Effect of Energy Density Over 5 Days in Preschool Children

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1.0 Objectives

1.1 Study Objectives

Aim: To determine the effect of varying the energy density of foods served over five days on energy intake in preschool children.

Hypotheses:
1. Mean daily energy intake will be greater when children are served higher-energy-dense versions of foods over five days than when they are served lower-energy-dense versions of the same foods over five days.
2. Daily energy intake in the conditions with higher and lower energy density will begin to converge across the 5-day period.
3. Energy intake across the 5-day period will be adjusted closer to baseline in response to decreases in energy intake than in response to increases in energy intake.

1.2 Primary Study Endpoints

1. Daily intake of food and beverages by energy (kilocalories)

1.3 Secondary Study Endpoints

2. Daily intake of food and beverages by weight (grams)
3. Daily intake of food and beverages by energy density (kilocalories/gram)

2.0 Background

2.1 Scientific Background and Gaps

It has been proposed that preschool children are in a formative stage during which the ability to regulate energy intake is being replaced by eating in response to environmental food cues. In recent studies [1-4], we have found that increases in both food portion size and energy density have been robust in promoting excess energy intake in preschool children over one to two days. These results challenge the proposition that preschool children show self-regulatory behavior by altering their energy intake when it is perturbed by variations in the available foods.

At present, no controlled studies have been conducted over a sufficient duration, estimated to be three to four days, to determine whether children adjust energy intake in response to differences in energy density in the eating environment.

2.2 Previous Data

See references 1 through 4

2.3 Study Rationale

This study will allow us to investigate preschool children's ability to regulate their energy intake and to assess how energy density affects intake over a longer period of time.

3.0 Inclusion and Exclusion Criteria

3.1 Inclusion Criteria
1. Children enrolled in one of the participating child care centers
2. Children who are between the ages of 3 and 5 years old at the time of enrollment
3. Parents (18 years or older) of children enrolled in the study
4. Teachers (18 years or older) in a classroom with enrolled children

3.2 Exclusion Criteria
1. Children with allergies or restrictions to any of the foods served
2. Children with health issues that preclude participation
3. Children who are unavailable for the entire duration of the study

3.3 Early Withdrawal of Subjects
3.3.1 Criteria for removal from study
There are no criteria for removal of subjects from the study. All participation is voluntary and a child can refuse a meal session and parents may withdraw from the study at any time.
3.3.2 Follow-up for withdrawn subjects
N/A

4.0 Recruitment Methods

4.1 Identification of subjects
Any child and parent in a participating classroom of the child care center may participate. Teachers of participating children in the classroom will also be asked to participate.

4.2 Recruitment process
We will recruit through a parent letter placed in each child's mailbox. A study staff member who is approved (in this application) to do recruitment and consenting of subjects will be available in the center during child pick-up to answer any questions parents may have.
Teachers in classrooms will be verbally asked to participate by study staff.

4.3 Recruitment materials
Parents will receive a letter in their child’s mailbox that will describe the study. The consent form will be included with the letter.
Teachers in classrooms will be verbally asked to participate by study staff. A consent form will then be reviewed and signed by each teacher willing to participate.

4.4 Eligibility/screening of subjects
Children with allergies or restrictions to the foods served in the study will not be eligible to participate. Screening questions regarding food allergies and intolerances will be included with the consent form.

5.0 Consent Process and Documentation

5.1 Consent Process

5.1.1 Obtaining Informed Consent

5.1.1.1 Timing and Location of Consent

Consent will be signed by the parent. Consent will be obtained at the child care center by a trained member of the study staff.

Teachers will consent to fill out a questionnaire about enrolled children prior to the first study week in their classroom at the child care center.

An addendum consent was added to this study due to university closure for inclement weather. Since five consecutive days are needed for data collection, Study Week 2 was restarted for one cohort.

Only parents will be given the consent addendum as teacher participation does not change with this rescheduling. Parents will be given the addendum at the child care center. Consent will be obtained at the child care center by a trained member of the study staff.

5.1.1.2 Coercion or Undue Influence during Consent

Parents will be given the consent form to take home to review on their own and can decide if they want their child to participate.

Teachers will be given the opportunity to review the consent form on their own and can decide if they wish to participate.

5.1.2 Waiver or alteration of the informed consent requirement

N/A

5.2 Consent Documentation

5.2.1 Written Documentation of Consent

Participation in this study is voluntary. Participation in the changed schedule is voluntary.

A parent of the participant will sign the consent form. Parents will be given a copy of the consent form to keep for records.

A parent of the participant will sign the consent addendum. Parents will be given a copy of the consent addendum to keep for their records.

Teachers will sign a separate consent form for their participation and will be given a copy for their own records.

5.2.2 Waiver of Documentation of Consent

N/A

5.3 Consent – Other Considerations

5.3.1 Non-English Speaking Subjects

It is not anticipated that there will be any non-English speaking or illiterate subjects.

5.3.2 Cognitively Impaired Adults

5.3.2.1 Capability of Providing Consent

N/A

5.3.2.2 Adults Unable To Consent

N/A

5.3.2.3 Assent

N/A

5.3.3 Subjects who are not yet adults (infants, children, teenagers)

5.3.3.1 Parental Permission

Parents will sign consent for their child to participate.

5.3.3.2 Assent

Children can refuse to eat any meal if they choose. Before height and weight are measured or the Tasting Game occurs, children are asked if they want to do it and can refuse to participate.

6.0 Study Design and Procedures

6.1 Study Design

This crossover study has a within-subjects design. There will be three experimental conditions; one condition in which meals of lower energy density (ED) are served, one condition in which meals of baseline energy density are served, and one condition in which meals of higher energy density are served. The order of conditions across the three 5-day periods will be counterbalanced across classrooms. Children will be served the same amount (weight) of food and beverages across all three conditions. In the lower-ED condition, the amount of energy served over each day is ~225 calories less than in the baseline condition. Energy served over the day in the higher-ED condition is ~225 calories more than in the baseline condition. Daily menus in all conditions meet the minimum guidelines for energy and food groups outlined by the USDA and the Child and Adult Care Food Program (CACFP).

6.2 Study Procedures

1. Over 5 consecutive days, enrolled children will be served breakfast, lunch, dinner, and snacks of foods commonly served in the child care center according to their regular meal and snack schedules. Study menus were developed from the menus at each child care center to be similar to the foods that children are regularly served. Milk or water will be served as beverages. Meals will be served at tables of 3 to 6 children and one adult, which is a standard practice at the child care centers. The adults at the table will be instructed not to discuss the food or to encourage the children to eat. There will be three experimental conditions, which differ only in food energy density. The lower-energy-density condition will provide foods 20% lower in energy density than the baseline condition, and the higher-energy-density condition will provide foods 20% higher in energy density than the baseline condition. Each participant will be served individual pre-weighed meals. All food and beverage items will be weighed with a food scale before and after meals to within 0.1 grams in order to determine the amount consumed. Participants will be told they can eat as much or as little of the foods as they would like. Trained study staff will document food and beverage spillage and any comments made about the food. The children will be provided with an evening snack pre-packaged for consumption at home. Any leftover food from the evening snack will be returned to the child care center the following day to be weighed.

2. Parents will be asked not to serve any additional food or beverages to their child apart from those provided by the study and water. If there is any deviation from this procedure, parents will be asked to report the extra food and beverage consumption.
3. Physical activity levels will be measured using tri-axial accelerometers worn over the five study days in each period. The accelerometers will be worn while the children are present at the child care center (from before breakfast to after dinner). Study staff will attach a device to the child's waist upon arrival at the center each morning and remove the device upon the child's departure from the center each evening.
4. On the final (16th) visit to the child care center, children will have their height and weight measured by a trained member of the study staff. Body weight will be measured in triplicate using a portable digital scale, and height will be measured in triplicate using a portable stadiometer. The children will also complete the Tasting Game, in which they are asked to taste a small food sample and point to a cartoon face that represents their liking of the food on a scale of "yucky" to "yummy".
5. Parents will be asked to complete an Evening Report form, Background Questionnaire, Children's Eating Behavior Questionnaire, Caregiver's Feeding Style Questionnaire, and Child Feeding Questionnaire. The Evening Report form will be completed at the end of each study day and returned each morning to study staff. The Background Questionnaire will be completed during the first 5-day study period and returned to study staff. The Children's Eating Behavior Questionnaire, Caregiver's Feeding Style Questionnaire, and Child Feeding Questionnaire will be administered during the last 5-day study period. All questionnaires will be completed using paper copies.
6. Photographs may be taken of children eating meals, participating in the Tasting Game, or having their height and weight measured.
7. There will be a 1-week break between 5-day study periods. There will be a 4- to 6-week wash-out period between this experiment and Experiments 1 and 3 at each child care center. We will rotate the participating child care centers to ensure that each child completes the wash-out and is eligible to participate in the next experiment if they choose.
8. Approved study staff (on this application) will email parents on the Friday before a study week begins to remind parents of the upcoming study week.
9. Teachers will be asked to complete one questionnaire (Caregiver's Feeding Style Questionnaire) per participating child in their classroom. Teachers will only complete questionnaires about children who are enrolled in the study. This questionnaire will be administered using a paper copy. Teachers will be verbally informed by study staff about the children for whom they are to complete questionnaires.
10. Data from questionnaires completed by teachers will be linked to child participants by a three digit number and letter only.

6.3 Duration of Participation

The duration of each study period will be five consecutive days, and each participant will be asked to complete three of these 5-day periods. During study days, each meal and snack will take approximately 30 minutes to complete. The estimated time required by the participant each day is 2.5 hour for meals. The estimated total time required for all of the meals is 37.5 hours across 15 days. The height and weight measurements and the

Tasting Game on the final visit will require an additional hour of time. For the parents, 30 minutes will be required to complete the questionnaires. The total time commitment for the study is 39 hours.
Teachers will spend approximately 20 minutes per questionnaire.

7.0 Data and Specimen Banking For Future Undetermined Research

7.1 Data and/or specimens being stored
N/A

7.2 Location of storage
N/A

7.3 Duration of storage
N/A

7.4 Access to data and/or specimens
N/A

7.5 Procedures to release data or specimens
N/A

7.6 Process for returning results
N/A

8.0 Statistical Plan

8.1 Sample size determination
The sample size for the study was estimated from a linear mixed model and an approximation technique [5] using exemplary data sets based on prior 1- and 2-day studies in preschool children [2,3]. We assessed the required sample size for several scenarios with different assumptions about changes in intake on days 3 to 5 that represented quadratic trajectories over time. To detect a clinically significant change of 50 kcal/d over time (movement toward adjustment after 3 to 5 days) with a Type 1 error rate of 5% and power of 90%, it was determined that 45 participants would be required. To allow for withdrawals and non-compliance to the protocol, at least 55 children will be enrolled.

8.2 Statistical methods
The main outcomes of the study are daily consumption (by weight, ED, and energy) of manipulated foods, non-manipulated foods and milk, and their combined total. Other outcomes are cumulative intake for the entire 5 days, daily macronutrient intake, daily intake of non-manipulated items by meal component (fruits and vegetables at main meals, grain-based snacks, dairy snacks, fruit and vegetable snacks, and milk), and

physical activity time (daily step counts, sedentary time, and moderate-to-vigorous time). To analyze differences in mean daily outcomes across the 3 experimental conditions, linear mixed models with repeated measures are used. The fixed factors in the models are ED condition (lower-ED, baseline-ED, or higher-ED), study week, study day, menu, classroom, and sex. Interactions between these factors are tested and removed from the model if not significant. Participants are treated as a random effect. The Tukey-Kramer method is used to adjust for multiple pairwise comparisons between means. In order to evaluate the contribution to children's intakes of non-study foods reported by parents, the energy content of the reported items is estimated by study staff. The outcome of daily energy intake is analyzed both with and without the non-study items. This estimated data is not included in further analyses, because these estimates are based on parental recall and were less accurate than measured intake.

Random coefficients models are used to test whether the trajectories of daily intake in the 3 conditions converge over the 5 days, i.e., whether regulation of energy intake occurs over time in response to ED variations. The trajectories of intake over time are modeled separately for each child and allowed to vary randomly. Time (study day) is treated as a continuous covariate in the model and polynomial factors of time (linear and quadratic coefficients) are tested as both fixed and random effects to determine the shape of the intake trajectory. The intercept of the trajectory reflects the magnitude of daily intake. The linear coefficient represents the rate of change in intake (slope) across time after Day 1, and the quadratic coefficient represents the rate of acceleration or deceleration in intake (curvature) across time after Day 1.

The influence of continuous participant characteristics (age, body weight, height, BMI-for-age percentile, BMI z-score, step counts, and questionnaire subscales) on the relationship between the experimental factors and intake is assessed by analysis of covariance with linear mixed models. Because multiple participant characteristics are tested as covariates, the method of Benjamini and Hochberg [6] is used to adjust the significance levels, with the false discovery rate set at 0.05 [6]. In order to standardize for energy needs, models having significant covariance with weight status are adjusted for estimated energy requirements [7]. Differences in subject characteristics between boys and girls, as well as differences in intake between children with and without obesity (sex-specific BMI-for-age percentile ≥85 and<85, respectively), are assessed by independent-samples t-tests. Within conditions, the means of daily energy intakes expressed as a percentage of estimated energy requirements are compared to 100% using a one-sample t-test and controlling the family-wise error rate using the Bonferroni correction.

It has been predetermined that children who have incomplete intake measures on ≥3 days in all 3 conditions will be excluded from analysis. It has also been predetermined that children who eat >95% of the food weight served on at least 1 day will be classified as “plate cleaners”, and their influence on the results will be tested. To evaluate whether the distribution of taste ratings (yummy, just okay, yucky) of the lunch and snack dishes differs significantly across experimental conditions, ordinal logistic regression is used; results are reported as odds ratios (OR) with 95% confidence intervals. Outcomes from

statistical models are reported as mean ± SEM and subject characteristics are reported as mean ± SD. Standardized effect sizes are calculated using Cohen's d statistic, with no adjustment for correlation due to repeated measures. Results are considered significant at $P < .05$. All data are analyzed using SAS software (SAS 9.4, SAS Institute, Inc., Cary, North Carolina, USA).

9.0 Confidentiality, Privacy and Data Management

9.1 Confidentiality

We may take photographs of children eating meals, participating in the Tasting Game, or having their height and weight measured, which may be used for poster or oral presentations at scientific meetings. Parents will indicate on their consent form if they agree to have their child's photograph taken. All images will be stored on a password-protected network drive which can be accessed only by those identified on this application. Images will be stored with a generic title and will not be labeled with any identifiable information. The images will be deleted from the network drive within 3 years of completion of the study.

9.1.1 Identifiers associated with data and/or specimens

Children's data will only be identified by a 3 digit number, dot color, and a letter of the alphabet. Teachers will not have their own identifiers.

9.1.1.1 Use of Codes, Master List

The list that links the ID code to subject identifiers will be stored in a locked closet in the Lab Manager's office in 226 Henderson Building. Only those listed on this application will have access to it. The master list of the codes will be destroyed upon publication of the study or five years after the close of the study, whichever comes first.

9.1.2 Storage of Data and/or Specimens

Paper data with identifiers will be stored in a locked cabinet in a locked closet in the Lab Manager's office. Data on network drives will have no identifiable information. Access to network drives is protected by passwords.

Paper and digital copies of data with identifiers removed will be stored indefinitely.

This study will be issued a Certificate of Confidentiality. Researchers will not disclose or provide any identifiable information without the subject's prior consent or where permitted according to NIH's Policy on Issuing Certificates of Confidentiality.

9.1.3 Access to Data and/or Specimens

Only those listed on this application will have access to data.

9.1.4 Transferring Data and/or Specimens

The researchers do not plan to release identifiable information collected in the study. However, if researchers consider releasing identifiable information in the future – the individual or institution receiving the identifiable information will be made aware they are also subject to the requirements of subsection 301(d) of the Public Health Service Act.

9.2 Privacy

No personal information other than first name, telephone number, and email address is stored where it can be seen by study staff. Participant data will remain unidentified except by study number and letter. Only senior staff members listed on this application have access to personal information such as address, age, weight, etc.
Data on food consumption is collected in a separate room where only study staff is present. Heights and weights for both children and parents are collected in a private area of the child's classroom.

10.0 Data and Safety Monitoring Plan

The proposed study poses minimal risk to participants, since the procedures involve little change from the usual meals and activities at the child care centers.

11.0 Risks

There are minimal risks associated with participation in this project. The risks are no greater than those associated with the children's usual attendance and consumption of meals at the child care center and at home, which include the risk of food allergy, food-borne illness, and choking on food.
The amounts served in all conditions meet or exceed minimum requirements for calorie and nutrient content for this age group as specified by the UDSA and the Child and Adult Care Food Program (CACFP).
There are no potential risks for teacher participants.

12.0 Potential Benefits to Subjects and Others

12.1 Potential Benefits to Subjects

There are no direct initial benefits to subjects participating in the proposed study.

12.2 Potential Benefits to Others

The research will benefit society by advancing understanding of children's eating behavior and identifying meal-related strategies for the prevention of obesity in children.

13.0 Sharing Results with Subjects

No results will be shared with the subjects.

14.0 Economic Burden to Subjects

14.1 Costs

N/A

14.2 Compensation for research-related injury

It is the policy of the institution to provide neither financial compensation nor free medical treatment for research-related injury. In the event of injury resulting from this research, medical treatment is available but will be provided at the usual charge. Costs for the treatment of research-related injuries will be charged to subjects or their insurance carriers.

15.0 Other Approvals

The Bennett Family Center, The Child Care Center at Hort Woods, and Step by Step School for Early Learning have given permission to conduct this study in their facilities.

16.0 Adverse Event Reporting

16.1 Reporting Adverse Reactions and Unanticipated Problems to the Responsible IRB

In accordance with applicable policies of The Pennsylvania State University Institutional Review Board (IRB), the investigator will report, to the IRB, any observed or reported harm (adverse event) experienced by a subject or other individual, which in the opinion of the investigator is determined to be (1) unexpected; and (2) probably related to the research procedures. Harms (adverse events) will be reported to the IRB in accordance with the IRB policies and procedures.

16.2 Auditing and Inspecting

The investigator will permit study-related monitoring, audits, and inspections by the Penn State quality assurance program office(s), IRB, the sponsor, and government regulatory bodies, of all study related documents (e.g. source documents, regulatory documents, data collection instruments, study data etc.). The investigator will ensure the capability for inspections of applicable study-related facilities (e.g. pharmacy, diagnostic laboratory, etc.).

17.0 Study Monitoring, Auditing and Inspecting

17.1 Auditing and Inspecting

The investigator will permit study-related monitoring, audits, and inspections by the Penn State quality assurance program office(s), IRB, the sponsor, and government regulatory bodies, of all study related documents (e.g. source documents, regulatory documents, data collection instruments, study data etc.). The investigator will ensure the capability for inspections of applicable study-related facilities (e.g. pharmacy, diagnostic laboratory, etc.).

18.0 References

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