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Research Article

Hip Hop Nutrition Math Curriculum: Study Protocol for a Randomized Control Trial to Address Menu Board Calorie Literacy and Food Purchasing Behavior of Minoritized Children

Olajide Williams[1], Vanessa Sawyer[1*], Gabriela Drucker[1], Ewelina Swierad[1], John Rausch[2], Joseph Eimicke[3], Jian Kong[3], Stephanie Silver[3], Jeanne Teresi[3], Rachael Gazdick[4], James M. Noble[1,5]

[1]Department of Neurology, Columbia University, New York, USA; [2]Department of Pediatrics, Columbia University, New York, USA; [3]Department of Medicine, Columbia University, New York, USA; [4]New York Edge, New York, USA; [5]Taub Institute for Research on Alzheimer's Disease and the Aging Brain, GH Sergievsky Center, Columbia University, New York, USA

ABSTRACT

Objective: Federally mandated calorie postings in chain restaurants have the potential to significantly impact average annual population weight gain by providing consumers with point-of-purchase nutrition information for healthier dietary decisions. However, at the individual level, several key barriers to behavior change persist including, low health literacy, simple numeracy and health prioritization. This study is designed to test the effect of "Hip Hop H.E.A.L.S (Healthy Eating and Living in Schools; HHH)", an intervention targeting the use of point-of-purchase calorie postings for healthier food purchases among 5th grade children and their families.

Methods: Hip Hop H.E.A.L.S uses a music-based "Menu Board Literacy" curriculum designed for 5th grade students. HHH incorporates the New York State Common Core Learning Standards for Mathematics into a point-of-purchase, hip hop themed, healthier decision-making intervention. Delivered *via* a Learning Management System and facilitated by teachers, the final HHH intervention is an interactive 10-week, 40 h, intervention. Using a pretest-posttest design, we plan to randomize 14 after-school sites in low-income NYC (New York City) neighborhoods into one of two arms: The HHH nutrition-math curriculum arm *versus* a "Food Explorers" control condition that does not specifically address fast-food restaurant calorie postings. The unit of randomization is the after-school site from which 280 5th grade students will be enrolled. Children will complete a validated instrument called the Menu Board Calorie Literacy (MBCL) questionnaire and undergo a blinded voucher-based food purchasing assessment at baseline, 1 week following the program and at 2-months post-program. Child-to-parent communication of newly acquired nutrition literacy to participating parents will also be assessed. The primary outcome is the child's food purchasing behavior as measured by the caloric and nutrient-density of purchased items with vouchers. Children are unaware that their purchases are being tracked.

Conclusion: This study aims to evaluate the cognitive and behavioral effects of an intervention designed to improve point-of-purchase food choice behaviors of minoritized children and the ability of these children to successfully transfer newly acquired nutrition literacy to their parents.

Keywords: Health; Randomized trial; Nutrition education; Calories; Menu board

INTRODUCTION

Current federal legislation requires chain food establishments with at least 20 locations to post calorie counts for all menu items. Barriers to the effectiveness of using calorie postings include low literacy [1,2] and poor numerical skills [2], which are more prevalent among low-income minority populations. We define MBCL as the ability to obtain, understand and utilize menu board terminology including abbreviations; the meaning of serving size; calorie ranges posted by food items, which includes the ability to perform simple math; and knowledge of how many calories on average the individual requires on a given day.

Most studies evaluating the impact of calorie mandates demonstrate modest to no effect on the consumer's point-of-purchase dietary decisions, particularly among low-income people [3-7]. Studies evaluating the effect of calorie postings on parental purchases for their children found no difference before and after calorie-labeling legislation, despite parents noticing the calorie postings [8,9]. A key additional finding was that children who ate more food away from home choose their own meals at the point-of-purchase and continued to choose the same items before and after calorie posting

Correspondence to: Vanessa Sawyer, Department of Neurology, Columbia University, New York, USA, E-mail: vs2360@cumc.columbia.edu

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legislation [8]. Community Socioeconomic Status (SES) influenced the use of caloric information in a dose-response manner, with the weakest effects observed among the poorest communities [10-12]. Beyond the disproportional access to cheap unhealthy food, poorer consumers must also be motivated to utilize these calorie postings, understand what they mean and have self-efficacy for using them properly in dietary decision-making MBCL.

These observations led to our pilot study of a 3 h hip hop themed intervention targeting the MBCL of 5th grade New York City public school students. Results demonstrated improved MBCL and point-of-purchase food purchases (higher nutrient density, lower calories) during school food sales in which the children were not aware their purchases were being tracked [13]. Building upon the body of literature suggesting that general nutrition knowledge, practices and attitudes do not increase to maximal levels until after 40-50 h of instruction, we adapted our hip hop point-of-purchase nutrition literacy intervention by integrating common core math standards [14-16]. We then successfully tested its feasibility and expanded this hybrid approach into a 40 h nutrition-math curriculum [14-17]. Given well-known implementation barriers to nutrition education in schools, we chose to deliver the program in the after-school setting in partnership with New York Edge, the largest after-school program vendor for New York City public schools [15,16].

Child mediated health communication

In a Randomized Controlled Trial (RCT), our group showed that children under age 12 can positively mediate parental stroke knowledge [18]. Additional studies have shown that children can influence parental food purchases [19,20].

Theoretical principles

Our intervention was guided by the Multisensory Multilevel Health Education Model for diverse communities and built on Entertainment Education (EE) concepts and theory [21,22]. Guided by these models, we incorporated behaviorally focused original rap music and animated cartoons featuring posted point-of-purchase dietary decision information and strategies for motivating their use. Theoretical models of EE interventions include the Extended Elaboration Likelihood Model, which addresses key components of engagement, including experiential involvement, the Theory of Reasoned Action and Self-Efficacy [22-24]. The Theory of Reasoned Action (TRA) addresses the decision-making process (Figure 1) for the children, who are the primary targets of the intervention. Social Cognitive Theory (SCT) posits that control over one's outcomes produces a sense of mastery, or Self-Efficacy (SE), for those behaviors and that increased SE leads to increased motivation to engage in the desired behavior, which is utilizing menu board calorie information for dietary decision support and sharing what they learn with their families (Figure 1).

Study aims

The primary aim is: a) Evaluate the food-purchasing behavior of 5th graders using standardized school-based food-sales at baseline, 1-week and 2-months following the end of the 40 h after-school HHH intervention and control program. Our primary outcome is the change in purchased calories per meal at 1-week and 2-months following the intervention. Secondary aims include: b) Assessing the effect of a 40 h HHH curriculum on the menu board calorie literacy of 5th graders at baseline, 1-week and 2-months following the end of the intervention, c) Assessing the extent to which children communicated knowledge of calorie recommendations to a parent within 1-week following the end of the intervention; and d) Assessing the parent's knowledge of calorie recommendations at baseline and at 1-week and 2-months following the end of the intervention. Finally, we will explore the effect of the intervention on real-world food purchasing behavior of child parent dyads at a participating chain restaurant.

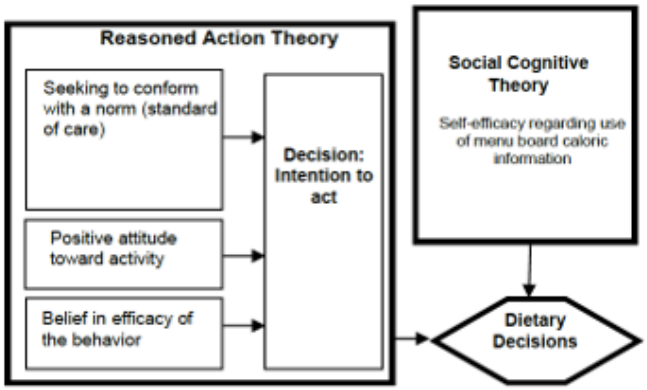

Figure 1: Model of behaviour change.

MATERIALS AND METHODS

Study design overview

The intervention will be online and in-person, delivered in a classroom setting during after school programs, using an innovative, modular, musical, interactive, multi-media curriculum embedded in a Learning Management System (LMS) to teach nutrition concepts including calories, nutrient density, MBCL, healthy food choices and energy balance. Due to the COVID-19 pandemic, curriculum delivery was modified to hybrid learning and the LMS was adapted for online lessons. The curriculum comprises 14 self-administered core lessons and 6 teacher facilitated review lessons. Teacher facilitators will be trained by research staff and their performance will be monitored through quality audits and standardized fidelity measures. The Child Mediated Health Communication (CMHC) will include giving students specific home-based learning activities for parental engagement. Acquired nutrition knowledge and menu navigation skills of parents will be measured at baseline and following CMHC. This study has received ethics approval from the Columbia University Medical Center Institutional Review Board.

Setting

This study will be conducted in 14 New York City after-school programs (7 interventions; 7 control). We have partnered with New York Edge (NYE), NYC's largest after-school program vendor serving over 110 public schools.

Personnel

Research Coordinators will conduct the screening, consent, enrollment procedures and all study assessments. They will also oversee the administrative activities of the study including the tracking of attendance and provision of study materials. NYE after-school education specialists assigned to the intervention will be trained on the HHH nutrition-math curriculum and content mastery assessed *via* the LMS. Education specialists assigned to the

control group will receive a 3 h basic nutrition education training program at baseline and, prior to each season, will be retrained on the Food Explorers "control" program.

Recruitment and randomization

Recruitment will occur first at the after-school program level followed by the participant level. We will recruit after-school programs from NYE's contracted network of public elementary schools matched by demographic variables. After-school programs will be randomized on a 1:1 ratio basis to either the intervention or control group (Food Explorers program). The randomization allocation will be generated by the study statistician. Students at intervention sites will receive 40 h of nutrition instruction and children at the control sites will receive the standard Food Explorers program.

Participant eligibility

All 5th grade children in each after-school site will be invited to participate in the study; however, data collection will be limited to consented children and their parents. Parents/caregivers must: a) Have internet access and a computer at home (a component of the intervention involves online activities), b) Have a working phone line, c) Not have major psychiatric disability or medical condition that may affect participation (e.g., psychotic illness, terminal illness); and d) Be fluent in English or Spanish. Note: Our pilot data showed that >90% families attending local NYC schools have internet access at home.

Student recruitment

5th grade children participating in recruited after-school programs will be identified from rosters, along with their parents. Researchers will provide parents with a link to the online program information and consent form and parental consent will be obtained. Printed copies will be provided upon request. The study will be explained to consented students prior to baseline testing and child assent obtained.

Parent recruitment

To maintain statistical independence, only one adult from each family will be eligible to participate in pretest-posttest procedures. We will ask the parent encountered during recruitment efforts to identify the adult caregiver in the household ("household" may include relatives) who is most likely to be the target of the child's calorie knowledge/homework communications. This individual will be invited to participate in the study and consented. Consent for parent participation will be obtained separately from consent for their child's participation.

Study conditions

Participants will be randomly assigned to either the intervention or control group, ensuring comparability of baseline characteristics across groups:

Intervention arm: Implementation will begin following student baseline assessments. Trained education specialists will facilitate the HHH program in 60 min sessions administered as an after-school class two-times-a-week for 10 weeks and an additional 20 h of reinforcement/parental engagement home activities. Fourteen core sessions will be self-administered online *via* interactive multi-media modules on the LMS. Six review sessions will be conducted in person or online using presentation slides, interactive games and role play activities.

Hip hop media integrated math curriculum

A transdisciplinary team comprised of nutritionists, public health researchers, schoolteachers, physicians, behavioral scientists, a 5th grade student advisory board, artists and notable musicians developed the storyboards, animated features and lessons incorporated into the intervention and LMS (Figure 2). The HHH lessons address five core content areas related to nutrition: a) Calories, b) Nutrient density, c) Healthy food choices, d) Menu board calorie literacy and 5) Energy balance. The intervention will be comprised of 20 lessons, 1 h each and 20 h of child-mediated parental engagement home-based activities. Each lesson incorporates a combination of independent and group activities, comic books, cartoons and music to teach students. Due to overall low math proficiency among incoming 5th graders (only 22% of students across our school network reached or exceeded proficiency in math as determined by NYS ELA standardized test scores), we incorporated 4th grade math standards into our intervention, which targets 5th graders. The final curriculum incorporated 17 of the 28 (61%) 4th grade math Common Core Standards, which we have found serves as an important applied math review for incoming 5th graders. Fast food meals selected for inclusion in lesson plans were derived from focus group sessions with representative children and surveys related specifically to fast food tastes and preferences, as well as the 2009 IOM's report, "School Meals: Building Blocks for Healthy Children" [25]. Menu options were identified through an internet search of the menus of several national fast food restaurant chains with establishments in NYC minoritized neighborhoods. The final list of food items included in the curriculum was derived from 13 fast food restaurants. Lessons were designed to teach children about healthier and more balanced meal alternatives available at fast food chains. Example meals qualifying as healthier alternatives in the curriculum were limited to a total caloric amount of 600 calories, with specific items containing less than 35% of total calories from fat and 660 mg or less of sodium. These lesson plan meals, which were contrasted with high calorie low nutrient alternatives, comprised a main dish, vegetable, fruit and beverage/dairy and were designed to cost less than $5. Lessons also incorporate physical activity "recesses", which are three-minute desk-based physical activity breaks. Finally, twenty hours in the curriculum is made up of 20 (up to 1 h per activity) home-based activities that students are required to conduct with their parents. Examples of homework include the child sharing their daily calorie requirement with the parent and playing a HHH online game that balances food choices and physical activity with the child's daily caloric need and identifying neighborhood chain restaurants with calorie labeling on the menus. At the end of the intervention (and control activities) a subset of children will be given a homework activity that involves a field trip with a parent to a collaborating local chain restaurant to assess the feasibility of real-world assessments. Each child-parent dyad will receive a trackable complimentary de-identified restaurant voucher, ostensibly as a thank you gift for their participation in the program. These tagged vouchers will allow us to perform nutritional analyses on purchases by each dyad (who are unaware that their purchases are being tracked) in collaboration with a partnering chain restaurant. Table 1 and Figure 3 show examples of lessons.

Figure 2: Sample Hip Hop H.E.A.L.S media. **Note:** A) Menu Board Navigation musical cartoon video-sensitizes kids to calorie postings and how to use them in fast food outlets; B) Exercise and be calorie wise musical cartoon video-highlights health benefits of exercise, and its relationship to calories; C) Go Slow Whoa musical cartoon-teaches nutrient density using traffic light food categorization model; D) LMS-Learning Management System screenshot-online platform where students access education modules, cartoons, games, songs and comics, builds in self-monitoring and incentives.

Table 1: Lesson plan examples.

Lesson	Common core math standard	Assessment
Nutrition facts labels		
Nutrition facts labels	4.OA.2; 4.NBT.5	No stress tests 1, 2 and 3
Comparing nutrition facts labels	4.OA.2; 4.NBT.5	No stress test 1
Go, Slow, Whoa drinks	4.OA.3; 4.NBT.5	No stress tests 1 and 2
Sugar sweetened beverages	4.OA.3; 4.NBT.5	No stress test 1
Bodega snack sale	4.OA.2; 4.NF.4c; 4.NBT.5	In class activity
Menu boards		
Go, Slow, Whoa foods Pt.2	4.OA.2; 4.OA.3; 4.NBT.4	No stress test 1
Menu board calorie literacy	4.OA.3	No stress tests 1 and 2
Calorie number form comparisons	4.NBT.2 (<, >, =)	No stress tests 1 and 2
Mental math for food choices	4.NBT.3; 4.NBT.4	No stress tests 1, 2 and 3
Choosing a meal	4.NBT.2	No stress test 1
Choose and evaluate meals Pt.1	4.OA.2; 4.NBT.2	No stress tests 1 and 2
Choose and evaluate meals Pt.2	4.OA.2; 4.NBT.2	No stress test 1
Wrap-Up		
Energy balance Pt. 1	4.OA.2; 4.OA.3; 4.NBT.5; 4.NBT.6; 4.MD.1	No stress tests 1 and 2
Energy balance Pt. 2	4.OA.2; 4.OA.3; 4.NBT.5; 4.NBT.6; 4.MD.1	No stress test 1
NMC family feud review	4.OA.2; 4.OA.3; 4.NBT.2; 4.NBT.4; 4.NBT.5; 4.NBT.6; 4.MD.1	In class activity
Menu board game	4.OA.2; 4.OA.3; 4.NBT.4; 4.NBT.5; 4.NBT.6; 4.MD.1	In class activity

Abbreviations: OA: Operations and Algebraic thinking; NBT: Number operations in Base Ten; NF: Number operations and Fractions; MD: Measurement and Data.

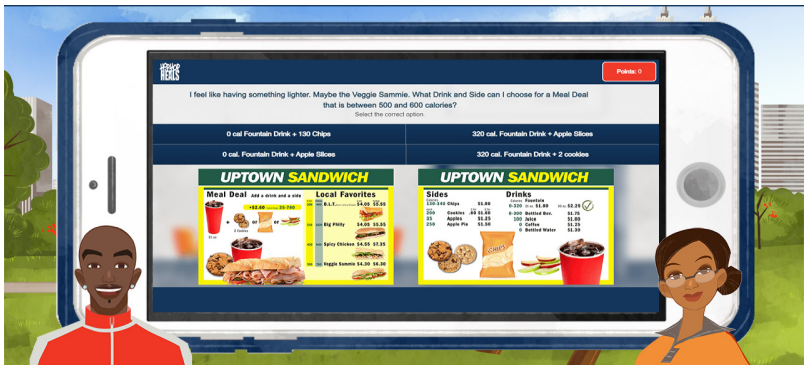

Figure 3: Example LMS activity-choosing a meal.

Control arm

NY Edge after-school partners will deliver their regular programming three hours each day, five days per week. Their nutrition and wellness after–school program Food Explorers will represent the control group. This program, which includes "exploring" diverse foods, nutrition concepts and tasty recipes, does not include consumer socialization and specific education around calorie postings on fast food menu boards. Research coordinators will document Food Explorers nutrition activities in the control arm. All study assessments will mirror the intervention arm at baseline, 1-week and 2-months post-study for knowledge (MBCL) and behavioral (food purchasing assessments) measures. Following completion of data collection at the end of the study, control program sites will receive a complimentary version of the HHH intervention.

Treatment fidelity

We will follow recommendations of the Behavioral Change Consortium's comprehensive model of treatment fidelity [26]. We will standardize training of education specialists and measure their skill acquisition with pre/post testing. We will use scripted intervention protocols and conduct random site visits, during which researchers will review curriculum delivery checklists. We will also capture delivery fidelity through student and education specialist surveys, attendance and engagement data. Student and education specialist attendance and engagement will be measured by online LMS tracking data, including time spent. Brief exit surveys will be administered to all student participants and education specialists.

Data collection

All evaluation surveys and data collection procedures will be the same for both the HHH intervention and control and administered by trained researchers.

Student MBCL and self-efficacy

Participating students will complete a validated MBCL and Self-Efficacy survey developed by our team to assess knowledge of caloric recommendations and understanding menu board nutrition labeling as well as self-efficacy for MBCL [27]. Surveys will be administered online *via* Qualtrics during video conference calls with researchers.

Parent MBCL

Participating parents will complete a structured survey adapted from the validated student instrument to assess knowledge of caloric needs, recommendations and MBCL. Surveys will be administered online *via* Qualtrics and printed copies will be provided upon request.

Student food-purchasing behavior

Prior to implementation of the intervention and control programs and following their completion, we will conduct standardized school-based food sales during the beginning of after-school programming. Food items will comprise a spectrum of nutrient-to-caloric density snack foods that are available in local stores, ranked for acceptability by a focus group of target kids and approved by our senior dietitian. Single food items will be displayed on a demonstration counter and a large menu board display will feature photographs of each food item next to the number of calories each contains in a format that is similar to popular chain restaurants. Two food sales over two designated after-school days will be conducted at baseline, mid-way (after 20 h of programming), 1-week post-intervention and 2-months after. Through their participation in the education programming, students will earn digital vouchers which students exchange as payment for one snack item at each food sale. Food purchases will be tracked across the food sales, but children are blind to the tracking, eliminating the possibility of a "compliance bias." Data on caloric and nutrient content per food item purchased will be collected.

Child-to-parent communication

Participating parents will complete a structured survey to assess child-to-parent communication of nutrition information, specifically knowledge of caloric needs, recommendations and MBCL. Surveys will be administered online *via* Qualtrics and printed copies will be provided upon request.

Measures

Measures involved at baseline, mid-intervention and post-intervention to evaluate changes over time:

Student food purchasing behavior: We will conduct food sales (behavior change evaluation) during the beginning of after-school programming. Food items were selected based on the following criteria-availability in local bodegas, chosen *via* focus groups of our student advisory board, approved by study senior dietitian to fulfill nutrient-to-caloric density spectrum. All foods will require a digital voucher for purchasing and individual's food choices tracked. Children will not be aware that their purchases are being monitored.

Child menu board calorie literacy: We will assess these measures with our novel validated MBCL questionnaire, which comprises 20 MBCL items and seven self-efficacy items [13]. Tests will be administered online *via* Qualtrics.

Parent knowledge and nutrition guidelines: We will use a structured survey instrument that assesses parents: a) Awareness of calorie postings on menus, b) Level of usage of calorie postings and c) Nutritional knowledge. Nutrition knowledge will be assessed using a 7-item nutrition questionnaire, adapted from the validated child MBCL instrument.

Child BMI percentiles: Research staff will be trained by the lead study dietitian to measure child height and weight utilizing the Seca 217 Mobile Stadiometer and Seca 874 Flat Scale. The same staff member will measure the same children throughout the entire study period. We will convert BMI data into z-scores (which reflect the number of standard deviations above or below the mean a child is for BMI) and centiles. We will explore changes in BMI z-scores and differences between intervention and control groups at the end of the school year.

Demographics: This will be administered to parents at baseline and includes age, sex, race/ethnicity, educational status and income. We will also collect the following demographic data from children: Age, gender and school the child attends. We will include sex as a biological variable due to findings that sex may influence the effect of menu labels on food selection [28]. Finally, we will collect data on the number of adults and number of children in the household, language spoken at home, years in the United States and if the primary caregiver works outside the home.

Parent numeracy: We will assess numeracy of parents, using a 4-item scale adapted from the subjective numeracy scale [29]. Two of the four items will apply mathematical skills to health behaviors in the MBCL. We will include this as a statistical covariate to control for varying levels of health literacy.

Educator measures: Surveys will be administered to after-school education specialists to capture socio-demographic factors such as age, race/ethnicity, highest educational degree and number of years teaching. Pre/post test data from measures of knowledge acquisition from educator training will also be collected *via* LMS along with fidelity data (curriculum adherence checklist) derived from direct observation by our research team.

Data analyses and statistical power

Data analyses and statistical power include:

Primary hypothesis (Aim 1): Evaluate the food-purchasing behavior of 5th graders at baseline, 1-week and 2-months following the end of the 40 h HHH intervention.

The design is a cluster randomized trial with randomization at the level of the school and analyses at the level of the child. The basic regression model: $y_{ik} = \beta_0 + \beta x t_k + e_{ik}$ (i subjects, k=3 time points and x is a dummy variable for group). Change over the three waves of data will be modeled using a mixed model, adjusting for clustering within schools. Power analyses were performed for the primary aim, assuming both 20 and 25 children per school and 7 schools per arm. Based on prior research, the Intracluster Correlation Coefficient (ICC) is estimated as 0.03. Two scenarios regarding the average correlation between outcomes over time were examined (0.5 and 0.6). Assumptions related to the standard deviation were obtained from an earlier study in which it was shown that the average reduction in purchased calories was from 179 to 144. Sensitivity power calculations for average change were also performed, relaxing the assumption of linear change.

Regression model: The power analyses equations for modeling rate of change are as follows [30]:

$$n = \frac{2(z_\alpha + z_\beta)^2 \sigma^2 (1-\rho) I_{fn}}{T_n s_x^2 d^2 R_{el}} \text{ and } s_x^2 = \sum (t_j - t) / T_n = 0.62 / 3$$

Assuming: ρ=0.5 (average correlation of outcomes), σ=84.8 (pooled SD from the baseline of the pilot study), α=0.05, R_{el}=0.9 (reliability) and 3 time points (baseline, 1-week, 2-month) for most participants, with an n of 140 per group (20 per school) and adjusting for clustering within school, the variance inflation factor is: I_{fn}=1+(20-1)*I_{cc}=1.57 with I^{cc}=0.03, it will be possible to detect an effect size (group difference) of δ=33.67 calories per 2-months (Cohen's d=0.397), with power of 0.80. This translates to a group difference in calories between control and intervention groups of 33.67 calories at study end (after 2-months of follow up). The assumptions are α=0.05, power=80%, for a two-tailed test, with ρ=0.5 or ρ=0.6, n=140 or n=175 (25 per school, I_{fn}=1.72).

Sensitivity analyses: The first model (Manova for repeated measures) does not include a baseline outcome covariate:

$y_{ij} = \beta_0 + \beta_x + e_{ij}$ (i subjects, j=2 follow-up time points and x is a group dummy variable). The power analysis equation is as follows:

$$n = \frac{2(z_\alpha + z_\beta)^2 \sigma^2 (1 + (n-1)\rho) I_{fn}}{T_n d^2 R_{el}}$$

With the same assumptions as above, with an n of 140 per group (20 per school) and adjusting for clustering, it will be possible to detect an effect size of δ=32.48 calories (Cohen's d=0.383), with power of 0.80. This translates to an average group difference in calories between control and intervention of 32.48 calories over 2 follow-ups.

The second model (Mancova for repeated measures) includes a baseline outcome covariate:

$y_{ij} = \alpha_0 y_{io} + \beta_o + \beta_x + e_{ij}$ (i subjects, j=2 follow-up time points and x is a group dummy variable). The power analysis equation for this model is as follows:

$$n = \frac{2(z_\alpha + z_\beta)^2 \sigma^2 (1 + (n-1)\rho) I_{fn}}{T_n d^2 R_{el} (1-\rho^2)}$$

Under the same assumptions as above and adjusting for clustering; it will be possible to detect an effect size of δ=28.15 calories per year (Cohen's d=0.332), with power of 0.80. This translates to an average group difference in calories between control and intervention of 28.15 calories.

Secondary aims 2 and 4: To assess the effects of the intervention on menu board calorie literacy and knowledge of calorie recommendations. Analyses similar to those proposed in aim 1 will be performed with respect to these continuous outcome variables.

Aim 3: To assess the extent to which children communicated knowledge of calorie recommendations to a parent within 1-week following the end of the intervention. The outcome is binary; thus, a generalized linear mixed effects model, adjusting for clustering within schools will be performed using SAS Proc Glimmix.

RESULTS AND DISCUSSION

Fast food restaurant calorie postings are highly variable and their interpretation often exceeds the customers' understanding [31]. Although nutrition education can be effective at achieving behavior change and despite federal calorie posting mandates, these programs have not traditionally focused on Menu Board Calorie Literacy in fast food restaurants [32-34]. This study is designed to address this gap by focusing on specific knowledge and skills required to use these calorie postings as a dietary decision tool at the point-of-purchase using a novel approach that centers young children and leverages their parental purchase influence regarding food purchases [19].

Our intervention focuses on specific food choice behaviors that may be influenced at the point of purchase by dietary decision cues. It recognizes that by the age of 13 most children begin to have discretionary income (usually from their parents) giving them the freedom to make their own food purchasing decisions [20]. We hypothesize that an immersive entertaining approach to consumer socialization of these young children around point-of-purchase calorie postings will improve their nutrition literacy, food purchases behaviors and the food purchases of their parents. The incorporation of common core math improves the acceptance of the intervention by teachers and may enhance the children's' self-efficacy and proficiency for math.

CONCLUSION

An integrated nutrition-math curriculum incorporating dynamic affective dimensions of behavior change that is focused on leveraging point-of-purchase calorie postings may be a novel approach to optimizing healthier food purchases by young fast-food patrons and their families. By addressing both cognitive and behavioral aspects of decision-making, this intervention has the potential to empower children with the skills necessary to make informed dietary choices while simultaneously fostering a ripple effect of health awareness within their households. Moreover, embedding common core math standards into the program not only aligns it with educational goals but also enhances its adaptability and acceptance among educators.

LIMITATIONS

Our intervention targets the immediate prepubescent period (ages 9-12) when children are on the cusp of food purchasing independence. This is a critical and underexplored period for behaviorally focused food purchasing interventions. We decided to first focus on efficacy in a controlled after-school food-sale setting and examine real-world food purchasing effects as an exploratory feasibility outcome. We acknowledge that our intervention afterschool-based effects may regress to baseline due to negative real world environmental forces such as the presence of a food swamp or healthy food desert promoting unhealthy behaviors. However, our study focuses on increasing healthier food demand in the child's available food environment and evaluating the early (1 week) and delayed (3 months) sustainability of this change following the conclusion of the intervention. Finally, we do not plan to collect detailed information on parental communication styles which may influence purchase influence, although we do include measures of child-to-parent communication of nutrition information.

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