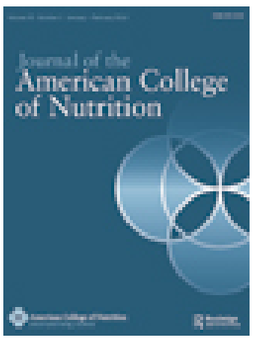

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Journal of the American College of Nutrition

ISSN: 0731-5724 (Print) 1541-1087 (Online) Journal homepage: http://www.tandfonline.com/loi/uacn20

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To cite this article: Ingrid Kohlstadt MD, MPH, Joel Gittelsohn PhD, MSc & Yu Fang MSPH, RD Candidate (2016): NutriBee Intervention Improves Diet and Psychosocial Outcomes by Engaging Early Adolescents from Diverse and Disadvantaged Communities, Journal of the American College of Nutrition, DOI: 10.1080/07315724.2015.1110507

To link to this article: http://dx.doi.org/10.1080/07315724.2015.1110507

Original Research

NutriBee Intervention Improves Diet and Psychosocial Outcomes by Engaging Early Adolescents from Diverse and Disadvantaged Communities

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Key words: early adolescence, collaborative, inquiry-based, hands-on and experiential learning, games-based learning, food safety, nutrition education, Institute of Medicine, community-based participatory research, preventive medicine

Objective: NutriBee was the first clinical nutrition intervention designed to bring the Institute of Medicine recommendations for 20 hours of experiential nutrition-themed learning to grades 4–7 into club and camp settings. We piloted NutriBee to assess acceptability and impact among early adolescents in diverse and disadvantaged communities in order to evaluate its future potential as a group medical nutrition intervention.

Methods: Nine communities across Guam, Maryland, Michigan, and New Mexico representing South Pacific Island, American Indian, urban African American, recently immigrated Hispanic, and rural Caucasian ethnic groups piloted NutriBee in nonclinical settings (clubs, schools, camps). The 6 club and camp pilots administered consenting NutriBee participants a 41-question pre–post survey assessing impact on food selection and the psychosocial parameters of intentions, outcome expectations, self-efficacy, and knowledge. Process measures included dose, fidelity, and acceptability questions.

Results: Pre- and postsurveys were completed by 170 of 179 (95%) consenting, eligible participants. Impact scores increased significantly ($p < 0.001$): Food selection behavior (+9.3%), intentions (+19.1%), outcome expectations (+15.1%), self-efficacy (+7.4%), and knowledge (+17.6%). Each pilot ($n = 6$) demonstrated significant ($p < 0.001$) impact, a mean dose delivered of 80% (16 hours) or higher, and an acceptability score of at least 74%. Girls participating in girl-only programs ($n = 72$) shared greater impact than girls in coed programs ($n = 41$; 13.6% vs. 10.4% mean score increase, $p = 0.05$).

Conclusions: NutriBee successfully extended the impact of an IOM-aligned intervention to club and camp settings to which clinicians can refer at-risk early adolescents.

BACKGROUND

The Institute of Medicine (IOM) reports that schoolchildren who participate in 20 hours of hands-on nutrition learning annually are absent less and score higher on standardized tests [1]. The IOM's findings build on the foundational work of Dr. Maria Montessori [2] and life-course approaches implemented in school settings [3–6]. Children experiencing healthful foods are more likely to prefer and eat those foods later and develop eating patterns that promote healthy growth and weight [7,8]. Recent studies corroborate these findings with the impact of gardening [9] and fruit and vegetable consumption [10,11].

Despite the evidence, school uptake of IOM-aligned programs is low. For most schools, the IOM recommendation represents a 10-fold increase in nutrition curricula [1], which may be challenging to implement. Among implementation barriers are insufficient teacher topic-specific knowledge of nutritional science, competing classroom priorities, sparse classroom resources, and unavailability of curricula that celebrate the diverse food traditions of America's communities [12].

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Journal of the American College of Nutrition, Vol. 0, No. 0, 1–9 (2016) © American College of Nutrition
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Accompanying the implementation gaps is a research gap in studying how to combine the knowledge acquisition needed to navigate modern food choices and the engagement needed to make nutrition relate to today's early adolescents [13]. As fast-food marketing becomes increasingly sophisticated, harder to avoid and targeted to progressively younger ages, industry is spotlighting the lack of comparably effective strategies for positive nutrition engagement. Industry's untoward impact has been gained with extensive proprietary research on brand "education" and innovating methods to engage early adolescents [14].

Another gap is cross-talk between the classroom and the clinic. The IOM's findings are metrics of both health and academic achievement, implying that school teachers and health professionals have overlapping aims. At-risk pupils are often at-risk patients. We found no established infrastructure for health professionals and teachers to collaborate toward nutrition engagement for early adolescents [12].

Community-based clubs and camps have been able to overcome some of the barriers common to schools, and research has shown impact [15,16]. The intensity of effective nutrition interventions vary from offering more healthful foods at residential camps [17] and incentivizing nourishing packed lunches [18] to immersion camps for youth with medical conditions [19]. Clubs and camps tend to emphasize behavior change and link nutrition to students' outside-of-school interests and the natural environment [20]. Some youth participate in community organizations across several years, enabling sustainable life-course interventions separate from and complementary to schools. Participants and instructors are more likely to be able to opt in or choose the nutrition intervention, and voluntary participation enhances impact [21]. Primarily because they tend to be engaging and participation is voluntary, clubs and camps for nutrition-related chronic diseases achieve higher retention than similar programs in clinical settings [22–24].

The overarching goal of this pilot trial was to design, implement, and evaluate the IOM-aligned NutriBee intervention for fourth- to seventh-grade (ages 9–12 years) boys and girls in school and community settings. We reasoned that impact and acceptability were outcomes clinicians would consider when referring early adolescents with nutrition-related chronic diseases to interventions in nonclinical settings. This was the first IOM-aligned 20-hour program implemented primarily in community-based club and camp venues, coinstructed by teachers and health professionals and evaluated for impact on diet and psychosocial parameters of participants.

METHODS

NutriBee Intervention

NutriBee was developed as a preventive nutrition intervention for clinicians to refer their early adolescent patients at risk for nutrition-related chronic diseases. Preventive nutrition behaviors commonly recommended by clinicians for their pediatric patients form the basis of the NutriBee intervention (Table 1), but because few clinics currently provide group medical visits for preventive nutrition due to well-characterized barriers [24–26], NutriBee was developed for nonclinical settings with both clinicians and educators as instructors.

Acquiring positive nutrition behaviors is especially important for early adolescents at high risk for nutrition-related chronic diseases [27]. However, because the IOM [1] demonstrated that early adolescents universally benefit from nutrition-themed learning, chronic disease risk was not a selection criterion in this pilot trial.

The intervention consists of 20 hours of active nutrition-themed learning aligned with the IOM recommendation and consisting of 10 2-hour modules (Table 1) [28]. Each module addresses 2 to 4 of 10 selected nutrition behaviors (Table 1). The nutrition behaviors were selected to be achievable by participants from households with food insecurity and from diverse cultures and geography.

To achieve impact sufficient to change the target behaviors, an intervention needs to come across as relevant and engaging to its participants [29,30]. Therefore, multiple engagement strategies proven effective among early adolescents were incorporated into NutriBee's learning materials:

Table 1. Key Health Behaviors of the NutriBee Intervention, Organized by Curriculum Module

Behavior No.	Key Health Behaviors	Title of 2-Hour Module	Behavior Nos. Emphasized
1	Mindful eating (tasting and smelling food)	Taste testing hot cocoa: Don't yuck my yum	1, 3, 9
2	Balanced portion sizes	Rice and Bean-efits	4, 5, 9
3	Less sugar	Inventing healthful ice cream	2, 3, 6
4	More fiber	"Sea" 4 yourself	6, 9, 10
5	More food from plant sources	Ethnobotany: Connecting plants and people	5, 9
6	Less processed and saturated animal fat	Sweet sensations	1, 3
7	Proper hydration	Hydrating the athlete	3, 7
8	Eating breakfast	I "eight" my breakfast	1, 8, 10
9	Linking food with its natural sources	The why in buy	4, 6
10	Using food safely	My plate, my planet	1, 9, 10

- Active learning was selected to be:
  - multisensory, emphasizing taste and smell [2,31,32].
  - collaborative to include communal food preparation and eating [20,32].
  - inquiry-guided similar to science, technology, engineering, math programs [33].
  - games-based to incorporate physical activity and reinforce collaboration [21,34–36].
- Entertainment–education was incorporated using a bee-style game show as the primary review activity [28,37–39]. A collaborative national-level gameshow is being planned.
- Peer leadership was incorporated because youth have a unique conduit for engaging early adolescents. We have published the findings of NutriBee's youth-led component [13].
- Household-level involvement includes take-home activities and food-related incentives. Participants equipped with take-home activities and food-related incentives are able to be change agents at home, reinforcing the perceived value of the intervention [32].
- Community involvement has been shown to increase impact among NutriBee's pilot communities [40,41] and elsewhere [42]. NutriBee incorporates community venues, instructors, and organizations.

Figure 1 illustrates NutriBee's framework and how each component relates to the foundational 20 hours of active learning. A sample game show is appended.

NutriBee considered the needs of low-income communities. It can be implemented without computers and kitchen access for participants. The learning materials, nonperishable foods and supplies, are organized by module and shipped to the sites, and nonconsumable items are then returned. The role of incentives was expanded beyond their conventional uses for motivation and reinforcing concepts in order to equip low-income families with items important for safe food handling and healthful behaviors.

The intervention was developed to proactively minimize risks from food exposure and address the concern voiced by schools and community partner organizations around food allergies (Table 2).

Instructor Selection and Training

All pilots were coinstructed by school teachers and health professionals as described in Table 3. Instructors responded to e-mails and web postings of Johns Hopkins University, NutriBee, and the local school and community organizations hosting NutriBee. Instructors held a degree in education or health sciences or were enrolled in a health sciences degree program at Johns Hopkins University. Each instructor was interviewed by one or more members of NutriBee's research team. Instructors received the NutriBee instructor training manual, an informational video, and in-person instruction. The in-person instruction was presented as 1–3 hours of experiential learning intended to parallel the learning format of the NutriBee intervention, culminating in a game show. On completion of the pilot, instructors received a stipend (sites 1–6) and certificate of participation and were asked to complete an anonymous process evaluation form.

Study Site Description

The 3 school-based pilots were implemented in intervention sites A, B, and C of the OPREVENT (Obesity Prevention Research and Evaluation of interVention Effectiveness in NaTive North Americans) community intervention trial as the fifth- to seventh-grade curriculum. Sites A–C completed the process evaluation but did not participate in the NutriBee Youth Impact Questionnaire (NYIQ).

Girl Scouts of Central Maryland (GSCM) was the community partner for sites 1 and 4. NutriBee was offered to girls in the fifth to seventh grades from Title 1 schools. Some girls were participating in a GSCM health program entitled Girlz Go Fit. NutriBee was offered at no cost and transportation was provided. The buffet lunch provided daily allowed participants

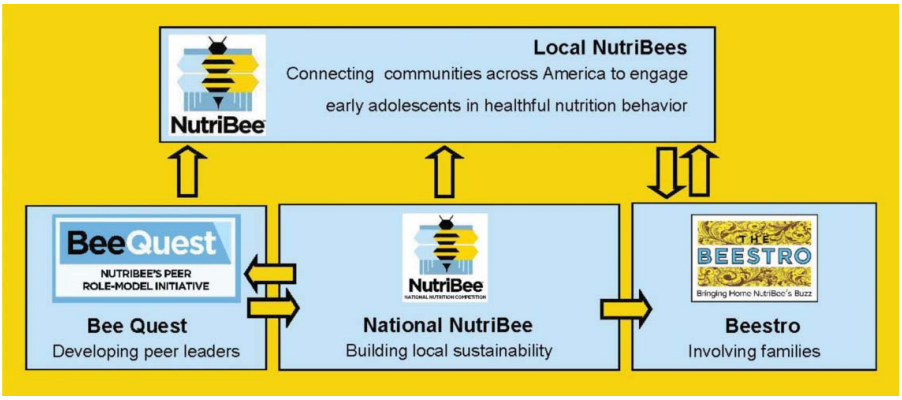

Fig. 1. NutriBee is a nutrition intervention for early adolescents. To increase impact, NutriBee is implemented in nonclinical settings and includes cross-age peers, household reach, and a planned national platform.

Table 2. Measures Taken to Reduce Food-Related Risks in an Experiential Nutrition Program for Early Adolescents

Measure #	Measures taken to reduce food-related risks
1	Foods with elevated risk of acute allergies were excluded or substituted for less allergenic foods of equal or greater nutritional value.
2	Schools and community organizations were asked to provide a written copy of their updated food policy.
3	Perspective was provided that although food allergies can develop at any age, NutriBee participants average 10–12 years of age, which is a time when new onset acute food allergies is relatively low.
4	Religious dietary codes were considered. Specifically, a Jewish day school and a school affiliated with the Seventh Day Adventists field-tested the materials at their school.
5	Participation in food-related activities while encouraged was voluntary.
6	Safe food handling including hand-washing is part of every 2-hour module, thereby reducing infection risk and risk of allergic reactions from indirect contact.
7	Health professionals are coinstructors and their role includes teaching safe food handling practices.
8	Although kitchens are not required for the curriculum, if present, they were expected to be maintained at health department specified standards.
9	Participants were invited to report any food allergies, intolerances, or religious abstentions during registration, so that substitutions could be made where possible.

to gain experience in food selection. NutriBee was augmented by approximately 8 hours of GSCM-led activities including a rock wall, dancing, crafts, and nature talks.

Site 2 was a club held on Saturdays at Maryland City Elementary School. Flyers were distributed in English and Spanish through the school. The aspects of NutriBee that emphasize reading and reasoning skills were highlighted and physical activity was incorporated daily. A buffet lunch was served to apply skills on food selection.

As the community partner for sites 3 and 5, Chesapeake Bay Environmental Center enrolled rising fifth- to seventh-grade students in urban Anne Arundel County and rural Queen

Table 3. Characteristics of NutriBee Pilot Study Sites Listed in Chronologic Order

Study Site	Program Venue	Geography	Primary Race or Ethnicity	Instructors	Month of 2013	Length in Days	Survey Interval in Days	Participants (*n*)	Mean Age in Years	Percentage Girls
Sites A–C	Schools	Tribal land	Native Americans	School teachers; community health workers	February–June	10	NA	NA	NA	NA
Site 1	Camp	Suburban	Multicultural	School teacher, physicians, program educators	March	4	4	29	9.9	100
Site 2	Club	Suburban	Multicultural	School teachers, physician	April	4	35	25	10.2	52
Site 3	Camp	Rural	Caucasian	School teachers, environment education director, physician, high school student volunteers	June	4	4	43	10.5	42
Site 4	Camp	Urban	African American	School teacher, program educators, medical student, public health specialist	August	4	4	29	10.8	100
Site 5	Camp	Rural	Caucasian and Hispanic	School teachers, education director, public health specialist, physician, high school volunteers	August	4	4	34	10.5	35
Site 6	Club	Island	Pacific Islanders	School teacher, program director, health educators, doctoral-level nutritionist	September	9	11	19	11.5	100
Total								$N = 179$	10.5	67

Anne County Maryland attending Title 1 elementary and middle schools. Students from non-Title 1 schools were enrolled on a space-available basis and received the same benefits of no cost to attend the camp, buffet breakfast, and transportation if needed. The NutriBee intervention was augmented by outdoor sports and nature hikes that related nutrition to ecology and environmental conservation.

The Children's Healthy Living Program of the University of Guam and Guam Girl Scouts led the NutriBee intervention in site 6. The Pacific Island community included diverse ethnicities and military families. Girls in the sixth and seventh grades from a low-income community attended. Daily healthful snacks available in Guam were provided and the intervention was augmented with Guam Girl Scouts–organized physical activities.

Screening Procedures and Inclusion or Exclusion Criteria

Participants in the 6 camp and club NutriBee pilots were invited to join the study, and they were included upon their assent and the consent of an adult caregiver. Foster children participating in the NutriBee program were excluded from the study. Participants were included in the analysis regardless of the dose of the intervention they received. If absent during the postquestionnaire, participants were contacted via the information provided during registration, and those unreached after 3 attempts were excluded from the analysis.

The Institutional Review Board of the Johns Hopkins Bloomberg School of Public Health reviewed and approved NutriBee pilot research (IRB #4821). Additionally, an addendum to implement the NutriBee curriculum was approved for the OPREVENT study (IRB #2866).

General Study Design

A total of 183 students participated in the 6 NutriBee pilot NYIQ study sites; 182 participants were eligible to participate. One student was not eligible for the study due to being a foster child; 179 participants completed the presurvey, of whom 170 (95%) completed the postsurvey.

The study employed a nonrandomized pre–post design where student participants (pilots A and B) were assessed preintervention and postintervention. The dose of the exposure to the intervention was measured as assessed via instructor-recorded attendance and corroborated with self-reported participation by child participants. The intervention was delivered across different timeframes ranging from 4 days to 4 months (Table 3).

Instrument

The NYIQ included 41 questions and took no more than 20 minutes to complete. It contained scales for dietary knowledge (8-item scale), intentions (6-item scale), outcome expectations (6-item scale), self-efficacy (11-item scale), and food frequency (10-item scale) that ask specific questions related to the behavioral goals of the NutriBee modules. Dietary knowledge questions assessed respondents' knowledge regarding behaviors emphasized in the NutriBee modules. A scale on dietary intentions assessed the respondents' intentions to perform the behaviors emphasized in the NutriBee modules. The section on outcome expectation assessed participants' perceived benefits of performing the emphasized behaviors. The dietary self-efficacy questions assessed each participant's confidence that he or she would be able to perform the behaviors emphasized in the NutriBee curriculum. Finally, the food frequency questions assessed diet and the potential impact on the frequency with which students ate NutriBee-promoted foods in the 3 days prior to the questionnaire. Factor analysis was used to determine the final scales and Cronbach's alpha was used to assess internal reliability of each scale.

Each question comprising the dietary knowledge, intentions, outcome expectations and self-efficacy scales was assigned a score of 2 (*completely correct*), 1 (*partly correct*), or 0 (*completely wrong* or no response). Each item in food frequency was assigned a maximum score of 4 (*4 or more times*), 3 (*3 times*), 2 (*twice*), 1 (*once*), or 0 (*never*). The possible score ranges of the 5 sections were 0–16, 0–12, 0–12, 0–22, and 0–40, respectively. The initial Cronbach's alpha values of the 5 sections were 0.50, 0.43, 0.44, 0.64, and 0.72, respectively, with all questions included.

Sample Size Calculation

The primary research question was used for calculating the 2-sided detectable difference with a power of 80% and a type I error of 5%. Pilot data from the Baltimore Healthy Eating Zones Youth Impact Questionnaire of girls and boys aged 10–15 years old was used estimate detectable difference for each of the scales of dietary knowledge, self-efficacy, outcome expectations, and behavioral intentions expected for a sample size of 200 [23].

Data Analysis

We first examined differences between pre and post scores for each scale. *T* tests were conducted for normally distributed continuous variables and nonparametric Wilcoxon-Mann-Whitney tests for nonnormally distributed continuous variables. Chi-square and Fisher's exact tests were conducted for all dichotomous variables. An intervention exposure scale was developed by using data from the process evaluation forms used to assess curriculum adherence. We then examined the impact of the intervention by subtracting the baseline scores from the postintervention scores and examined associations with exposure. *T* tests were conducted for normally distributed continuous variables and nonparametric Wilcoxon-Mann-

Table 4. NutriBee Youth Impact Questionnaire Data Presented by Parameters Assessed ($N = 170$)

Parameter	Questions (n)	Max Response	Mean Presurvey Response	Mean Postsurvey Response	Mean Difference	SD	p Value
Intentions	6	12	7.23	9.52	2.29	0.21	<0.001
Outcome expectations	6	12	7.84	9.64	1.81	0.17	<0.001
Self-efficacy	11	22	17.32	18.95	1.63	0.22	<0.001
Knowledge	8	16	10.51	13.32	2.81	0.22	<0.001
Food frequency	10	40	14.08	17.78	3.71	0.48	<0.001
Total	41	102	56.97	69.22	12.25	0.70	<0.001

Whitney tests for nonnormally distributed continuous variables. Chi-square and Fisher's exact tests were conducted for all dichotomous variables. Multivariable linear regression modeling was used incorporating the variables of camp/club site, gender, age, and exposure (e.g., length of program attendance).

RESULTS

Mean attendance at each site was at least 80%, which represents 16 of 20 curriculum hours. Ninety-five percent (170) of the 179 participants completing the presurvey also completed the postsurvey. A composite of appropriateness of length and appropriateness of difficulty, the maximum student acceptability score was 2, and site average acceptability scores ranged from 1.5 to 1.8 (74% to 90%).

All psychosocial parameters assessed increased significantly from pre to post: Intentions (19.1%), outcome expectations (15.1%), self-efficacy (7.4%), and knowledge (17.6%). Participants increased their overall selection of healthful foods by 9.3%. Specifically, dried fruit selection increased significantly by 1.9% and fresh fruit selection increased by 1.4%. Bottled water selection increased by 1%, whereas consumption of sugary sports drinks decreased by 1.2%. Participants selected more wild rice by 0.4%, eggs by 0.45%, cultured dairy by 0.95%, and porridge by 0.38%. Light or unbuttered popcorn selection increased by 0.78% and popcorn from the cob without pre-added salt or oil selection increased by 1.4% (Table 4).

Each pilot ($n = 6$) demonstrated significant ($p < 0.001$) impact across parameters (see Table 5). The finding persisted with multiple linear regression modeling, which uses level of exposure to the NutriBee intervention as the primary independent variable. We examined the change in the combined psychosocial variable score from pre- to postintervention and found a significant impact ($p = 0.028$). When age was included in the model, 10-years-old showed a significant change ($p = 0.038$). Importantly, age 10 was the target age of the NutriBee intervention. Age was not associated with impact of the intervention on foods/beverages consumed (behavior).

Coed programs and girl-only programs had equal impact. However, NutriBee's impact may have been greater among the girls participating in girl-only programs ($n = 72$, 13.6% mean score increase) than among girls in coed programs ($n = 41$, 10.4% mean score increase, $p = 0.05$; see Table 6).

DISCUSSION

NutriBee is the first study of an IOM-aligned intervention for early adolescents implemented in club and camp settings. The community-based NutriBee intervention favorably changed the diet of early adolescents from diverse and disadvantaged communities in each of 6 pilots. Significant impact was observed across multiple psychosocial parameters: Intentions, outcome expectations, self-efficacy, and knowledge. Impact was consistent across pilot groups even though these pilot groups varied with participant diversity, instructor variability, partnering community organizations, gender ratios, and settings. Similarly, appeal of the club and camp environment to participants was demonstrated by 91% average attendance and a high acceptability score, which remained consistent across

Table 5. Youth Impact Questionnaire Data Presented by Site

Site	Presurvey n	Postsurvey n	Mean Dose Received[a]	Mean Change in Response Pre–Post	SD	p Value	Student Acceptability Score (Range 0 to 2)[b]
1	29	27	0.93	14.33	1.27	<0.001	1.7
2	25	24	0.80	9.88	1.81	<0.001	1.8
3	43	43	0.96	12.67	1.63	<0.001	1.5
4	29	28	0.91	12.29	1.63	<0.001	1.8
5	34	31	0.94	9.77	1.67	<0.001	1.5
6	19	17	0.87	9.88	1.81	<0.001	1.6
Total	179	170	0.91	12.25	0.70	<0.001	1.6

[a]Dose is defined as the days of attendance as recorded by instructors on a daily roster, divided by the maximum days of the program.

[b]The acceptability score is a maximum 2-point subjective score composed of difficulty level and appropriate length.

Table 6. Response to NutriBee's Youth Impact Questionnaire among Girls Participating in All Girls Programs and Coed Programs

Parameter	Pre–Post Change Girls-Only Programs, $n = 72$	Pre–Post Change Girls in Coed Program, $n = 41$	Mean Difference	SD	p Value
Intentions	2.10	2.20	−0.10	0.51	0.85
Outcome expectations	1.81	1.41	0.39	0.45	0.39
Self-efficacy	1.96	0.68	1.28	0.54	0.02
Knowledge	3.14	2.63	0.50	0.54	0.35
Food frequency	4.85	3.71	1.14	1.13	0.31
Total	13.85	10.63	3.21	1.65	0.05

pilots. Therefore, we concluded that the short-term impact of our intervention in club and camp settings was consistent with the IOM research around school-based interventions and that it engaged early adolescents in diverse, underserved communities.

There were several limitations to this study:

- Though the psychosocial parameters we evaluated were associated with sustained behavior, we did not directly evaluate sustainability beyond the trial's completion. A future comparative effectiveness study for participants at high risk of chronic diseases could evaluate sustainability beyond the trial's completion and compare it to existing interventions in the clinical setting.
- This study did not have a non-intervention comparison group but rather compared the diverse pilot sites to each other and used exposure to examine treatment effects. The 3 school-based pilots were not able to complete NutriBee due to unrelated constraints on classroom time and were therefore not a comparison group.
- This study achieved 85% of the enrollment in the initial power calculation, which would have mattered more had the results been negative. Similarly, NutriBee's youth-led projects researched separately [13] were not included in this pilot; nevertheless, the intervention's impact was significant.

Despite its limitations, this positive pilot trial is relevant to the clinical setting, where nutrition interventions for early adolescents may be needed [25,43].

- Improving diet and psychosocial parameters translates into greater preventive benefit among participants at higher risk of chronic disease.
- The attrition rate for this intervention was very low compared to similar interventions in clinical settings [24].
- This pilot trial's cultural, geographic, and socioeconomic diversity allows the findings to be generalized to similarly diverse health clinic populations.
- Extensive taste-testing of new foods can uncover medically significant food allergies, yet in this intervention food allergies were planned for and did not limit participation.
- NutriBee's household reach through child-as-change-agent strategies is likely to buttress similar efforts of clinicians [44].
- This study found greater impact among girls in girl-only pilots compared to girls in coed pilots, a finding previously reported in science, technology, engineering, math programs [45] but not in the medical literature. Yet offering girls a choice of learning environments may be a clinically meaningful one.
- A modified NYIQ has been approved (JHSPH IRB #5301) for use as an intervention evaluation tool. Relevance of the questionnaire to clinicians could be studied.
- A unique aspect of NutriBee is that educators and health professionals coinstructed the intervention. This approach was well received by all stakeholders, especially by the health professionals, because they could focus on the content of the learning materials and be career role models for the participants. NutriBee instructors included nursing and medical students, medical doctors, health educators, public health professionals, and a naturopathic physician.

In light of this study's findings, we propose a comparative effectiveness trial, where early adolescents with asthma, high cholesterol, hypertension, and/or obesity are randomized to NutriBee in community settings or the standard in-clinic nutrition counseling.

Availability Of Supporting Data

Requests for the deidentified data set supporting the article's research findings may be requested in writing from its principal investigator, Dr. Joel Gittelsohn.

ACKNOWLEDGMENTS

We thank Katherine Nelson, Valerie Montague, and Rachael Leon Guerrero, PhD, for their careful data collection. Dedicated efforts of Vickie Fish, EdD, executive director of Guam Girl Scouts International, and Wonha Kim, MD, MPH, made the Guam pilot possible. We thank the OPREVENT team for their valuable input in the learning materials and NutriBee implementation. Liane M. Summerfield, PhD, Elizabeth Anderson Steeves, Preety Gadhoke, PhD, MPH, and Este de Fossard-Nelson, MED, MA, contributed their insights in nutrition education and behavior change relevant to NutriBee's design and implementation. Claire Welsh assisted with the JHSPH IRB.

CONFLICT OF INTEREST

Ingrid Kohlstadt is the founder and Executive Director of the nonprofit organization (501c3) NutriBee National Nutrition Competition, a component of whose intervention was evaluated in this research. Joel Gittelsohn and Yu Fang have no competing interests.

AUTHOR CONTRIBUTIONS

I.K. developed the intervention materials and designed and implemented the study. J.G. designed the questionnaire (instrument), analyzed the data, and directed the implementation of the OPREVENT study, which included NutriBee Sites A–C. Y. F. completed the data entry and worked with J.G. on data analysis.

FUNDING

We thank the MetLife Foundation for the generous grants that supported the design, implementation, and evaluation of this research study.

REFERENCES

1. McGuire S, and the Institute of Medicine: Accelerating progress in obesity prevention: solving the weight of the nation. Adv Nutr 3:708–709, 2012.
2. Montessori M: "The Montessori Method." George AE (trans). New York, NY: Frederick A. Stokes Company, 1912.
3. Lee H, Contento IR, Koch P: Using a systematic conceptual model for a process evaluation of a middle school obesity risk-reduction nutrition curriculum intervention: choice, control & change. J Nutr Educ Behav 45:126–136, 2013.
4. Hoelscher DM, Evans A, Parcel GS, Kelder SH: Designing effective nutrition interventions for adolescents. J Am Diet Assoc 102 (Suppl):S52–S63, 2002.
5. Society for Nutrition Education: State of Nutrition Education and Promotion for Children and Adolescents, 2009 Report. 2009. Accessed at: http://www.sneb.org/documents/SNENENPES630_exec_summary_000.pdf.
6. Bay JL, Mora HA, Sloboda DM, Morton SM, Vickers MH, Gluckman, PD: Adolescent understanding of DOHaD concepts: a school-based intervention to support knowledge translation and behaviour change. J Dev Orig Health Dis 3:469–482, 2012.
7. Gluckman SP: "Improving the Transition: Reducing Social and Psychological Morbidity during Adolescence." Interim Report. Office of the Prime Minister's Science Advisory Committee, New Zealand, 2010.
8. Health Resources and Services Adminstration: "A Lifecourse Approach Resource Guide Developed by the MCH Training Program." U.S. Dept. of HHS, 2011. Accessed January 4, 2016 at mchb.hrsa.gov/lifecourseapproach.html.
9. McAleese JD, Rankin LL: Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. J Am Diet Assoc 107:662–665, 2007.
10. Sharma S, Helfman L, Albus K, Pomeroy M, Chuang RJ, Markham, C: Feasibility and acceptability of brighter bites: a food co-op in schools to increase access, continuity and education of fruits and vegetables among low-income populations. J Prim Prev 36:281–286, 2015.
11. King KM, Ling J: Results of a 3-year, nutrition and physical activity intervention for children in rural, low-socioeconomic status elementary schools. Health Educ Res 30:647–659, 2015.
12. National Association of Elementary School Principals: "Comments submitted to NutriBee booth compiled by Kohlstadt I. NAESP's 92nd Annual Convention and Expo." Kohlstadt I (ed): Baltimore, MD: 2013.
13. Kohlstadt IC, Steeves ET, Rice K, Gittelsohn J, Summerfield LM, Gadhoke, P: Youth peers put the "invent" into NutriBee's online intervention. Nutr J 14:60, 2015.
14. Vikraman S, Fryar CD, Ogden CL: Caloric intake from fast food among children and adolescents in the United States, 2011–2012. NCHS Data Brief 213:1–8, 2015.
15. American Dietetic Association: Position of the American Dietetic Association: individual-, family-, school-, and community-based interventions for pediatric overweight. J Am Diet Assoc 106:925–945, 2006.
16. Contento I: The effectiveness of nutrition education and implications for nutrition education policy, programs and research: a review of research. J Nutr Educ 27:277–418, 1995.
17. Di Noia J, Orr L, Byrd-Bredbenner C: Residential summer camp intervention improves camp food environment. Am J Health Behav 38:631–640, 2014.
18. Beets MW, Tilley F, Weaver RG, Turner-McGrievy GM, Moore JB: Increasing fruit, vegetable and water consumption in summer day camps—3-year findings of the healthy lunchbox challenge. Health Educ Res 29:812–821, 2014.
19. Carraway ME, Lutes LD, Crawford Y, Pratt KJ, McMillan AG, Scripture LG, Henes S, Cox J, Vos P, Collier DN: Camp-based immersion treatment for obese, low socioeconomic status, multiethnic adolescents. Child Obes 10:122–131, 2014.
20. Robinson-O'Brien R, Story M, Heim S: Impact of garden-based youth nutrition intervention programs: a review. J Am Diet Assoc 109:273–280, 2009.
21. Lyons EJ, Tate DF, Ward DS, Ribisl KM, Bowling JM, Kalyanaraman S: Engagement, enjoyment, and energy expenditure during active video game play. Health Psychol 33:174–181, 2014.
22. Skelton JA, Beech BM: Attrition in paediatric weight management: a review of the literature and new directions. Obes Rev 12: e273–e281, 2011.
23. Dolinsky DH, Armstrong SC, Ostbye T: Predictors of attrition from a clinical pediatric obesity treatment program. Clin Pediatr (Phila) 51:1168–1174, 2012.
24. Skelton JA, Irby MB, Geiger AM: A systematic review of satisfaction and pediatric obesity treatment: new avenues for addressing attrition. J Healthc Qual 36:5–22, 2014.
25. Kohlstadt I, Wharton G: Clinician uptake of obesity-related drug information: a qualitative assessment using continuing medical education activities. Nutr J 12:44, 2013.
26. Dietz WH, Economos CD: Progress in the control of childhood obesity. Pediatrics 135:e559–e561, 2015.

27. U.S. Preventive Services Task Force: Obesity in children and adolescents: screening, January 2010. 2010. Accessed at: http://www.uspreventiveservicestaskforce.org/Page/Document/RecommendationStatementFinal/obesity-in-children-and-adolescents-screening
28. NutriBee: National Nutrition Competition. 2014. Accessed at: http://www.NutriBee.org/BeeQuest
29. Story M, Neumark-Sztainer D, Ireland M, Evans T: Adolescent health and nutrition: a survey of perceived knowledge and skill competencies and training interests among dietitians working with youth. J Am Diet Assoc 100:362–364, 2000.
30. Neumark-Sztainer D, Story M, Perry C, Casey MA: Factors influencing food choices of adolescents: findings from focus-group discussions with adolescents. J Am Diet Assoc 99:929–937, 1999.
31. Kohlstadt I: Coming to our senses on education and nutrition. Time November 12, 2014. Accessed at: http://time.com/3582298/coming-to-our-senses-on-education-and-nutrition/
32. Gittelsohn J, Dennisuk LA, Christiansen K, Bhimani R, Johnson A, Alexander E, Lee M, Lee SH, Rowan M, Coutinho AJ: Development and implementation of Baltimore Healthy Eating Zones: a youth-targeted intervention to improve the urban food environment. Health Educ Res 28:732–744, 2013.
33. Lee VS: What is inquiry-guided learning? New Directions for Teaching and Learning 129:5–14, 2012.
34. Munguba MC, Valdes MT, da Silva CA: The application of an occupational therapy nutrition education programme for children who are obese. Occup Ther Int 15:56–70, 2008.
35. Hieftje K, Edelman EJ, Camenga DR, Fiellin LE: Electronic media–based health interventions promoting behavior change in youth: a systematic review. JAMA Pediatr 167:574–580, 2013.
36. Baranowski T, Frankel L: Let's get technical! Gaming and technology for weight control and health promotion in children. Child Obes 8:34–37, 2012.
37. Beacom AM, Newman SJ. Communicating health information to disadvantaged populations. Fam Community Health 33:152–162, 2010.
38. de Fossard-Nelson E: Bee-style game shows as entertainment–education with health impact. Communication to Kohlstadt I (ed): Dec. 2014. Baltimore, Maryland.
39. Coleman PL: Enter-educate: new word from Johns Hopkins. JOICFP Rev 15:28–31, 1988.
40. Gittelsohn J, Anderson Steeves E, Mui Y, Kharmats AY, Hopkins LC, Dennis D: B'More Healthy Communities for Kids: design of a multi-level intervention for obesity prevention for low-income African American children. BMC Public Health 14:942, 2014.
41. Gadhoke P, Christiansen K, Pardilla M, Frick K, Gittelsohn J: "We're changing our ways": Women's coping strategies for obesity risk-reducing behaviors in American Indian households. Ecol Food Nutr 1–20, 2014.
42. Bogart LM, Elliott MN, Uyeda K, Hawes-Dawson J, Klein DJ, Schuster MA: Preliminary healthy eating outcomes of SNaX, a pilot community-based intervention for adolescents. J Adolesc Health 48:196–202, 2011.
43. Kohlstadt I: Primary care approaches to weight reduction. In Kohlstadt I (ed): "Advancing Medicine with Food and Nutrients," 2nd ed. Boca Raton, FL: CRC Press, pp. 349–372, 2013.
44. Fiese BH, Rhodes HG, Beardslee WR: Rapid changes in American family life: consequences for child health and pediatric practice. Pediatrics 132:552–559, 2013.
45. Girl Scouts: Generation STEM: what girls say about science, technology, engineering and math. 2012. Accessed at: http://www.girlscouts.org/research/pdf/generation_stem_full_report.pdf

Received June 16, 2015; accepted October 16, 2015.