Education (ADE) and the University of Arkansas for Medical Sciences Center for Distance Health (CDH), offering specialty educational services through tele-visits. It was designed to complement School Based Health Centers using telemedicine to deliver educational services through interactive video sessions, or "distance education". The program focused on dental health, physical activity, mental health and nutrition. As part of the nutrition component, a nutrition professional (project principal investigator) provided seven, 20 minute one-on-one tele-visit sessions with participating students throughout the duration of the program. Nutrition topics included the relationship between nutrition and exercise, heart health, protein, carbohydrates, dietary fats, goal setting, benefits of fruits and vegetables, and portion sizes. The principal investigator (PI) also provided nutrition education using food models at each participating school before the program began, created nutrition challenges such as "try a new red vegetable this week", and designed materials for seven, nutrition-related computer modules covering macronutrients, fiber, label reading and comprehension of nutrition facts, setting achievable nutrition-related goals, and covered eating disorders and the principles of intuitive eating.

Data collection

Participants completed a retrospective (*After* then *Before* intervention) questionnaire (Table 1) assessing frequency of consumption in five areas: fruit and vegetable intake, sugary beverage consumption, caffeinated beverage consumption, milk consumption, and water consumption. The questionnaire was adapted (with permission) from Shilts et al. [18] and adjusted to meet the objectives of this project. The adapted tool was a 16-item questionnaire, asking participants to provide the number of days per week (ranging from zero to seven) that they completed each dietary behavior. The PI introduced and explained the questionnaire by reading a script (Figure 1) to standardize the directions for participant completion of the questionnaire. The questionnaire was administered to

Figure 1: Script for Administration of Research Questionnaire:

Before we get started with today's session, I have a questionnaire that I would like for you to complete. I will share my screen with you so that you are able to see and read each question. Take your time in answering. When you have selected your choice, please share your answer so I can record it on my sheet that I have here with me. All your answers will be anonymous; no one will know that these answers came from you. We will start with the left column, which will be dietary questions in relation to after the STAR HealthyNOW! Program, or what you are currently doing. Then we will move to the right column. These will be the same dietary questions but will be in relation to your habits before the STAR HealthyNOW! Program. This questionnaire will provide me, as well as others working on the STAR program, with useful information for my school research project and feedback that may help us make improvements for next year. Please be as honest as possible in the answers you provide. Do you have any questions? Feel free to ask any questions or clarification if needed while you complete the questionnaire. (Thank participant at the end of session for completing questionnaire).

participants during scheduled nutrition tele-visit sessions for the month of February 2019, which was six months after the start of the tele-visits. The questionnaire was visible to each participant through a shared computer screen. Participants began by completing the left column, which pertained to their current dietary habits *after* participating in tele-visits as part of the STAR HealthyNOW! program. Then participants completed the right column, which asked the same questions but reflected participants' dietary habits *before* the start of the tele-visits and STAR HealthyNOW! program. The project was determined to be *not human subject research* by the University of Arkansas for Medical Sciences Institutional Review Board (IRB), as defined in 45 CFR 46.102, and therefore it did not fall under the jurisdiction of the IRB review process.

Data analysis

Statistical analysis was conducted using IBM SPSS 24 Statistics software. Wilcoxon signed-rank tests and exact sign tests [19] were used to determine if there were statistically significant differences between the number of days per week fruits, vegetables, sugary beverages, caffeinated beverages, milk and water were consumed before and after the intervention. Statistical significance was determined at $p < 0.05$.

Results

Forty (40) participants volunteered to participate in the project; however, 11 participants were excluded from the statistical analysis because they did not meet the inclusion criteria, leaving 29 participants for the purpose of this research. One student was no longer participating in the program, two students were absent at the time of the questionnaire and had not been exposed to the tele-visit sessions, and the remaining eight students had not been exposed to the tele-visit sessions. Of the 29 participants, 19 received five nutrition sessions, one participant received four sessions, one participant received three sessions, and the remaining eight participants received two sessions.

There was a statistically significant median increase (+1.00 day/week) in drinking eight glasses of water per day after completion of the intervention (4.00 days/week) compared to before the intervention (3.00 days/week), $p = 0.03$ (Table 2). There were no statistically significant differences between the before and *After* intakes of non-starchy vegetables, starchy vegetables, fruits, vegetables, beans, coffee drinks, energy drinks, 100% fruit juice, Kool-Aid or lemonade, sports drinks, regular milk, or flavored milk (all $p > 0.05$) (Table 2).

Even though statistical significance was lacking with most results, there was evidence of positive change for some participants, as the Wilcoxon signed-rank and exact sign tests revealed positive changes, negative changes, and ties (no changes from before to after) regarding intakes of fruit, vegetables, sugary beverages, caffeinated beverages, milk, and water (Table 2). Twelve participants reported increased frequency of fruit consumption, while six participants reported decreased frequency,

Table 1: How many days a week do/did you

	AFTER *NE Tele-visits	BEFORE *NE Tele-visits
1. Eat fruit? (fresh, frozen, canned)	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
2. Eat Vegetables? (Fresh, frozen, canned)	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
3. Eat non-starchy vegetables (such as spinach, broccoli, cauliflower, tomatoes, green beans)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
4. Eat starchy vegetables (such as potatoes, sweet potatoes, peas, corn)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
5. Eat beans (kidney, black, garbanzo, navy, pinto), lentils, or soybeans?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
6. Drink an energy drink (such as Monster, Red Bull, or Rockstar)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
7. Drink regular soda (such as Coke, Dr. Pepper, Pepsi, Mountain Dew, or Sprite)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
8. Drink coffee with added sugar/syrup, or frozen/blended coffee drinks?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
9. Drink sweet tea?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
10. Drink 100% juice (such as orange juice, apple juice, grape juice, or cranberry juice)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
11. Drink Kool Aid or lemonade?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
12. Drink Gatorade, PowerAde or other sports drinks?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
13. Drink at least 8 glasses of water (with no added sweeteners)?	0 1 2 3 4 5 6 7	0 1 2 3 4 5 6 7
14. Do you think you are drinking more water NOW than BEFORE the STAR HealthyNOW!?	0 1 2 3 4 5 6 7 Yes No	0 1 2 3 4 5 6 7

*Nutrition Education.

Table 2: Differences between frequency of intakes before and after participation in the nutrition education tele-visits intervention.

How many days a week do/did you…	Behavior Change (N = 29)			Z statistic	p-value
	Positive Change (n)	Negative Change (n)	No Change (n)		
1. •Eat fruit? (fresh, frozen, canned)	12	6	11		.238
2. •Eat Vegetables? (Fresh, frozen, canned)	8	5	16		.581
3. ◊Eat non-starchy vegetables (such as spinach, broccoli, cauliflower, tomatoes, green beans)?	11	7	11	1.173	.241
4. •Eat starchy vegetables (such as potatoes, sweet potatoes, peas, corn)?	5**	11	13		.210
5. ◊Eat beans (kidney, black, garbanzo, navy, pinto), lentils, or soybeans?	8	5	16	0.776	.438
6. •Drink an energy drink (such as Monster, Red Bull, or Rockstar)?	3**	1	25		.625
7. •Drink regular soda (such as Coke, Dr. Pepper, Pepsi, Mountain Dew, or Sprite)?	12**	4	13		.077
8. ◊Drink coffee with added sugar/syrup, or frozen/blended coffee drinks?	10**	3	16	1.798	.072
9. •Drink sweet tea?	12**	4	13		.077
10. •Drink 100% juice (such as orange juice, apple juice, grape juice, or cranberry juice)?	4**	9	16		.267
11. •Drink Kool Aid or lemonade?	6**	7	16		1.000
12. •Drink Gatorade, PowerAde or other sports drinks?	7**	7	15		1.000
13. •Drink at least 8 glasses of water (with no added sweeteners)?	14	4	11		.031*
14. •Do you think you are drinking more water NOW than BEFORE the STAR HealthyNOW!?	14	5	10		.064
15. •Drink regular (such whole, 2%, 1%, or non-fat) milk?	9	4	16		.267
16. ◊Drink flavored milk?	5**	5	19	.000	1.000

◊Wilcoxon signed-rank test

●Exact Sign test

*The significance level is .05

**Positive behavior change indicates participants less often consumed these foods/beverages

and 11 participants reported no change in frequency of fruit consumption. Eight participants reported increased frequency of vegetable intake per week, while five participants reported a decreased frequency of vegetable intake, and 16 participants did not change their frequency of vegetable intake. Twelve participants reported decreased frequency of regular soda intake, while four participants increased frequency, and 13 participants did not change their frequency of regular soda intake. See table 2 for similar results regarding food/beverage intakes.

Discussion

The purpose of this project was to assess dietary changes related to fruit, vegetable, sugary beverage, and caffeinated beverage consumption among adolescents who received nutrition education intervention through tele-visits. Change in dietary habits may influence change in BMI. Despite the lack of statistical significance, there were potentially meaningful dietary changes among participants. Positive changes among participants included an increased frequency in consumption for fruits (n = 12), vegetables (n = 8), beans (n = 8), regular milk (n = 9), and water (n = 14). There was also a decreased frequency of consumption of sugary beverages among participants, including consumption of flavored milk (n = 5), Gatorade or other sports drinks (n = 7), Kool-Aid or lemonade (n = 6), regular soda (n = 12), coffee beverages (n = 10), sweet tea (n = 12), and 100% fruit juice (n = 4). Of the 29 participants, 25 indicated no changes in the frequency of consumption for energy drinks, of which 20 participants were not consuming any energy drinks (before or after the intervention). Of the four participants who reported changes, three participants reported consuming energy drinks less often.

Many cross-sectional studies [20-22] have shown that sugary beverages, which include regular sodas, energy drinks, juice, flavored milk, sports drinks, and other caffeinated beverages [23], are correlated with an increased risk for obesity. The American Academy of Pediatrics (AAP) also recommends that no more than half of a child's servings of fruit should derive from 100% fruit juice, and caffeine should be nonexistent in the child's diet [24, 25]. Energy drinks also contain added sugars, further promoting excess energy intake [25]. Fruits and vegetables are often lower in calories and higher in nutrients, which could positively affect caloric intake and energy density of a child's diet [13]. These findings and recommendations relate closely to the present project since these dietary behaviors were targeted through the nutrition education intervention and measured via the questionnaire.

Thompson et al. [13] sought to see how an increase in fruit and vegetable consumption would impact a child's diet in terms of caloric intake, energy density of foods consumed,

nutrient intake, and intake of added sugars. While caloric intake did not significantly change, results showed improved dietary quality, intake of nutrients, and decreased intake of energy-dense foods; however it is worth noting that the study evaluated fruit and vegetables only, which are just one aspect of a diet [13]. Langer et al. [6] found that fruit and vegetable intake had an inverse relationship with a permissive parenting style, highlighting the role parents play in a child's dietary choices. Restrictive and authoritarian styles of parenting were associated with lower intakes of sugary beverage, another key contributor to energy intake. While self-reported parenting styles were a limitation, Langer et al. [6] provided insight regarding the impact parents have on the dietary behaviors of their children [6]. Parental feeding practices were not assessed or included as part of this current nutrition education project, but are worth consideration with future development of the STAR HealthyNOW! Program, if possible.

Many participants in the current project reported increased frequencies of fruit (n = 12) and vegetable (n=8) consumption, and of those who reported no changes (n = 16), many already had what could be considered moderate (three or four days) to high (five, six or seven days) frequencies of consumption for fruits and vegetables. Many participants also reported decreased frequency of consumption for soda (n = 12) and energy drinks (n = 3); however, some participants reported negative behavior changes, such as decreased fruit and vegetable consumption and increased sugary beverage consumption. Perhaps dietary changes could have been more apparent had there been parental involvement in the current project; however, many participants continued to make positive changes that were defined as more favorable by previously mentioned studies [13, 20-23] and AAP recommendations [24, 25].

Participants involved in this current program were determined to have a BMI greater than or equal to the 95th percentile using height and weight for calculations. Tovar et al. [5] found that children who were clinically obese were more likely to eat two or more servings of fruits and vegetables, and less likely to drink whole milk. Researchers suggested that parents of these children were at an advanced state of change, based on the Transtheoretical Model. This study demonstrates the importance of including behavior change theory when developing health interventions, as well as parental involvement when addressing dietary change among children and adolescents. The Transtheoretical Model states that health behavior change involves an advancement through six stages of change: precontemplation, contemplation, preparation, action, maintenance, and termination [26]. These stages of change may have been an influential factor among participants within this project, who reported no changes between before and after the intervention.

While the current project provided relevant information for the program in which participants were involved, the project had limitations, including a small sample size, amount of exposure to the tele-visit sessions, and use of self-reported responses. The small sample size of 29 participants prevents generalization to the pediatric population. Several students had joined the program later than others had and some students were absent, decreasing exposure to the nutrition intervention and its potential effectiveness. The research questionnaire administered in this project conveniently and inexpensively looked at key dietary aspects related to excessive weight gain but can still be subject to bias [27]. Children may overestimate or underestimate dietary behaviors depending on their perception of what is acceptable or desirable, as suggested by Tovar et al. [5]. With a traditional pre and post-test, there is often a response-shift bias, which participants shift their answers to what they think is expected based on that point in time [28]. To reduce this bias and lessen the burden on participants, a retrospective after then before questionnaire was modified for use [18]. The retrospective questionnaire may prevent overestimation of initial dietary behaviors, enabling for a more accurate depiction at the time of administration, but there is no gold standard for comparison [18].

Conclusion

While majority of the results from this project did not indicate statistically significant differences before and after the nutrition education intervention, and given the limitations, the results still provided valuable information for future programs and held relevance among participants. Many participants reported favorable dietary changes that may potentially lead to long-term health benefits; however, some participants reported dietary behaviors that favor an elevated weight status. Developing an intervention of longer duration to increase consistency and repetition of information across more than the current seven tele-visit sessions may provide better outcomes in terms of short-term and long-term behavior changes.

While interventions that incorporate tele-visits are convenient and can help reduce barriers, more research is warranted for the effectiveness among the pediatric population and in a school-based setting. Engagement of participants during each session differed greatly; thus, motivation seems to be another driving force for behavior change, which may vary between school and home environments. Further development of the intervention with the use of behavior change theory and inclusion of parental/family involvement could lead to more robust dietary behavior change.

Conflict of Interest Statement

The nutrition education tele-visit intervention was funded through the STAR program, a grant-funded project (Telehealth Network Grant Program) under the Arkansas Department of Education (ADE) and the University of Arkansas for Medical Sciences Center for Distance Health (CDH), offering specialty educational services through tele-visits. The program was funded by Health Resources and Services Association (HRSA) Grant.

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