

Slow and Steady Wins the Race

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ABSTRACT

Childhood obesity has become an epidemic in America. Methods of teaching healthy eating habits are rare in primary schools, and the media encourage an unhealthy relationship with food. To prevent diet-related diseases, a healthy approach to eating must be established at the primary level. Principles of food metabolism were presented to 40 fifth grade students at the Kids Judge Neuroscience Fair in Pullman, WA. The general chemical structure of fats, proteins, simple carbohydrates and complex carbohydrates was explained, as well as the digestive pathways of glucose. Students were assigned one of three breakfast/lunch combinations on meal cards to be worn around their necks. Following meal assignment, students were instructed to participate in a five-station obstacle course. Completion of each station was determined by the complexity (i.e., health value) of the assigned meals. The story of *The Tortoise and the Hare* was utilized to encourage critical thinking, as well as assess the students' understanding of the concepts presented. Following the station exercises, students were able to correctly identify the meal combination eaten by the tortoise and the hare. Student evaluations ranked the model in first place; results of the evaluations indicated a high level of concept comprehension. The model could serve as an effective means of altering current conceptions about food.

Introduction

Current obesity trends in the United States (4) indicate a general lack of knowledge regarding mechanisms of food digestion. Obesity among American children has been rising since 1980 (4). Currently, thirty percent of children ages 6-11 are overweight and 15.3 % are obese (4). Recent fad diets suggest the elimination of one or more food groups, and neglect basic biochemical evidence for a balanced diet (4). American society and media encourage healthy eating as a means of reaching a socially acceptable physical ideal, rather than overall health and longevity. Shortened school lunch periods and vending machines only facilitate unhealthy eating behaviors, and primary schools have only recently attempted to teach a balanced attitude toward food. It is therefore necessary to implement effective and realistic nutritional education that emphasizes eating for mental and physical health.

Recent literature suggests multiple tools for determining the benefits of ingesting specific types and combinations of food. These tools include the glycemic index (1), oxidation analysis of varying types of carbohydrates (2), and diet-induced thermogenesis (3). The glycemic index (GI) classifies carbohydrates according to their rates of absorption (1). Specifically, the GI measures the effects of carbohydrates on postprandial blood glucose and insulin response. The

GI gives a numeric physiologic classification of relevant carbohydrate foods: a lower GI level indicates a lower rate of carbohydrate absorption, which is correlated with a reduced post-meal rise in hormones associated with digestion. Foods with low levels on the GI cause minimal fluctuations in blood sugar levels, and sustain satiety longer than foods high on the glycemic index (2). Implications for use of the GI in the health care field are significant, in that foods low on the GI index are linked to lowered LDL cholesterol, decreased insulin sensitivity, satiety, lowered rates of colon, breast and prostate cancers, among other biological improvements following digestion. Utilization of the GI has been determined to be helpful for individuals suffering from coronary heart disease, diabetes and obesity (1).

Carbohydrates vary significantly in composition, and thus impact digestion differently (1, 2 & 3). Factors of control, time course, and onset of hunger in humans can be done by measuring substrate oxidation rates following digestion of carbohydrates (2). Available carbohydrates are absorbed readily in the small intestine, and produce rapid changes in blood glucose levels following ingestion (1). Unavailable carbohydrates are usually not metabolized until reaching the colon, and therefore do not cause a significant or rapid change in blood glucose levels (1). A high content of unavailable carbohydrates is defined as a dense portion of slowly digested carbohydrates, and has been associated with a lower and delayed rise of postprandial carbohydrate oxidation as well as less hunger than that following ingestion of a low content of unavailable carbohydrates. Awareness of the different types of carbohydrates and their subsequent metabolic effects on hunger, satiety, and blood glucose levels can therefore aid in the prevention of obesity. Specifically, ingestion of large portions of slowly digested unavailable carbohydrates can be a method of treatment and prevention for obesity and related diseases.

Diet-induced thermogenesis (DIT) refers to the increase in energy expenditure above basal metabolic rate. Postprandial effects on DIT can be measured for all types of foods (Westerberp, 2004). Levels of DIT differ for the type of food ingested: 0-3% for fats, 5-10% for carbohydrates, 20-30% for proteins, and 10-30% for alcohol. Diet-induced thermogenesis increases body temperature, which may be related to feelings of satiety (3). For example, individuals ingesting high-protein/high-carbohydrate foods report higher satiety scores than those ingesting other combinations of foods (3). This suggests that the combination of foods ingested may be important for the control of feeding behaviors.

The current societal focus on diet as a means of achieving a physical goal has contributed to an unhealthy attitude towards food among Americans. We hypothesize that teaching a cause and effect relationship between the types of food ingested and overall health will ameliorate unhealthy attitudes towards food. An active demonstration of how the brain and body utilize different types of foods for energy will instruct children about healthy eating behaviors, and could eventually aid in the prevention of diet-related diseases.

Method

General Set-up

The model was a five-station obstacle course, to be completed following the assignment of a breakfast/lunch meal combination. Three meal combinations were used, ranging from unhealthy/high content of available (i.e., simple) carbohydrates to healthy/high content of unavailable (i.e., complex) carbohydrates. All students were told to participate in Station One. Students were then instructed to either sit down or go on to Station Two. Students assigned meal combination one were told to stop after station one; meal combination two to stop after Station Three; meal combination three were allowed to complete the final station, which was a mental task. Prior to the station activities, a brief explanation of the chemical structure of fats, proteins, simple carbohydrates and complex carbohydrates was presented. Points emphasized during this presentation were as follows: the brain utilizes glucose for energy, the body uses simple carbohydrates very quickly, complex carbohydrates take longer to digest and therefore give more energy, and the optimal food combination for sustained energy for the brain and body is a balance of complex carbohydrates, healthy fats, and lean proteins. The story of *The Tortoise and the Hare* was used as a tool to assess the students' understanding of the model. Following the presentation and explanation of the meal combinations, the students were asked to think about the following question: Which meal combination did the hare and tortoise eat before they began the race? This question was asked again following the students' participation in the station activities.

The model was demonstrated in the WSU ballroom at the Kids Judge Neuroscience Fair. A total of 40 fifth graders participated in the experiment, in groups ranging from three to eight students. Following the 15-minute model demonstration, the students evaluated the model using a six-question evaluation sheet (see Figure one).

Materials

Stations: A hula-hoop, basketball & football, jump rope, math test, and bubbles were used as activities for each station. Stations were labeled one through 5, and were completed in that order. Meal combination tags were made using printed pictures of each meal, which were glued to small pieces of poster board and laminated. Strings were attached to each tag to allow the students to wear the tags during the station activities. Chairs were used to support the hula-hoop, basketball & football, and jump rope stations.

Meal examples: Three breakfast/lunch meal combinations were displayed using real food as examples. Combination one: breakfast- can of soda, donut, and jellybeans; lunch- hot dog with white-bread bun, can of soda, crackers. Combination two: breakfast- sugary cereal, carton of milk, orange; lunch- pizza, carton of milk, M&Ms. Combination three: breakfast- granola, carton of yogurt, banana; lunch- turkey, cheese, lettuce and tomato on two slices whole wheat bread, string cheese, apple, carton of milk.

Presentation: Poster board was used to display the chemical structure of fats, proteins, simple carbohydrates, and complex carbohydrates. Also, the digestion process of each type of food was displayed using a diagram of the brain and torso, also drawn on poster board.

Results

Results of the evaluation sheets can be seen in Figure One. The majority of the students initially asked general questions regarding their tasks in the obstacle course. Three students asked questions about the chemical structure of carbohydrates and fats. Following the model demonstration, the fifth graders were able to correctly identify which meals the tortoise and hare ate before the race. The students were also able to report the importance of eating a balance of foods with low contents of simple carbohydrates for optimal brain and body performance. There were many follow-up questions regarding whether certain types of foods would give them energy.

The student evaluations ranked our model in first place for the Kids Judge Neuroscience Fair. The highest ranking (i.e., 4.9) reflected the students' understanding of our presentation. The lowest ranking (i.e., 3.6) was in response to the students' desire to learn more about the topic. The most frequent comments for question five (see Figure One) were related to the students' enjoyment of the activities at each station. The students reported that they learned "It is good to eat healthy foods." Additional comments suggested that we use real food in place of meal cards, as well as explain more about the chemical structure of foods.

Discussion

Students' understanding of the material was determined both subjectively, by the presenters, as well as objectively with the use of the evaluation sheets and specific questions following the model demonstration. The majority of the students appeared to be interested in how the brain and body utilized food. It was apparent that the students had previous knowledge that food with sugar (i.e., table sugar) is bad for you, but were not aware that food ingested can directly affect the brain. We used the story of *The Tortoise and the Hare* as a means of emphasizing how simple sugars can make an individual sleepy. This proved to be a useful tool in demonstrating that the brain has priority over any glucose present in the body, and when an individual ingests only simple sugars, glucose will be used quickly leaving the body with deficient fuel. The students were able to determine quickly which meals the tortoise and the hare ate, indicating they understood the connection between food ingested and energy levels.

For reasons of time and simplicity, we could not explore the detailed mechanisms of food metabolism in the body. Also, we did not explain how the brain utilizes glucose, only that it was the brain's main source of fuel. While our research investigated specific tools for determining optimum combinations of foods (i.e., Glycemic Index, carbohydrate oxidation rates & diet-induced thermogenesis), we did not mention or explain those concepts. Rather, we utilized the basic principles of those concepts to convey ideal meal combinations for optimum energy. To

minimize the above compromises, a future model could present a more specific aspect of food metabolism, such as the metabolic pathway of glucose in the brain.

While the real-food examples of the meal combinations were helpful, the students appeared distracted by the examples during the presentation. Using pictures rather than real food could perhaps allow for the students' full attention during the presentation. Also, to increase the students' desire to learn more about the topic

The model proved useful for emphasizing the need to eat healthfully for overall health. Our model could be an effective means of creating a healthy relationship with food, as it encouraged eating to energize the brain and body rather than achieve a physical ideal. To prevent further increases in rates of childhood obesity, a different approach to food must be taught to students at the primary level. Specifically, children must be taught the cause and effect relationship between food ingested and mental and physical longevity.

References:

1. Jenkins, D., Kendall, C., Augustin, L., Franceschi, S., Hamidi, M., Marchie, A., & Axelsen, M. (2002). Glycemic index: overview of implications in health and disease. *American Journal of Clinical Nutrition*. 76(1), 266S-273S.
2. Sparti, A., Milon, M., DiVetta, V., Schneiter, P., Tappy, L., Tequier, E., & Schutz, Y. (2000). Effects of diets high or low in unavailable and slowly digestible carbohydrates on the pattern of 24 h substrate oxidation and feelings of hunger in humans. *American Journal of Clinical Nutrition*. 73(6), 1461-1468.
3. Westerterp, Klaas R. (2004). Diet induced thermogenesis. *Nutrition & Metabolism*. 1(5),1743-1775.
4. Obtained from American Obesity Association webpage, at http://www.obesity.org/subs/fastfacts/obesity_youth.shtml

Kids Judge Neuroscience Fair

Judge Evaluation Form Results Sheet

Exhibit # A2

Exhibit Title: Slow and Steady Wins the Race

Tally, count and average the number of marks for each scale number:

1. Could you understand what the presenters were trying to tell you?

1 (0) 2 (0) 3 (1) 4 (11) 5 (37)

Total entries: 40

Average score: 4.9

2. Were the presenters friendly?

1 (0) 2 (1) 3 (1) 4 (3) 5 (35)

Total entries: 40

Average score: 4.8

3. Was the exhibit fun?

1 (0) 2 (1) 3 (4) 4 (8) 5 (27)

Total entries: 40

Average score: 4.53

4. Would you like to learn more about this topic?

1 (5) 2 (3) 3 (9) 4 (8) 5 (15)

Total entries: 40

Average score: 3.6

Summarize the written entries:

What was your favorites part of this exhibit?

Participating in the activities of the stations.

What did you learn from this exhibit?

It is good to eat healthy.

Additional comments?

Great job; It would have been better if we could have eaten real food.

Figure One. Judge Evaluation Form Results Sheet