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# Behaviorally oriented nutrition education at a Russian summer camp improves children's dietary choices: a quasi-experimental study

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## Abstract

**Background:** It is presently unknown whether behaviorally oriented, theory-based nutrition education from a Western context could be effective for improving healthy eating behavior and its psychosocial determinants among Russian children. Effective nutrition education delivered in summer programs could potentially impact dietary patterns and play an important role in efforts to reduce childhood obesity. We hypothesized that nutrition education including an additional behavioral skills component would be superior to nutrition education without this component and that boys and girls would differ in their response to nutrition education.

**Methods:** Boys ($n = 19$) and girls ($n = 21$), aged 8–12 years, were assigned to one of two conditions receiving 15 daily sessions of behaviorally oriented, theory-based nutrition education. One condition received an additional skills training component, including activities such as snack preparation, role-playing, and games. An innovative objective measure was used to assess change in healthy snack choices. Psychosocial determinants of healthy eating (i.e., healthy eating knowledge, fruit self-efficacy, vegetable self-efficacy, healthy eating attitudes, and fruit and vegetable enjoyment) were assessed via questionnaire.

**Results:** Across both educational conditions, there were significant improvements in healthy snack choices ($p < .001$; Cohen's $d$ effect size = 1.33), attitudes ($p = 0.001$; $d = 0.55$), and knowledge ($p < 0.001$; $d = 0.80$), but not self-efficacy for fruit ($p = 0.822$; $d = 0.04$), vegetables ($p = 0.118$; $d = 0.25$), or enjoyment of fruits and vegetables ($p = 0.472$; $d = 0.12$). Contrary to our hypothesis, there were no significant differences in any change scores by nutrition educational condition ($p > 0.05$). Among the six outcomes, there was one significant sex difference for fruit and vegetable enjoyment change score ($p = 0.002$), as girls showed a larger increase in enjoyment over time compared to boys, and the overall nutrition education effects differed by sex ($F = 3.03$, $p = 0.019$).

**Conclusions:** Nutrition education, with or without behavioral skills training, was associated with improved healthy snack choices, healthy eating attitudes, and knowledge, but the impact differed by sex. Future research should evaluate the long-term impacts of behaviorally oriented nutrition education among Russian boys and girls.

**Trial registration:** ClinicalTrials.gov NCT03077464

**Keywords:** Health education, Diet, food, and nutrition, Health behavior, Prevention and control, Malnutrition

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## Background

In Russia, approximately 50% of the adult population is overweight or obese, and prevalence has rapidly increased since the mid-1990s [1]. Healthful eating patterns are important for obesity prevention, but the typical Russian diet is calorically dense, low in fruits, vegetables, and dietary fiber, and high in animal fat and added sugars [2]. Childhood and adolescence are key times when eating behavior patterns are established, and these patterns tend to be maintained into adulthood [3]. Throughout the school years, children become more independent and learn to make their own food choices [4]. Thus, nutrition education and primary obesity prevention are critical for Russian children to reduce obesity incidence and to improve the health of the general population in Russia.

Previous research indicates that nutrition education programs should be focused on behavior, based on theory, and should provide opportunities to develop food-related skills [4, 5]. Behaviorally oriented, theory-based programs tend to be more effective in producing actual behavior change (e.g., fruit and vegetable consumption) compared to programs that are merely knowledge-oriented [6]. Well-designed theoretically based nutrition education programs should focus not only on the desired dietary behavior, but also on motivators, confidence, and skills necessary to perform the behavior [7].

Little is known about the effectiveness of nutrition education in Russia, as there is a dearth of English-language peer-reviewed studies. It is presently unknown whether behaviorally oriented, theory-based nutrition education from a Western context is effective for improving healthy eating behavior and its psychosocial determinants among Russian children. Effective nutrition education delivered in summer programs could potentially impact dietary patterns and play an important role in efforts to reduce childhood obesity [8, 9]. The summer camp setting could provide children an opportunity to experience an intensive health promotion learning experience, to practice healthy behaviors in a context that promotes healthy social norms, and to implement new knowledge, which may help children to continue making healthy choices beyond the camp setting [4, 9, 10]. Therefore, the primary objective of the present study was to evaluate the short-term effectiveness of theory-based, behaviorally oriented nutrition education, with and without a behavioral skills component, in a Russian camp setting. A secondary objective was to determine whether boys and girls would respond differently to the intervention. Our hypotheses were as follows: (1) that nutrition education including an additional behavioral skills component would be superior to nutrition education without this component and (2) that boys and girls would differ in their response to nutrition education.

## Methods

### Study design

This study is quasi-experimental, evaluating differential changes from baseline to post-intervention for two nutrition education conditions, without random allocation (see Fig. 1). Members of our research team (NR, NU) were offered the opportunity to teach two daily nutrition education sessions during the camp.

### Participants and recruitment

The study took place at Yantar, a summer camp in the Northwestern part of Russia (Veshniaki village, Cherepovets district, Vologda region). At this annual camp, children usually reside on the campgrounds for 3 weeks (21 days) without leaving.

Out of the full camp population, 40 participants were randomly selected to be assigned to participate in the nutrition education sessions. Following random selection, participating boys and girls were assigned to one of two sessions by their camp counselors, who were blind to study details. Participants included boys ($n = 19$) and girls ($n = 21$) aged 8–12 years (mean = 10.4; $SD = 1.0$ year) with mean body mass index (BMI) percentile of 56.7 ($SD = 26.7$). Prior to the study, informed consent documents were obtained from parents (through the camp office), and from the study participants on the first day of camp. Participants' parents also completed a questionnaire to provide demographic data. The study was approved by the Institutional Review Board at Kansas State University.

### Instruments

A stadiometer (RM-1 Diakoms, Moscow, Russia) was used to measure standing height. A digital scale (VEM-150, A3, Massa-K, Saint Petersburg, Russia) was used to measure weight. A non-elastic tape measure was used to measure waist circumference.

To assess healthy snack choices behavioral change from baseline to post-intervention, a special printed menu of snack options was created, modeled on the work of Matvienko [11]. The snack menu comprised six snack choices, with instructions for participants to select any two options—participants were required to choose exactly two—of the six, which they were to receive at the end of the day's session. Based on NuVal scores [12], three high-nutritional-value foods (carrots = 99, grapes = 91, walnuts = 82) and three low-nutritional-value foods (crackers = 4, cookies = 2, sugar-covered cereal = 4) were available for selection.

Previously published scales were adapted to the Russian camp context and translated by a research assistant who is bilingual in English and Russian (NR) to assess (1) children's healthy eating knowledge (8 items [13]; Cronbach's $\alpha = 0.715$); (2) healthy eating

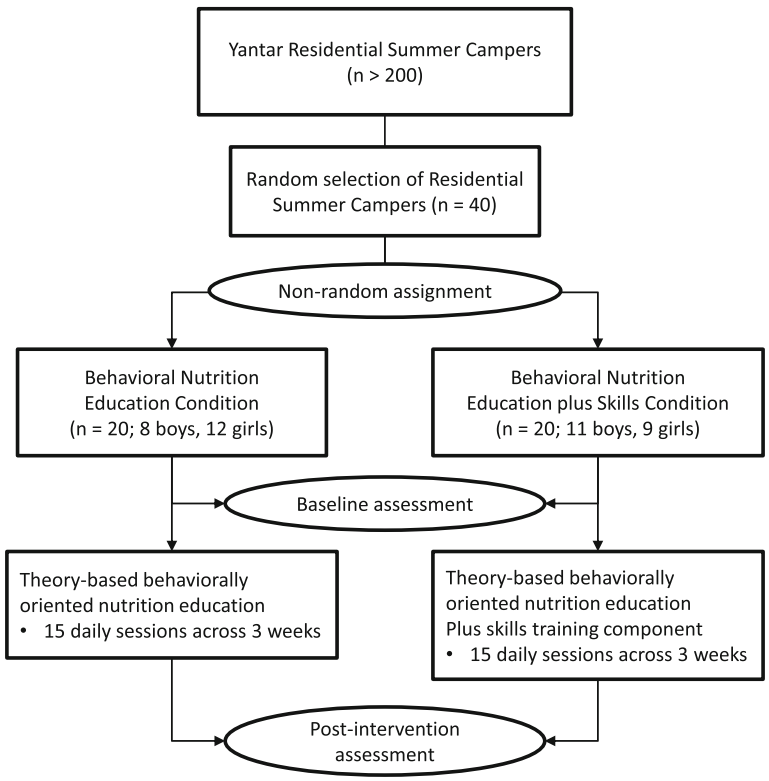


**Fig. 1** Flow diagram of participants within the study

attitudes (14 items [14]; Cronbach's $\alpha = 0.668$), self-efficacy for fruit consumption (3 items [15]; Cronbach's $\alpha = 0.796$), self-efficacy for vegetable consumption (3 items [15]; Cronbach's $\alpha = 0.841$), and enjoyment of fruit and vegetables (6 items [16]; Cronbach's $\alpha = 0.849$).

## Measures

Anthropometric measures (height, weight, waist circumference) were obtained on the day of arrival, by a trained research assistant, at the camp hospital building. Height was measured via stadiometer to the nearest 0.1 cm. Participants stood without shoes, heels together, with head held in Frankfort horizontal plane [17]. Weight was measured via a digital scale to the nearest 0.1 kg. Participants were shoeless, dressed in light clothing, for this assessment. Waist circumference was measured via inelastic tape measure, to the nearest 0.1 cm. Participants were asked to put their hands on their shoulders and to take a deep breath, followed by a slow exhale. Tape measure was placed around the abdomen, between the hip bone and umbilicus, parallel to the floor, with measurement at exhalation end. Height, weight, and waist circumference were measured three times for each participant, with mean used for data analyses. BMI percentile was calculated using gender, age, weight, and height for each child using the Centers for Disease Control and Prevention online calculator [18].

For healthy snack choices, each high-nutritional-value food chosen received a score of 2 (healthier), and each low-nutritional-value food received a score of 0 (less healthy). Participants' snack choice scores were calculated as the mean of their two chosen food items, with possible scores of 0, 1, or 2; higher scores represented healthier, more nutritious choices. For psychosocial determinants (i.e., healthy eating knowledge, fruit self-efficacy, vegetable self-efficacy, healthy eating attitudes, and fruit and vegetable enjoyment), mean scores were calculated for all items within their respective scales.

## Procedures

Anthropometric measures were obtained upon arrival at camp. On the first Monday (day 1), and on the last Friday (day 15) of nutrition education classes, each participant completed the set of behavioral determinant scales and snack choice menu. Research assistants read through scale items aloud, while participants silently completed scales as a class activity; all participant responses were kept confidential. After completion of the snack choices menu, participants were provided with their individually chosen pre-packaged snack foods for consumption in class, or afterward.

The behavioral nutrition education group sessions ran from 10 am until nearly 11 am, and the behavioral nutrition education plus skills training group sessions ran from 11 am until noon each weekday for three consecutive weeks. Both conditions used a set of curricular nutrition education modules, previously developed and based on Social Cognitive Theory, for the HOP'N After-School program [19, 20], with additional materials from MyPlate for kids [21]. These materials were employed to increase healthy eating behavioral capability, self-efficacy, attitudes, and enjoyment. Topics included (1) nutrition label literacy, (2) drinking water, (3) eating colors of the rainbow, (4) healthful snacks, (5) benefits of fruit and vegetable consumption, (6) moving more and sitting less, and (7) taking healthy habits home.

The behavioral nutrition education plus skills condition was designed to differ from behavioral nutrition education condition by devoting at least 15 min of each session to an additional behavioral skills training component. The behavioral skills component was designed to bolster behavioral capability, healthy eating attitudes, self-efficacy, and proxy efficacy with activities such as snack preparation sessions, role-playing games, fruit and vegetable tastings, and playing games that promoted healthier dietary behaviors. For both nutrition education conditions, educational materials were translated from English into Russian. All instruction was conducted in Russian by a bilingual research assistant (NR).

### Data analysis

Analyses were performed using SPSS version 22.0 (IBM Corp., Armonk, NY). Descriptive statistics were expressed as means ± standard deviations. Normality assumptions were assessed and were met for all outcome data. We used univariate ANOVA with a Bonferroni correction ($\alpha = 0.0083$) to assess differential change in snack choices and psychosocial determinants by educational condition and participant sex, and multivariate ANOVA ($\alpha = 0.05$) to assess the collective outcome by condition and sex. To assess change in snack choices and psychosocial determinants and from baseline to post-intervention time points, across educational conditions, paired $t$ tests were conducted with a Bonferroni correction ($\alpha = 0.0083$). To augment these analyses, we calculated 95% confidence intervals of means and Cohen's $d$ (effect size) by dividing the mean change score by the pooled standard deviation change score.

## Results

Table 1 displays baseline data for participants, including demographics, anthropometrics, and psychosocial determinants by sex and educational condition. Participants ranged in age from 8 to 12 years old. They ranged in body mass index from about 14 kg/m$^2$ to about 29 kg/m$^2$, representing a body mass index range that spanned the 1st to 98th percentiles. Psychosocial determinant scores showed ample variability and freedom from potential floor effects or ceiling effects for both sexes and both educational conditions.

Table 2 presents univariate and multivariate ANOVAs for healthy snack choices and psychosocial determinants by educational condition and sex. Results showed no significant differences in change scores by educational condition ($p > 0.05$). Among the six outcomes, there was

**Table 1** Characteristics of participating children at baseline

| | | All children ($n = 40$) | Boys ($n = 19$) | Girls ($n = 21$) | Behavioral nutrition education condition ($n = 20$: 8B, 12G) | Behavioral nutrition education + skills condition ($n = 20$: 11B, 9G) |
|---|---|---|---|---|---|---|
| | Range | M ± SD | M ± SD | M ± SD | M ± SD | M ± SD |
| Healthy snack choice | 0–2 | 0.8 ± 0.6 | 0.8 ± 0.6 | 0.8 ± 0.6 | 0.6 ± 0.6 | 1.0 ± 0.6 |
| Healthy eating knowledge | 0–8 | 5.0 ± 1.8 | 4.7 ± 1.8 | 5.3 ± 1.7 | 5.1 ± 1.4 | 5.0 ± 2.2 |
| Self-efficacy for fruit consumption | 1–3 | 2.5 ± 0.6 | 2.5 ± 0.6 | 2.4 ± 0.5 | 2.3 ± 0.6 | 2.7 ± 0.4 |
| Self-efficacy for veg consumption | 1–3 | 2.0 ± 0.7 | 2.1 ± 0.7 | 2.0 ± 0.6 | 1.8 ± 0.7 | 2.3 ± 0.6 |
| Healthy eating attitudes[a] | 1–5 | 1.6 ± 0.5 | 1.7 ± 0.6 | 1.5 ± 0.4 | 1.7 ± 0.6 | 1.5 ± 0.4 |
| Enjoyment of fruit and vegetables | 1–5 | 3.9 ± 0.9 | 4.4 ± 0.8 | 3.8 ± 1.0 | 3.8 ± 0.9 | 4.1 ± 0.9 |
| Body mass index (kg/m$^2$) | 13.8–28.8 | 18.3 ± 2.9 | 18.1 ± 2.5 | 18.4 ± 3.4 | 17.1 ± 1.9 | 19.4 ± 3.3 |
| Body mass index percentile | 1–98 | 56.7 ± 27.7 | 63.4 ± 26.2 | 50.6 ± 28.2 | 44.4 ± 23.2 | 69.0 ± 26.7[b] |
| Age (years) | 8.8–12.7 | 10.4 ± 1.0 | 9.7 ± 0.7 | 11.0 ± 0.7 | 10.5 ± 0.9 | 10.2 ± 1.0 |
| Weight (kg) | 23.9–77.3 | 39 ± 9.6 | 36.2 ± 6.4 | 41.6 ± 11.3 | 41.4 ± 11.5 | 36.6 ± 6.5 |
| Height (cm) | 126.5–163.9 | 145.3 ± 7.9 | 140.8 ± 5.9 | 149.4 ± 7.4 | 145.8 ± 7.3 | 144.8 ± 8.7 |
| Waist circumference (cm) | 52.9–100.5 | 65.8 ± 9.1 | 59.6 ± 3.1 | 71.3 ± 9.2 | 63.9 ± 5.6 | 67.7 ± 11.5 |

*B* boys, *G* girls, *n* sample size, *M* mean, SD standard deviation
[a]Reverse scored
[b]Significant difference in body mass index by condition

**Table 2** Behavioral change scores from baseline to post-intervention by educational condition and sex

| Univariate tests | Intervention condition M ± SD | | p | Sex M ± SD | | p | Condition by sex interaction p |
|---|---|---|---|---|---|---|---|
| | Behavioral nutrition education (n = 20) | Behavioral nutrition education + skills (n = 20) | | Boys (n = 20) | Girls (n = 20) | | |
| Healthy snack choices[a] | 0.9 ± 0.1 | 0.7 ± 0.1 | 0.338 | 0.9 ± 0.1 | 0.8 ± 0.1 | 0.381 | 0.967 |
| Healthy eating knowledge[a] | 0.8 ± 0.3 | 1.5 ± 0.3 | 0.125 | 1.5 ± 0.3 | 0.8 ± 0.3 | 0.183 | 0.974 |
| Healthy eating attitudes[b] | −0.3 ± 0.1 | −0.3 ± 0.1 | 0.975 | −0.3 ± 0.1 | −0.2 ± 0.1 | 0.600 | 0.830 |
| Self-efficacy for fruit consumption[a] | −0.1 ± 0.1 | 0.0 ± 0.1 | 0.718 | −0.1 ± 0.1 | 0.1 ± 0.1 | 0.191 | 0.024 |
| Self-efficacy for vegetable consumption[a] | 0.2 ± 0.2 | 0.1 ± 0.2 | 0.665 | 0.0 ± 0.2 | 0.4 ± 0.2 | 0.063 | 0.088 |
| Enjoyment of fruits and vegetables[a] | −0.1 ± 0.2 | 0.3 ± 0.2 | 0.281 | −0.4 ± 0.2 | 0.6 ± 0.2 | 0.002[c] | 0.305 |
| | Intervention condition | | | Sex | | | Condition by sex interaction |
| Multivariate tests | Value | F | p | Value | F | p | p |
| Wilks' Lambda | 0.861 | 0.834 | 0.553 | 0.370 | 3.029 | 0.019[d] | 0.358 |

Notes: *n* = sample size; *M* = mean; *SD* = standard deviation; *F* = F-statistic from ANOVA; *p* = probability; means are estimated marginal means ± standard deviation; alpha set at 0.00833 for multiple univariate tests, alpha set at 0.05 for multivariate tests

[a]Positive means indicate improvement from baseline to post-intervention for snack choice, healthy eating knowledge, self-efficacy, and enjoyment

[b]Negative means indicate improvement from baseline to post-intervention for attitudes

[c]Change in enjoyment significantly differed by sex, such that girls improved more than boys

[d]Significant multivariate effect by sex, suggesting that nutrition education worked differently for girls, as compared to boys

one significant sex difference for fruit and vegetable enjoyment change score ($p = 0.002$), as girls showed a larger increase in enjoyment over time compared to boys. There were no significant interactions between nutrition education conditions and sex when accounting for Bonferroni correction ($p > 0.0083$). In the multivariate analyses, which examined differences in all outcomes collectively, there were no significant differences between conditions ($F = 0.083$, $p = 0.553$), and no significant interaction between condition and sex ($p = 0.358$). There was, however, a significant multivariate effect by sex ($F = 3.03$, $p = 0.019$), indicating that the nutrition education programs worked differently for girls, as compared to boys.

Table 3 presents healthy snack choice and psychosocial determinant scores at baseline and post-intervention, across educational conditions. Among the six outcomes, there were significant differences between baseline and post-intervention scores for healthy snack choices ($t = 9.50$, $p < 0.001$), healthy eating knowledge ($t = 5.04$, $p < 0.001$), and healthy eating attitudes ($t = 3.46$, $p = 0.001$). The Cohen's effect sizes can be described as large for healthy eating knowledge and snack choices, and described as medium for healthy eating attitudes. There were no significant differences between baseline and post-intervention scores for enjoyment of fruit and vegetables, or self-efficacy for consumption of fruit or vegetables ($p > 0.05$). Across both educational conditions, all behavioral determinants and snack choices (see Fig. 2) indicated quantitative improvement from baseline to post-intervention, with statistically significant changes seen in healthy eating knowledge, attitudes, and snack choices.

## Discussion

The present study's objective was to evaluate the short-term effectiveness of two theory-based behaviorally

**Table 3** Outcomes from baseline to post-intervention across both behavioral nutrition education conditions (n = 40)

| | Baseline M ± SD | Post-intervention M ± SD | Cohen's d | Observed 2-tailed power | t | p value |
|---|---|---|---|---|---|---|
| Healthy snack choices | 0.8 ± 0.6 | 1.6 ± 0.6 | 1.33 | 0.98 | 9.50 | <0.001 |
| Healthy eating knowledge | 5.0 ± 1.8 | 6.2 ± 1.4 | 0.80 | 0.69 | −5.04 | <0.001 |
| Healthy eating attitudes[a] | 1.6 ± 0.5 | 1.3 ± 0.4 | 0.55 | 0.39 | 3.46 | 0.001 |
| Self-efficacy for fruit consumption | 2.5 ± 0.6 | 2.5 ± 0.6 | 0.04 | 0.03 | −0.23 | 0.822 |
| Self-efficacy for vegetable consumption | 2.0 ± 0.7 | 2.2 ± 0.7 | 0.25 | 0.12 | −1.60 | 0.118 |
| Enjoyment of fruit and vegetables | 3.9 ± 0.9 | 4.1 ± 1.0 | 0.12 | 0.06 | −0.73 | 0.470 |

Notes: [a]Reverse scored, lower scores indicate better attitudes, *n* sample size, *M* mean, *SD* standard deviation; *t* *t* statistic from paired *t* test, *p* probability value, *d* Cohen's *d* effect sizes, based on pre–post differences: 0.2–0.49 are small effects; 0.5–0.79 are medium effects; ≥0.8 are large effects

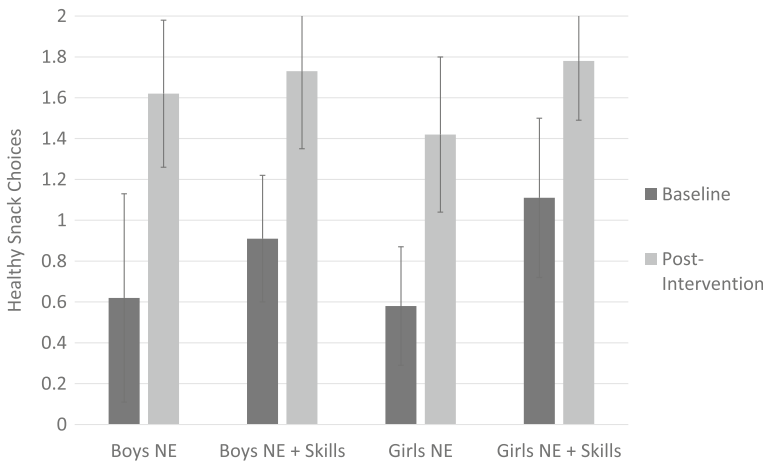


**Fig. 2** Healthy snack choices from baseline to post-intervention by condition and sex. *Bars* represent mean healthy snack choices; *whiskers* represent 95% confidence intervals. NE = nutrition education; NE + Skills = nutrition education with additional skills component

oriented nutrition education programs among boys and girls attending a summer camp in Northwestern Russia. Our main finding was that a relatively brief nutrition education intervention can have significant impact, with or without additional skill-building components. We hypothesized that both educational conditions would be associated with improvements in healthy snack choices and psychosocial determinants of healthy eating, and this hypothesis was supported. Although results indicated improvement for snack choices, healthy eating knowledge and attitudes across both conditions, our hypothesis that the addition of a behavioral skills component would be more effective was not supported by the results. This was surprising, given the substantial additional focus within daily sessions on behavioral skills, and the recommendations within nutrition education literature [4, 5]. It is possible that children in the nutrition education condition without additional skills training learned relevant behavioral skills without specific instruction or additional focus within the daily sessions, and that the theory-based behaviorally oriented nutrition education was sufficient to produce changes.

Our second hypothesis that boys and girls would respond differently was partially supported, in that change in enjoyment of fruits and vegetables differed by sex, and the overall multivariate test was significant by sex. Results showed a differential effect in enjoyment of fruit and vegetables by sex, such that girls showed improvement, while boys' scores worsened from baseline to post-intervention. Extant literature has shown that the impact of nutrition education often differs by sex [22, 23], and the current study extends that literature by demonstrating this phenomenon in a Russian context. Furthermore, systematic review by Kropski and colleagues [23] suggested that nutrition education programs that are based on social learning may be more appropriate for girls than for boys, while programs that involve environmental interventions with physical activity may be more suitable for boys. Kohlstadt and colleagues [22] found that girls who participated in single-sex nutrition intervention programs showed greater effect than girls who participated in coeducational programs, so developing and conducting separate nutrition education programs could potentially be beneficial for both sexes.

The largest effect size between baseline and post-intervention assessments was in healthy snack choices, as both educational conditions and both sexes shifted away from foods low in nutritional value, toward food higher in nutritional value. There was no difference between educational conditions, or between sexes for this outcome, suggesting that all participants understood the differences in nutritional value for the six snack choices, and made their selections accordingly. This finding is similar to that of Matvienko [11] who found that children who received nutrition lessons and healthy snacks were more likely than a comparison group to choose healthy snacks from a menu of various foods. Unlike Matvienko [11], who included a 4-month follow-up and showed sustained impacts from the intervention, the present study included only post-intervention snack choice data.

Consistent with a recent systematic review of interventions promoting healthy eating among children in Europe [24], our study found significant improvement in healthy eating knowledge and also attitudes associated with both educational conditions. Although boys appeared to improve knowledge scores more than girls did, there was no statistically significant difference by sex. At the post-intervention time point, boys and girls were nearly identical in their healthy eating knowledge scores, which suggests that the nutrition education lessons and instruction may have helped reduce disparities in knowledge between boys and girls.

Our study participants did not show significant increases in self-efficacy or enjoyment related to fruit and vegetable consumption, although there was a non-significant small effect ($d = 0.25$) across nutrition education conditions for self-efficacy to consume vegetables. This lack of significant and larger effects was contrary to our hypotheses that were derived from Social Cognitive Theory [25]. According to this theory, self-efficacy can be increased by participating in active mastery experiences, through verbal persuasion, by observing a behavioral role model, and through emotional arousal. Both of our nutrition education conditions involved verbal persuasion and role modeling, and the enhanced condition was rich in active mastery experiences. We hypothesized that having a female nutrition educator may have contributed to differential impacts in self-efficacy between boys and girls, as Social Cognitive Theory indicates that role models who are apparently more similar to the learner are more likely to be effective models. Notwithstanding these hypotheses, there were no significant differences in self-efficacy by sex or educational condition; although self-efficacy for both fruit and vegetable consumption in girls was numerically higher, the difference was not significant. It is difficult to explain the lack of detectable effect on self-efficacy, but it is possible that children responded to the content of the items on the scales (e.g., how sure are you that you can eat one serving of fruit each day?), based on a real perception of poor availability outside of the camp setting, or that the scales are not sufficiently valid or sensitive to change. In the original HOP'N After-school program [19], there was a similar lack of detectable impact on self-efficacy, so the lack of effect observed in the present study is not without precedent. In the Nutribee Intervention [22], girls experienced much smaller self-efficacy gains in coeducational settings as compared to the larger gains made in girls-only settings. So, it is conceivable that the present study could have made significant impacts on fruit and vegetable self-efficacy, at least among girls, if we had employed sex-segregated nutrition education classes.

### Limitations

The present study holds several limitations: Primarily that it was a small and non-representative sample of Russian children; it used self-reported measures that were not validated for use in the Russian context to assess behavioral determinants; and it assessed only the short-term impacts of nutrition education. Another limitation is that we did not employ a no-treatment control group to serve as comparator, and the two educational conditions were very similar to one another, limiting our potential for determining differences in effectiveness between the two conditions. It is possible that demand characteristics and social desirability bias may also have influenced the results, particularly for the post-intervention time point, although we would also expect to see such bias appear in measures of self-efficacy and enjoyment, and that was not apparent. It is also possible that some level of contamination could occur if children discussed their nutrition education experiences at length outside of the classroom, although it is doubtful this was a widespread practice at the camp. Counter-balancing these limitations was the strength of using an innovative and ecologically valid behavioral indicator of healthy snack choices to measure impact. This measure was unique in that it was backed with real-world consequences for participants in receiving the chosen snacks, and simultaneously losing the opportunity to receive the snacks that were not chosen. The present study has unique potential to contribute to the literature by providing otherwise scarce nutrition education evaluation data not only from a summer camp context, and also among Russian children. Future studies could examine the short- and long-term impacts of nutrition education interventions within larger camp systems or organizations of Russian summer camps, and could do so in comparison to a no-treatment control group.

Providing nutrition education in summer programs within Russia may ultimately be an important component of an effective national strategy to improve dietary habits and reduce weight gain to reduce obesity incidence, but further research and implementation of nutrition education programs in Russian school-aged children are warranted. Researchers and practitioners should investigate the benefits and drawbacks of sex-segregated nutrition education programs. Additionally, both researchers and practitioners could evaluate combinations of behaviorally oriented nutrition education with structural and environmental interventions to promote healthy eating, particularly those drawing on lessons from behavioral economics and choice architecture [22, 24, 26].

## Conclusions

Regarding the primary objective, the present study shows a positive impact of theory-based behavioral nutrition education program, with or without a behavioral skills component, on children's healthy snack choices, knowledge, and attitudes. Nutrition education had differential impact, however, on boys and girls; girls showed improvement in enjoyment of fruit and vegetables, while boys' scores worsened from baseline to post-intervention. Future research should assess nutrition education interventions relative to a no-treatment control group, across a variety of Russian camp settings, and examine the long-term impact on dietary behavior and weight status.

#### Abbreviations

ANOVA: Analysis of variance; BMI: Body mass index; HOP'N: Healthy Opportunities for Physical Activity and Nutrition; M: Mean; N: Sample size; SD: Standard deviation

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**Availability of data and materials**
https://www.researchgate.net/profile/Richard_Rosenkranz/publication/313191829_Data_from_a_nutrition_education_intervention_at_Russian_children's_camp_Summer_2014/data/5892187e458515aeac945912/RussianNutrEduc1Feb17.sav.

**Authors' contributions**
NR and RR conceived the study. SR, DD, and NU provided critical input on study design and data collection procedures. NR and NU traveled to Russia and collected the data; NR delivered the nutrition education sessions. NR and NU input and cleaned the data. RR and DD analyzed the data. RR wrote the first draft of the article. All authors edited and provided critical feedback on the manuscript and approved the final version.

**Ethics approval and consent to participate**
This study was conducted according to the guidelines issued by the Declaration of Helsinki, and all procedures involving human subjects were approved by the IRB at Kansas State University (approved project #7214). We obtained written informed consent from all participants and their parents/caregivers. The study was registered on ClinicalTrials.gov, identifier: NCT03077464.

**Consent for publication**
Not applicable.

**Competing interests**
The authors declare that they have no competing interests.

## Publisher's Note



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