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*This study compared the Peak Health and Performance curriculum (PHP) to the Teen Cuisine curriculum (TC) on improving nutrition, food safety, and physical activity (PA) behaviors among youth. The quasi-experimental study was conducted in Michigan middle and high schools and included 1007 5$^{th}$- through 12$^{th}$-grade students, who participated in either the PHP or the TC curriculum. There were 465 students in the PHP group and 495 students in the TC group. Nutrition, food safety, and PA behaviors were surveyed before and after each program. Individual curriculum pre- and post-scores were compared using a paired t-test, and between-group changes were examined using a repeated-measures ANOVA. Missing data were excluded case-wise. The results showed that vegetable and fruit consumption significantly increased for both groups. Washing vegetables before consumption and putting food back into the refrigerator within 2 hours increased in the PHP vs the TC group; however, there was not a significant group difference. PA behaviors increased for the TC group, but not for the PHP group. Both the PHP and the TC were shown to be effective in increasing vegetable and fruit consumption among Michigan youth. Further, the PHP improved food safety practices, while the TC increased PA behaviors.*

*Keywords:* school intervention, adolescents, sports nutrition, nutrition, food safety, physical activity, Teen Cuisine, Peak Health and Performance, SNAP-Ed

## Introduction

Youth health behaviors have been the topic of conversation among public health professionals for several decades, as youth have failed to meet nutrition and physical activity (PA) recommendations (Friel et al., 2020; Lange et al., 2021). Only 7.1% of US adolescents consume enough fruit per day, and only 2.0% meet vegetable recommendations (Lange et al., 2021). Additionally, only 1 in 4 reportedly consume a whole-grain food in any 2-day period (Tester et al., 2017), and nearly two-thirds report consuming a sugary sweetened beverage (SSB) on a given day (Russo et al., 2020). Furthermore, recent data show that only 23% of youth are meeting the PA guideline of performing at least 60 minutes of PA every day of the week, and just 32.9% are meeting the recommendation of less than 2 hours of recreational screen time per day (Friel et al., 2020). Nutrition and PA behaviors practiced during youth often track into

adulthood and are associated with medium- and long-term cardiometabolic outcomes (Movassagh et al., 2017; van Sluijs et al., 2021).

Over the years, many school-based programs have been developed to improve these behaviors among youth (Evans et al., 2012; Nally et al., 2021). However, school-based interventions have produced mixed results regarding their effectiveness for improving these behaviors in children. For example, a meta-analysis found that school-based interventions led to moderate improvements in fruit intake but small benefits for increasing vegetable intake (Evans et al., 2012). In contrast, a more recent meta-analysis reported that school-based interventions did not improve fruit and vegetable consumption (Nally et al., 2021). Furthermore, a recent Cochrane Review found that school-based interventions appear to have little to no effect on increasing moderate to vigorous PA in youth aged 6 to 18 (Neil-Sztramko et al., 2021). The findings were partially due to inconsistent results from the studies included in the analyses. Due to the mixed results on school-based intervention effectiveness, it may be worthwhile to examine individual curricula on improving these outcomes.

While school-based programming has been popular among public health practitioners, there are other avenues that may also be effective for reaching youth (Hoelscher et al., 2002). In the U.S., approximately 60 million youth and adolescents participate in organized sports (Gould, 2019), and youth sports participation can play an influential role in improving a participant's physical, mental, and emotional well-being (Danish et al., 2003). Sports participation during adolescence is also associated with several positive nutrition behaviors, including higher vegetable consumption and eating breakfast more often (Heikkila et al., 2021). Healthy nutrition behaviors are important for adolescent athletes to promote normal growth and development and improve sports performance and recovery from exercise (Purcell, 2013). As such, the Peak Health and Performance (PHP) curriculum was designed to encourage healthy eating and long-term PA behaviors among youth using sports performance as a motivator (Gibbs & Becker, 2021). The PHP curriculum has been explained in detail elsewhere (Gibbs & Becker, 2021). In short, PHP is a nutrition education program developed by faculty and staff at Michigan State University's (MSU) College of Osteopathic Medicine, Spartan Performance Training Center, and MSU Extension. Specifically, the curriculum consists of 6 lessons focused on improving general and sports-specific nutrition behaviors, including information on macronutrient functions for performance, recommended food-group servings, energy balance, meal timing and intake, hydration recommendations, and selecting healthy meals and snacks from restaurants.

Peak Health and Performance was designed using Bandura's Social Cognitive Theory (McAlister et al., 2008), which accounts for how cognitive factors and one's environment impact learning and behaviors. Lesson content and learning activities center around improving the athlete's knowledge and self-efficacy around healthy eating behaviors and the importance of these toward improved health, as well as improved performance and recovery within their sport. Further, athletes and coaches are provided examples of how to create optimal environments to

reinforce these key messages. This follows the suggestion that learning through observation is achieved through the process of **attention** (observing and extracting critical information), **retention** (committing that critical information to memory), **reproduction** (practicing the observed behavior), and **motivation** (the intensity and direction of the desired behavior) (McAlister et al., 2008). An example of this includes the importance of pre- and post-workout nutrition, where athletes are provided examples of snacks and meals to consume to ensure proper energy levels and address recovery, and teams are given suggestions for incorporating these meals and snacks into their daily schedules.

Although this Supplemental Nutrition Assistance Program Education (SNAP-Ed) curriculum has been implemented in several schools across the state of Michigan, no results from the PHP curriculum have been published. Furthermore, the results have not been compared to an evidence-based youth curriculum with similar goals. One popular nutrition education curriculum that is widely used in SNAP-Ed is Teen Cuisine (TC). Created by Virginia 4-H and the Family and Nutrition Program (Price et al., 2017), TC uses primarily Kolb's Experiential Learning Model (McLeod, 2023) (specifically, the 5 steps that contribute to learning: experiencing, sharing, processing, generalizing, and applying from learned experiences [Price et al., 2017]) and Learner-Centered Education Model (Norman & Spohrer, 1996) within its lesson content and delivery. The curriculum's basis on these two models means that students learn through experience and use a greater level of understanding and thought process when learning nutrition concepts (Virginia Tech: Department of Human Nutrition & Virginia Cooperative Extension 4-H Youth Development Program, 2022). The program was designed to teach food preparation and cooking skills to adolescents, thereby promoting healthy eating behaviors including increasing fruit, vegetable, and whole-grain consumption. Additionally, the program included a PA component for each lesson. The curriculum consists of six 90-minute lessons that contain key nutrition content from the *Dietary Guidelines for Americans* (Virginia Tech: Department of Human Nutrition & Virginia Cooperative Extension 4-H Youth Development Program, 2022). Although the primary audience was originally 8$^{th}$- through 12$^{th}$-grade students, the materials have been adapted for younger audiences (5$^{th}$ through 12$^{th}$ grade) in later versions. Few studies have examined the effectiveness of TC in improving nutrition behaviors (Petty, 2016; Price et al., 2017; Wynn et al., 2016), and only 2 examined the effects of the intervention on improving food-safety practices (Petty, 2016; Price et al., 2017). For example, Price et al. (2017) reported that, as a result of the TC program, 72.1% of 531 high school students reported consuming more fruits and vegetables; 57.9% reported consuming less junk food; and 73.0% reported consuming less soda.

As there is a need to determine if the PHP curriculum is as effective as other SNAP-Ed curricula, the purpose of this research was to compare the PHP curriculum to an evidence-based, active comparison curriculum (TC) on improving nutrition and PA behaviors among Michigan adolescents. To the authors' knowledge, this will be the second study to examine pre- to post-intervention changes in nutrition behaviors following the TC intervention and the first study to

examine changes in PA behaviors. Furthermore, this is the first study to compare the effects of this curriculum to another.

## Methods

### Study design

This is a quasi-experimental study. The study was considered exempt by the MSU Human Research Protection Program (No. STUDY00009301). Child assent and parental consent were not required, as survey data were collected as part of MSU Extension's SNAP-Ed routine community nutrition programming efforts. Therefore, the data were examined as a secondary analysis. Participant assent was assumed by the participant's completion of the program evaluation survey. Participation was voluntary, and the participants could withdraw at any time during the lessons and survey completion.

### Study population

Participants for this study included middle school- and high school-aged youth who participated in either the PHP or the TC curriculum as part of MSU Extension's SNAP-Ed-funded community programming from October 2021 through September 2022. Community Nutrition Instructors (CNIs) recruit direct education participants through partnerships with local schools and other community organizations and provide nutrition education programming based on each site's needs. During the SNAP-Ed fiscal year 2022, CNIs from 20 counties in Michigan enrolled a total of 1,007 youth from grades 6 through 12 through schools and other community partners to participate in either the PHP or the TC curriculum.

### Instrumentation

Demographic information (i.e., grade level, gender, race) of those enrolled in the nutrition education programs was provided by the site leader or classroom teacher to the CNI. Demographic data were not self-classified by the individual students but collected in aggregate from each class using a group enrollment form. De-identified pre- and post-test evaluations were completed by those students attending the first lesson and the last lesson of the program, respectively. Nutrition, food-safety, and PA behaviors were measured using the age-appropriate Expanded Food and Nutrition Education Program (EFNEP) $6^{th}$-$8^{th}$ Grade or EFNEP $9^{th}$-$12^{th}$ Grade survey. These surveys have been approved by the U.S. Department of Agriculture's National Institute of Food and Agriculture to be used as part of program monitoring efforts among this demographic and are used among many land-grant universities nationwide. The survey instruments consisted of 14 questions, with the first 12 from each survey used in the current study. The last two questions on each survey were omitted, as they were different questions unique to either survey. Of the 12 questions, 6 questions could be classified as nutrition behaviors, 3 questions as food-safety behaviors, and 3 questions as PA behaviors. Four

of the nutrition-behavior questions asked the respondent about previous day intakes of different food groups: “Yesterday, how many times did you eat vegetables, not counting French fries?”; “Yesterday, how many times did you eat fruit, not counting juice?”; “Yesterday, how many times did you drink non-fat or 1% low-fat milk?”; and “Yesterday, how many times did you drink sweetened drinks like soda, fruit-flavored drinks, sports drinks, energy drinks, and vitamin water?” Response choices for these questions were: “None,” “1 time,” “2 times,” “3+ times,” and “4+ times” (coded from “0” to “4”), except for the last question about sweetened beverage consumption, as its response options stopped at “3+ times” (coded from “0” to “3”). Two other nutrition-behavior questions asked the respondent to indicate how often they consumed particular foods. These questions were: “When you eat grain products, how often do you eat whole grains, like brown rice instead of white rice, whole-grain bread instead of white bread, and whole-grain cereals?” and “When you eat out at a restaurant or fast-food place, how often do you make healthy choices when deciding what to eat?” Responses to these 2 questions included: “Never,” “Once in a while,” “Sometimes,” “Most of the time,” and “Always” and were coded from “1” to “5.”

Food-safety questions centered on how the respondent handled food, and these included: “How often do you wash your hands before preparing something to eat?”; “How often do you wash vegetables and fruits before eating them?”; and “When you take foods out of the refrigerator, how often do you put them back within 2 hours?” Response choices for these questions included: “Never,” “Once in a while,” “Sometimes,” “Most of the time,” and “Always,” with responses coded from “1” to “5.”

There were 3 PA-related questions. One PA question asked the respondent, “During the past 7 days, how many days were you physically active for at least 1 hour?” and included responses ranging from “0 days” to “7 days,” coded from “0” to “7.” Another PA question inquired about how often the respondent performed vigorous PA and was written as “During the past 7 days, how often were you so active that your heart beat fast and you breathed hard most of the time?” with the following responses: “Never,” “1 time last week,” “2 times last week,” “3 times last week,” and “4 or more times last week,” which were coded from “1” to “5.” The last PA question asked the respondent about average screen time per day and was written as “How many hours a day do you spend watching TV or movies, playing electronic games, or using a computer for something that is not schoolwork?” Responses for this question included: “1 hour or less,” “2 hours,” “3 hours,” “4 hours,” and “5 or more hours,” which were coded from “1” to “5.”

**Procedures**

Youth participated in a 6-lesson nutrition education program led by an MSU Extension CNI and participated in one lesson per week over a 6-week period. A summary of topics for each curriculum is illustrated in Table 1. Pre and posttest evaluations were completed during Lessons

1 and 6, respectively. Students who were absent during these lessons were not included in the overall analysis.

**Table 1. Curriculum Topics for the Peak Health and Performance and Teen Cuisine Curricula**

| **Peak Health and Performance** | | **Teen Cuisine (Active Comparison)[a]** | |
|---|---|---|---|
| **Lesson** | **Topic** | **Lesson** | **Topic** |
| Nutrition Basics | Importance of nutrition for performance<br>Energy balance<br>Macronutrient functions<br>Macronutrient recommendations | Eat Smart | Goal setting<br>My daily food plan<br>Cook like an expert<br>How to measure ingredients<br>Recipe reading<br>Cooking terms<br>Hand washing<br>Cutting/cooking techniques |
| Athletes Performance Plates | Training and energy demands<br>Athlete's plate models | You are What You Eat | Label reading<br>My daily food plan<br>Right size portions<br>How to use a chef's knife/cooking experience |
| Timing of Intake | Timing of intake and energy balance<br>Importance of eating breakfast<br>Meal frequency<br>Pre-workout nutrition<br>Post-workout nutrition | Power Up With Breakfast | Importance of eating breakfast<br>Nutrients on the Nutrition Facts Labels<br>How to cook eggs/cooking experiences<br>Cutting techniques |

**Table 1. Curriculum Topics for the Peak Health and Performance and Teen Cuisine Curricula**

| | | | |
|---|---|---|---|
| | Food safety practices | | |
| Hydration, Energy Drinks, and Sugary Beverages | Measuring hydration status<br><br>Sports drink recommendations<br><br>Hydration best practices<br><br>Energy drinks | Find the Fat | Choosing foods with go, slow, whoa!<br><br>Food comparison/cooking experience<br><br>Food safety |
| Convenience Foods | Choosing food at restaurants and convenience stores<br><br>Tips for eating out at restaurants and convenience stores | The Whole Truth on Whole Grains | Grain identification<br><br>Added sugars<br><br>Food safety<br><br>Cooking experience |
| More Than a Game | Sports as a vehicle for life | Snack Attack | Smart snacking<br><br>Measuring<br><br>Food safety<br><br>Cooking experience |

[a]Adapted from Table 1. The six lessons of the *Teen Cuisine* program, inclusive of topics and activities. (Price et al., 2017)

## Statistical analysis

Frequency data were calculated for all demographic variables and were compared using a chi-square test. Paired *t*-tests were performed to examine within-group differences following each intervention. A repeated-measures ANOVA was used to compare changes in nutrition, food safety, and PA behaviors between groups. Missing data were excluded case-wise for each variable listed. Data were analyzed using SPSS, version 28 (SPSS Inc., Chicago, IL), with significance determined at $P < 0.05$.

## Results

**Table 2. Baseline[a] Grade Level, Gender, and Race Characteristics of Students Enrolled in the Peak Health and Performance and Teen Cuisine Curricula**

| Characteristic | Peak Health and Performance | Teen Cuisine | *P* Value[b] |
|---|---|---|---|
| Total | 455 | 552 | |
| Grade, No. (%) | | | <.001 |
| 5th | 0 (0) | 11 (2) | |
| 6th | 118 (25.9) | 21 (3.8) | |
| 7th | 126 (27.7) | 42 (7.6) | |
| 8th | 128 (28.1) | 117 (21.2) | |
| 9th | 71 (15.6) | 178 (32.2) | |
| 10th | 6 (1.3) | 91 (16.5) | |
| 11th | 4 (.9) | 62 (11.2) | |
| 12th | 2 (.4) | 30 (5.4) | |
| Gender, No. (%) | | | .03 |
| Male | 249 (54.7) | 264 (47.8) | |
| Female | 205 (45.1) | 285 (51.6) | |
| Prefer not to respond | 1 (.2) | 3 (.6) | |
| Race, No. (%) | | | <.001 |
| American Indian/Alaskan Native | 0 (0) | 15 (2.7) | |
| Asian | 0 (0) | 18 (3.3) | |
| Black | 281 (61.8) | 77 (13.9) | |
| Native Hawaiian/Pacific Islander | 0 (0) | 1 (.2) | |
| White | 159 (34.9) | 416 (75.4) | |
| Prefer not to respond | 15 (3.3) | 26 (4.7) | |

[a]Sample sizes are higher in this table, as these represent the students who were enrolled at the beginning of either program, with characteristics being group-reported by a classroom teacher or site leader
[b]Compared using a chi-square test

The baseline grade level, gender, and race data of students enrolled at the beginning in both programs as reported by the classroom teacher or site leader are illustrated in Table 2. Overall, there were significant differences in all classroom variables collected at baseline. There were significantly more middle-school students enrolled in the PHP group and significantly more high-school students enrolled in the TC group ($P$ <0.001). There were significantly more males enrolled in the PHP group compared to the TC group (54.7% vs 47.8%; $P$ =0.03). Furthermore, there were significantly more black students enrolled in the PHP vs the TC group, and significantly more white students enrolled in the TC group compared to the PHP group. Since

demographic data were reported only at the group level, we are unsure of the demographic characteristics of those who completed both a pre- and a post-survey. At baseline, 960 of the 1007 enrolled students completed a pre-test survey, with 665 total students having completed both a pre- and a post-survey (PHP *n*=290; TC *n*=375). There were varying response numbers due to missing question responses.

**Table 3. Changes in Nutrition, Food Safety, and Physical Activity Behaviors Between Students Who Completed the Peak Health and Performance Curriculum (*n*=290) vs the Teen Cuisine Curriculum (*n*=375)**

| | Peak Health and Performance | | | | Teen Cuisine | | | | Between-Group Difference |
|---|---|---|---|---|---|---|---|---|---|
| **Question[a]** | **Pre** | **Post** | ***P* Value[a]** | **No.[b]** | **Pre** | **Post** | ***P* Value** | **No.[b]** | ***P* Value[c]** |
| Nutrition Behaviors | | | | | | | | | |
| Yesterday, how many times did you eat vegetables, not counting French fries? | 1.33±1.17 | 1.65±1.28 | <.001 | 290 | 1.44±1.19 | 1.63±1.25 | .003 | 372 | .17 |
| Yesterday, how many times did you eat fruit, not counting juice? | 1.33±1.35 | 1.56±1.29 | .01 | 288 | 1.55±1.27 | 1.80±1.30 | <.001 | 373 | .85 |
| Yesterday, how many times did you drink non-fat or 1% low-fat milk? | .82±1.15 | .84±1.21 | .85 | 289 | 1.06±1.26 | 1.06±1.23 | .97 | 372 | .91 |
| Yesterday, how many times did you drink sweetened drinks like soda, fruit-flavored drinks, sports drinks, energy drinks, and vitamin water? | 1.51±1.06 | 1.60±1.08 | .22 | 289 | 1.40±1.06 | 1.35±1.05 | .42 | 375 | .14 |
| When you eat grain products, how often do you eat whole grains, like brown rice instead of white rice, whole-grain bread instead of white bread, and whole-grain cereals? | 2.86±1.13 | 2.99±1.04 | .07 | 287 | 2.67±.96 | 2.79±1.02 | .03 | 371 | .91 |
| When you eat out at a restaurant or fast-food place, how often do you make healthy choices when deciding what to eat? | 2.48±1.09 | 2.41±1.07 | .34 | 288 | 2.33±1.03 | 2.43±1.03 | .05 | 372 | .05 |
| Food Safety Behaviors | | | | | | | | | |
| How often do you wash your hands before eating? | 4.32±.97 | 4.35±1.00 | .55 | 283 | 4.03±.99 | 4.06±1.06 | .65 | 371 | .92 |

**Table 3. Changes in Nutrition, Food Safety, and Physical Activity Behaviors Between Students Who Completed the Peak Health and Performance Curriculum (*n*=290) vs the Teen Cuisine Curriculum (*n*=375)**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| How often do you wash vegetables and fruits before eating them? | 4.27±1.21 | 4.40±1.15 | .05 | 277 | 3.99±1.21 | 4.02±1.25 | .69 | 366 | .25 |
| When you take foods out of the refrigerator, how often do you put them back within 2 hours? | 3.88±1.28 | 4.10±1.21 | .01 | 261 | 4.15±1.25 | 4.23±1.13 | .23 | 370 | .20 |
| Physical Activity Behaviors | | | | | | | | | |
| During the past 7 days, how many days were you physically active for at least 1 hour? | 4.01±2.21 | 4.10±2.27 | .52 | 282 | 4.19±2.22 | 4.57±2.02 | <.001 | 371 | .08 |
| During the past 7 days, how often were you so active that your heart beat fast and you breathed hard most of the time? | 3.35±1.32 | 3.44±1.34 | .21 | 281 | 3.19±1.31 | 3.34±1.27 | .03 | 368 | .67 |
| How many hours a day do you spend watching TV or movies, playing electronic games, or using a computer for something that is not schoolwork? | 3.79±1.38 | 3.78±1.31 | .96 | 263 | 3.58±1.37 | 3.41±1.36 | .01 | 367 | .10 |

[a]Within-group differences examined with a paired-samples *t*-test.

[b]Response sample sizes do not add up to the total sample size due to missing data.

[c]Between-group differences compared using a repeated-measures ANOVA.

### Nutrition Behaviors

Results revealed that the previous-day consumption for both vegetable and fruit significantly increased for both the PHP and TC curricula; however, there were no between-group differences ($P$ =0.17 and $P$ =0.85, respectively). Reported frequency of whole-grain consumption significantly increased for students who received the TC curriculum (2.67±.96 vs 2.79±1.02; $P$ =0.03), and there was a marginally significant increase for students who received the PHP curriculum ($P$ =0.07), with no group differences. There was a trend approaching significance for an increased frequency of choosing healthy foods at restaurants and fast-food restaurants in the TC group (2.33±1.03 vs 2.43±1.03; $P$=0.05), with no significant changes for the PHP group. There were no other significant differences in nutrition behaviors within or between either group.

### Food-Safety Behaviors

Regarding food-safety behaviors, there were no significant changes or differences in the frequency of washing hands for either group (Table 3). The reported frequency of washing vegetables and fruits before eating them for students following the PHP curriculum saw a marginally significant increase (4.27±1.21 vs 4.40±1.15; $P$=0.05), while the frequency of putting foods back into the refrigerator within 2 hours significantly increased (3.88±1.28 vs 4.10±1.21; $P$=0.01). There were no significant between-group changes for any of the surveyed food-safety behaviors, and none significantly changed for students who participated in the TC curriculum.

### Physical-Activity Behaviors

The reported number of days per week of being physically active for 1 hour significantly increased for students who participated in the TC curriculum (4.19±2.22 vs 4.57±2.02; $P$<0.001), but not for those in the PHP curriculum (4.01±2.21 vs 4.10±2.27; $P$=0.52) (Table 3). Further, the reported weekly frequency of vigorous PA significantly increased for the TC group (3.19±1.31 vs 3.34±1.27; $P$=0.03). The number of screen-time hours significantly decreased for the TC group, with no significant changes for the PHP group. There were no significant between-group changes for any of the PA behaviors.

## Discussion

This was the first attempt at comparing an emerging nutrition education curriculum (i.e., PHP) to an evidence-based curriculum (i.e., TC) used within SNAP-Ed programming. Although there were not many group differences between the two curricula, both PHP and TC demonstrated the ability to improve healthy behaviors among adolescent-aged participants.

Several improvements in nutrition, including improved fruit and vegetable consumption, were found among participants following either the PHP or the TC curriculum. Though limited data exist, Wynn et al (2016) did not find a significant change in previous-day fruit and vegetable

intake from participants who completed the TC intervention; however, these findings may be due to the low sample size ($n$ = 25). In a master's thesis with a larger sample size ($n$=531), it was reported that 27.2% and 44.9% of students "strongly agree" and "agree," respectively, that participation in the TC intervention led them to consume more fruits and vegetables (Petty, 2016). It is unclear if the results were statistically significant, as they were provided as a percentage of responses to Likert-scale questions. Improvements in fruit and vegetable intake among children and adolescents in school settings are consistent with the effectiveness of school-based interventions overall (Sharma et al., 2019; Wolfenden et al., 2021). In a systematic review by Wolfenden et al. (2021), it was reported that most school-based intervention strategies were effective in increasing intake of fruit and/or vegetables. However, Nally et al. (2021) found inconclusive results of school-based health interventions for increasing fruit and vegetable consumption. This suggests that examining an individual curriculum for impacts on these outcomes may be more favorable, compared to examining the impacts across multiple curricula.

Interestingly, there was not a significant change in reported prior-day SSB consumption following either intervention. A systematic review of 36 interventions focusing on adolescent behaviors found that 70% of these interventions effectively decreased SSB consumption (Vézina-Im et al., 2017). When examining previous work with the TC curriculum, Wynn et al. (2016) did not notice a significant change in intake or SSB consumption frequency ($P$=0.91) for adolescents who participated in the TC curriculum. In contrast, using the TC curriculum, Petty (2016) reported that the program led to favorable changes in drinking less soda and soft drinks, and Price et al. (2017) observed that 73% of respondents reported drinking less soda as a result of the TC intervention. It should be noted that it is unclear if the results observed in those TC interventions were significant for SSB consumption improvements, as no pre- to post-statistics were performed (Petty, 2016; Price et al., 2017). The systematic review by Vézina-Im et al. (2017) did note that interventions that changed school policies and environments using legislative and/or environmental changes had the highest success rate (90%) for decreasing SSB consumption. Perhaps, if both the PHP and TC curricula included a legislative and/or environmental change component, a decrease in SSB would have been more evident.

Reported frequency of whole-grain consumption significantly increased for TC and the PHP intervention, but only marginally for the latter ($P$ =0.07). In contrast to these findings with the TC curriculum, Wynn et al. (2016) did not observe a significant change in frequency of whole-grain intake. Petty (2016) did report that 20.9% and 39.2% of students strongly agreed and agreed, respectively, that participation in the TC program led to more whole-grain consumption, and Price et al. (2017) reported that 60.1% of participants reported consuming more whole grains following completion of the TC curriculum. Once again, it is unclear if the results observed were significant changes (Petty, 2016; Price et al., 2017). Although favorable results were observed for the TC intervention in the current study, perhaps an added intervention component would have yielded significant results for the PHP intervention. Multicomponent school-based health interventions are also effective in increasing whole-grain consumption (Burgess-Champoux et

al., 2008). Burgess-Champoux et al. (2008) performed a school-based intervention to increase whole-grain consumption among 4th- and 5th-grade students, which consisted of a five-lesson curriculum and increased offerings of whole-grain options in the cafeteria by food service professionals. Following the intervention, whole-grain consumption increased by one serving, while refined-grain consumption decreased by a serving. Additionally, Cohen et al. (2014) found that increased whole-grain offerings at lunch increase whole-grain availability to students. The results of the current study support the notion that various types of school-based interventions can improve whole-grain consumption in adolescents.

Overall, few school-based interventions have examined changes in food safety practices as a result of the intervention (Young et al., 2015). In a study of Indiana high school students, an eight-lesson food safety curriculum improved hand-washing techniques and the use of gloves when handling foods; however, exposure to the curriculum did not eliminate all unsafe food-handling practices, such as cross-contamination (Barrett & Feng, 2020). In the current study, neither group reported a significant change in how often students washed their hands before preparing something to eat. Petty (2016) reported that 90.6% of students who underwent the TC intervention, agreed or strongly agreed that program participation led to them washing their hands more before eating. Additionally, there was a significant effect by sex in washing one's hands prior to eating. In another study, 89.7% of 531 8th- through 12th-graders who had participated in the TC intervention reported washing their hands before eating (Price et al., 2017). Since the outcomes were measured differently, it is difficult to compare the changes examined in the current study to others that examined the effects of the TC intervention. There was a trend for a significant increase in the frequency of washing fruits and vegetables in the PHP group ($P$=.05), with no changes reported from the TC intervention. Furthermore, there was a significant increase in the frequency of putting food back into the refrigerator within 2 hours for students who participated in the PHP intervention, with no significant change for TC. Although both curricula include food-safety components, we are unsure why food-safety behaviors did not significantly improve in the TC group. Perhaps this is due to TC having a strong emphasis on food-preparation safety while cooking, while PHP emphasizes food-storage safety, which the specific EFNEP survey question mentions. Overall, the results observed for the PHP group add to the growing body of literature that knowledge of best practices for food safety can be improved for youth in school-based settings.

Interestingly, PHP did not significantly improve PA behaviors, while TC increased days per week of hourly PA, increased vigorous PA, and decreased screen time for students who participated in the program. These findings could result from the fact that the PHP curriculum has a PA component for only the last lesson, which highlights lifelong PA habits, while TC includes a PA component for each lesson. Further, PHP was typically delivered to student-athletes during their competitive season, which might also impact their reported PA. As seen in the literature, school-based interventions with PA as a component of the intervention increase PA levels in youth (Yuksel et al., 2020), which is supported by the results observed for the TC

curriculum. While PHP did not improve PA behaviors, it does promote a message of enjoying sports participation and encouraging life-long physical activity, which has been associated with health and well-being into adulthood (Eisenmann et al., 2020). Another potential explanation for the inability to observe significant changes for students who participated in the PHP curriculum was that those students may have mostly been athletes and already performed a higher amount of moderate or vigorous PA at baseline compared to their TC counterparts and, therefore, were unlikely to observe any notable changes. Further analyses corroborate this, as there was a trend for a greater number of days per week that the PHP participants reported performing activity that made their heart beat fast and breathe hard (3.33±1.29 days vs. 3.18±1.31 days; $P$ =0.05). It should be noted that, at baseline, the TC group reported significantly more days of being active for at least 60 minutes compared to the PHP group (4.19±2.20 days vs. 3.92±2.16 days; $P$ =0.04). Although differences do exist, the average number of days of PA were quite close, suggesting that perhaps including a PA component for each lesson may be beneficial in promoting more daily PA.

### Limitations

Due to the nature of data collection, demographic information could not be linked to each participant's pre- and post-test responses. Hence, we were unable to control potential confounders in our between-group analyses, which may have influenced the results. For example, there were more students in higher grade levels who participated in the TC program, and they may have had more autonomy over their food choices. Furthermore, the effectiveness of school-based health interventions may differ by ethnicity (Karczewski et al., 2016). However, we were able to include demographic variables for participating classrooms to provide an idea of the makeup of students enrolled in both programs, but we are not able to ascertain the ethnicity of those who completed either program. Also, as these data were collected through community nutrition education programming, attrition was noticed pre- to post-test because students were absent the day of evaluation, which could also have impacted the findings. Further, because of the limitations of the survey instrument used, behaviors such as breakfast consumption and sports-specific nutrition behaviors such as hydration practices could not be measured. As these are key behaviors promoted through PHP, future research should examine these behaviors.

## Conclusion

Overall, these results suggest that individual school-based interventions can be effective for improvements in nutrition, food-safety, and PA behaviors. Both of the SNAP-Ed curricula examined were effective in improving some adolescent nutrition behaviors, while TC was effective in improving PA behaviors. These results suggest that both curricula are viable options for use in SNAP-Ed nutrition education programs in middle and high schools. Future research will examine if knowledge of evidence-based sports nutrition practices improves in students who participate in the PHP curriculum. Furthermore, data collection with self-reported individual

demographic information would be instrumental in determining if these curriculum effects are affected by self-reported gender or race.

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