Purdue University
Purdue e-Pubs

College of Health and Human Sciences Honors Program Undergraduate Theses

College of Health and Human Sciences

5-2012

Timing of Dessert but Not Portion Size Affects Young Children's Intake at Lunchtime

Lyndsey R. Herdzina-Huss
Purdue University, lmaxwell@purdue.edu

Follow this and additional works at: http://docs.lib.purdue.edu/hhstheses

Recommended Citation
Herdzina-Huss, Lyndsey R., "Timing of Dessert but Not Portion Size Affects Young Children's Intake at Lunchtime" (2012). *College of Health and Human Sciences Honors Program Undergraduate Theses.* Paper 6.

This document has been made available through Purdue e-Pubs, a service of the Purdue University Libraries. Please contact epubs@purdue.edu for additional information.

ABSTRACT

Multiple factors effect children's capability to make healthy choices when it comes to food intake. A field of study pertaining to pediatric nutrition that has not been well studied relates to children's modification of food intake in response to the meal served. The purpose of this repeated exposure, randomized, cross-over quasi-experimental study was to determine food preference and portion control in two-to-five year old children of Caucasian and Asian descent (n=23). The study had two within-subject factors (portion size of main course and timing of dessert) and was conducted in West Lafayette, Indiana, from January-April 2011. Whether children participated in the study or not, all children at the child care center were served two study lunches (fish or pasta, each with dessert) twice a week for 12 weeks. The two interventions were: a) an increased portion size by 50% and b) dessert being served with or after the main course. Analyses of variance conducted on energy intake from the main course and dessert at lunch yielded significant portion size x timing of dessert interactions. Serving dessert after the meal was associated with higher kilocalorie (kcal) consumption from the main course (73 versus 64 kcal, P=0.03), from dessert (90 versus 84 kcal, P=0.04), and as total intake at the meal (162 versus 148 kcal, P<0.01). Portion size did not change the amount of food consumed. These results provide novel information supporting childhood obesity research.

I would like to thank the administrators, teachers, and parents of the Ben and Maxine Miller Child Development Laboratory School for their support for this study and the staff and students in the Kranz Lab who contributed to this study.

INTRODUCTION

Childhood obesity has become a public health issue over the past decades. Particularly in preschoolers of low-income families, obesity prevalence has increased from 12% in 1998 to 15% in 2008 (1). Since obesity is the result of positive energy balance, dietary intake patterns need to be examined to help children maintain energy balance (2-3).

Being exposed to ever-increasing portion sizes may have contributed to what is now perceived as age-appropriate portion sizes for children in schools (4) as well as at home (5). Fisher et al. concluded that children, three-to-five years old, ate 25% more of the entrée and increased total energy intake by 15% when offered an age-appropriate portion that had been doubled in size; however, when participants were allowed to serve themselves, children consumed 25% less of the entrée (6). Larger portion sizes may contribute to the childhood obesity epidemic; however, there is a lack of strong and consistent evidence to that effect (4). To date, only a few studies have investigated the effect of serving a larger portion of part of a meal, i.e. a side dish, on energy intake (7-9). A study conducted by Lown et al. showed that portion sizes increased children's intake at the intervention meal but did not affect children's total daily energy intake (9). Therefore, excessive food and total energy intake may or may not be due to increased portion sizes during one or more meals in preschoolers. In individuals older than six years, increased meal size has been found to be associated with increased body weight status (10).

There is conflicting literature on the effect of portion size on children's intake. In single meal studies, serving larger portion sizes of food to children (two-to-six years old)

was associated with higher food intake at a meal (6, 7, 11-14). When it comes to meal frequency, researchers have discovered that children who eat less at one meal compensate at another (15, 16) and when preload snacks were consumed prior to test meals, young children effectively responded by adjusting their energy intake (17). Although several researchers have shown that children (three-to-nine years old) are able to self-regulate food intake at a meal (15-18), children's intake (two-to-nine years old) may or may not be increased in response to larger portions at a meal (11, 19-21).

Despite the childhood obesity epidemic, most American children are served desserts that are high in sugar and fats and are therefore highly desired (3, 22-24). The effect of the timing of dessert is understudied to date. Modifying when dessert is served might be particularly powerful in children ages three-to-five years, who have demonstrated a strong preference for the high-fat foods commonly served as dessert (22). The effect on total intake when eating dessert with or after the main course may be confounded by the type of food served as dessert.

This study has 3 aims: 1) to examine the effects of serving 50% larger portions of the main course, 2) the timing of dessert, and 3) interactions between larger portion sizes and the timing of dessert. We pursued these aims in a sample of two-to-five year old children attending a local child care center. Our first hypothesis was that serving dessert with the main course would lower the amount of food consumed from the main course. The second hypothesis was that serving a larger portion of the main course would result in higher consumption of the main course, especially when dessert was served after the main course.

METHODS

A randomized, repeated exposure, crossover, quasi-experimental design study with two within-subject factors (portion size and timing of dessert) was conducted at a local child care center between January-April 2011. Whether children participated in the study or not, all children at the child care center were served fish on Thursday and pasta on Fridays for 12 weeks. Both of these meals were modified for this study, which was approved by the Institutional Review Board of Purdue University. Informed parental consent and child assent forms were completed by all participants prior to the first study day.

Participant Recruitment

The goal was to recruit at least 40 children for the study. Participants were recruited in person and with the use of flyers at the Ben and Maxine Miller Child Development Laboratory School, a child care center for children at Purdue University (West Lafayette, Indiana). All children were encouraged to participate in the study, if they were between two and five years of age, participated at child care for the full day, and did not suffer from food restrictions, food allergies, or digestive diseases, such as Crohn's Disease or Cystic Fibrosis. Each parent provided information on his or her child's demographic background using parts of a questionnaire adopted from the National Health and Nutrition Examination Survey 2009-2010.

Design

Each participant was exposed to combinations of two portion sizes and two timings of dessert. Portion size was based on the United States Department of

Agriculture Food and Nutrition Service Child and Adult Care Food Program Child Meal Pattern for Lunch for one-to-two year olds and three-to-five year olds. Portion size was served in the amount recommended or the larger portion size was served by increasing the amount of each food at the meal by 50%, excluding milk and dessert. Dessert was served immediately after the main course or along with the main course. Portion size and timing of dessert were randomly assigned to the four participating classrooms on each Thursday and Friday within the first four-week period (block), and the same design was repeated during the second and third blocks. The first four weeks of the study period served as acclimation time for children to get used to the researchers and the activities involved in plate-waste measurement. Thus, data was based on weeks 5-12 of the study, which represented two four-week menu blocks.

Experimental Meals

Prior to the beginning of the study, meetings were held with teachers, parents, and foodservice staff to determine which lunches teachers observed to be most liked by the children, which foods parents knew to be liked and disliked by the children, and which foods foodservice staff believed to be the easiest to increase portion size by 50%. The two lunches chosen were baked freshwater fish (Thursdays) and pasta (Fridays); although fish is not usually considered a meal preference by children, many children that attended the child care center were of Asian descent and are accustomed to eating fish.

The timing of regularly scheduled lunch menu items was modified so baked freshwater fish was served every Thursday (ocean perch or tilapia, rice, zucchini or California Blend steamed vegetables, orange slices, milk, and a dessert) and pasta

every Friday (ravioli or pasta shells with sauce, celery/carrots or peas/corn, blueberries or pears, milk, and a dessert). The study lunches were the foods of the regular menu and served for 12 weeks.

The normal portion size (1 ounce of fish with ¼ cup of rice or ¼ cup pasta with meat sauce, served with ¼ cup of vegetables, ¼ cup of fruit, and ½ cup of milk for two-year-olds and 1 ½ ounces of fish with ¼ cup of rice or ¼ cup of pasta with meat sauce, served with ½ cup of vegetables, ½ cup of fruit, and ¾ cup of milk for three-to-five year olds) was increased by 50% during half of the study occasions, however, the dessert portion (chocolate chip cookie) remained the same. Dessert was served with the main course or immediately thereafter. The energy provided by each main course (not including milk) was 187 kcal for the standard portion and 280 kcal for the larger portion size with an additional 172 kcal for the dessert.

Procedures

Children were randomly assigned to one of four possible combinations of the two factors imposed on the meal (normal portion, dessert with lunch; normal portion, dessert after lunch; larger portion, dessert with lunch; or larger portion, dessert after lunch). With a total of 16 intervention days post-baseline, children were observed four times in each condition. On each study day, parents completed an interview-based questionnaire to report the child's dietary intake prior to arrival. Type of food, amount consumed, and time of intake were recorded. To measure children's food consumption, 12 research assistants were trained on the plate waste method.

To account for children's hunger at lunchtime, the plate waste method was used to assess food and energy intake at mid-morning snack. In short, each child's snack

was plated and weighed prior to serving; food waste and plate weight were obtained after snack was completed. Snack intake was calculated by subtracting the amount of the plate and all uneaten portions of the food from the amount of plated food served. Lunch was served at the regular lunchtime, and again the plate waste method was used to measure children's consumption of the foods served as main course and as dessert. Teachers in participating classrooms were instructed to follow standard mealtime procedures; no child was encouraged to eat more or less than usual or allowed to share food.

Statistical Analysis

Measured intake data included repeated exposure for each of the intervention conditions for each of the 23 children in the study. Main course consumption, dessert consumption, and total (main course plus dessert) consumption, measured in grams of food consumed and in calories from food consumed, were analyzed using a mixed model analysis of variance that accounted for between-subject as well as within-subject variation. The between-subject factors were room (four levels), age (two, three, four, and five years), and four-week menu rotation (first and second). The within-subject factors were meal (fish and pasta), dessert (with or after the main course), and portion (normal or large portion of main course). Main effects and interactions of other factors were examined to verify that inclusion of such terms in the analytical model did not impact the assessment of the factors that addressed the research aims. Based on children's actual intake at mid-morning snack, the amount of snack consumed was categorized as missing, none, small, and moderate amount. Snack consumption was examined as an additional explanatory variable in the models. The average age differed

by room (two-year olds in one classroom, three-year olds in another, and two classrooms with four-year olds, $P<0.0001$); reflecting the policy of the school to assign students to classroom by age. Therefore, room can be viewed as a proxy for age, a fixed effect. Statistical significance was defined as $P<0.05$. All statistical analyses were conducted using the Statistical Analysis Software (version 9.2, 2008, SAS Institute Inc., Cary, NC).

RESULTS

Out of 60 two-to-five year olds, only 23 volunteered to participate. Low recruitment may be due to disallowance of recruiters to approach families (families must approach recruiters), a large number of studies being conducted at the child care center at the same time, and a high participation of families where English is not the primary language. There were 23 participants (17 boys, 6 girls) of middle to high socioeconomic status ranging in age from two to five years. The majority of children participating in the study were either Caucasian or Asian (Table 1).

A total of 368 eating occasions of measured food intake data were collected. Means and standard deviations of energy intake at lunchtime are provided in Table 2. Main course energy consumption was higher when pasta, not fish, was served [87 versus 48 kilocalories (kcal), $P<0.0001$] as the main course. Total energy consumption was also higher on pasta days (173 versus 137 kcal, $P<0.0001$). Serving dessert after the meal was associated with higher calorie consumption from the main course (72 versus 63 kcal, $P=0.04$), from dessert (90 versus 84 kcal, $P=0.05$), and as total consumption at the meal (162 versus 148 kcal, $P<0.01$) (Figure 1). Portion size did not have a statistically significant effect on calorie consumption from the main course,

dessert, or in total consumption at the meal (P>0.05). The interaction between portion size and timing of dessert showed that energy intake did not increase upon increasing portion size, but did increase when dessert was served immediately after normal portions and 50% larger portions.

In all models, the effect of room was not statistically significant; however, there were instances where statistically significant interactions were found (room by meal and room by dessert for main course consumption, room by portion for dessert consumption, room by dessert, and room by portion for total consumption). In no cases were these interactions large or interpretable, thus these interactions were likely due to the small sample size in each group and the multiple factors being tested on such a small group. One exception was the interaction of room with the meal effect for main course consumption where differences between pasta and fish consumption (21, 25, 51, and 60 kcal, P=0.002) corresponded approximately with the mean ages in the rooms. Snack intake was statistically significant only for main course consumption (66, 59, 65, and 81 kcal for missing, none, small, and moderate, respectively, P=0.04, no pairwise differences were statistically significant). No statistically significant effects of portion size or gender were found.

DISCUSSION

Although the results may not be generalizable to all preschool-aged children, this study provides new evidence on the effects of portion size, food type, and timing of dessert on food consumption of preschool-aged children. These data are a valuable contribution to improve children's food environment and may prove critical in efforts to overcome childhood obesity.

Recent research has indicated that the national increase of portion size is indeed positively correlated with obesity rates (22). In studies focusing on single-meal items, serving larger portion sizes of food to children was associated with larger consumption of those foods (6, 7, 11-14). However, one study increasing portion size by 50% did not confirm these results (25). Unless larger portions of food served are lower in energy density, an increase in consumption potentially affects the continuous growth in childhood obesity rates in the United States. Although some results from studies in children suggest that certain children are able to self-regulate food intake, independent of meal size and eating frequency (15-18), the premise that children are consistently able to self-regulate dietary intake, despite chronic exposure to larger portion sizes, is challenged by increasing childhood obesity rates.

Our results contribute in the discussion of children's dietary intake behavior by showing that portion size had no statistically significant effect on intake, but timing of dessert significantly affected food and energy intake of the main course. This finding is similar to the discovery of Spill et al., who found that children consumed larger amounts of vegetables when more vegetables were served first (21). When dessert was served immediately after the meal, children ate more of the healthier foods served as the main course. More data examining this phenomenon using different foods and diverse groups of children are needed.

Altering the timing of dessert may be sabotaged by convenience or other factors, such as State-specific child care center feeding rules that require all components of the meal to be served to children at the same time or that dessert can only be served a maximum of twice per week (26). The potentially detrimental effect of serving of dessert

with the main course may be that children categorize foods and prefer when they are familiar and/or sweet (22).

In summary, we raise the concern that the common practice of serving dessert at the same time as the main course alters children's intake of food and energy. Alterations of the current serving practices could significantly improve consumption of foods that are nutrient-dense but lower in energy density than desserts, thus lowering risk for diet-related diseases, such as childhood obesity.

Strengths of this study include, but are not limited to, the two-by-two cross-over randomized control design with two within-subject factors, the serving of two very different food combinations as the main course, four-times repeated exposure to each study condition, and the inclusion of children's morning snack food consumption data and other important covariates in the data analysis. The practical application of results includes the suggestion that caretakers of children may choose to explore whether serving dessert with or after the main course of a meal may alter children's consumption patterns. When it comes to public school lunch periods in the United States, the "cafeteria exit policy" for the majority of schools is children are free to leave when the individual child or all children from the same classroom are finished with lunch (27). With this in mind, individual schools and classrooms have the ability to determine what is best for children during the lunch period. Changes in children's intake behavior in response to the small, no-cost modification of serving dessert after the main course, has the potential to be of significance for children's health and well-being.

As with all interventions, this study has limitations with the main limitation being that all participants are from one child care center. Therefore, results may not be

applicable to children from other ethnic groups or other child care centers. Each child in the study missed a few days due to sickness or family vacation. Although variations in measured observations per meal likely affected data, fluctuations did not compromise reliability of the study. However, based on power analysis, our sample was sufficient to test our hypothesis. Finally, randomization occurred at the group level, by classroom, rather than for the individual child, thus individual-level variations could not be captured.

CONCLUSIONS

Results indicate that timing of dessert impacts the amount of food children choose to consume regardless of the portion size. Serving dessert immediately after a meal can be an effective strategy for increasing consumption of desired nutrients during the meal, but at the price of increasing total energy intake in preschool children. Future research on this topic may include larger and diverse samples, longer data collection period, and variation of foods served to determine if these findings can be generalized.

References

1. Centers for Disease Control and Prevention. Obesity prevalence among low-income, preschool-aged children - United States, 1998-2008. *MMWR Morb Mortal Wkly Rep.* 2009;58(28):769-73.
2. Nielsen SJ, Popkin BM. Changes in beverage intake between 1977 and 2001. *Am J Prev Med.* 2004;27(3):205-210.
3. Briefel RR, Johnson CL. Secular trends in dietary intake in the United States. *Annu Rev Nutr.* 2004;24:401-431.
4. Howell Davies O, Suleiman S, Nicholas J, et al. Food portion weights in primary and secondary school lunches in England. *J Hum Nutr Diet.* Feb 2008;21(1):46-62.
5. Croker H, Sweetman C, Cooke L. Mothers' views on portion sizes for children. *J Hum Nutr Diet.* 2009;22(5):437-443.
6. Fisher JO, Rolls BJ, Birch LL. Children's bite size and intake of an entree are greater with large portions than with age-appropriate or self-selected portions. *Am J Clin Nutr.* 2003;77:1164-1170.
7. Fisher JO, Liu Y, Birch LL, et al. Effects of portion size and energy density on young children's intake at a meal. *Am J Clin Nutr.* 2007;86(1):174-179.
8. Mrdjenovic G, Levitsky DA. Children eat what they are served: the imprecise regulation of energy intake. *Appetite.* 2005;44(3):273-282.
9. Lown DA, Fitzgibbon ML, Dyer A, Schiffer L, et al. Effect of variable energy served on 24-hour energy intake in 16 preschools, Chicago, Illinois, 2007. *Prev Chronic Dis.* 2011;8(3):58.

10. Huang TT, Howarth NC, Lin BH, et al. Energy intake and meal portions: associations with BMI percentile in U.S. children. *Obes Res.* 2004;12(11):1875-1885.

11. Kral TV, Kabay AC, Roe LS, et al. Effects of doubling the portion size of fruit and vegetable side dishes on children's intake at a meal. *Obesity (Silver Spring).*2010;18(3):521-527.

12. Ledikwe JH, Ello-Martin JA, Rolls BJ. Portion sizes and the obesity epidemic. *J Nutr.* 2005;135:905-909.

13. Fisher JO, Arreola A, Birch LL, et al. Portion size effects on daily energy intake in low-income Hispanic and African American children and their mothers. *Am J Clin Nutr.* 2007;86(6):1709-1716.

14. Fisher JO, Kral TV. Super-size me: Portion size effects on young children's eating. *Physiol Behav.* 2008;94(1):39-47.

15. Berg C, Lappas G, Wolk A, et al. Eating patterns and portion size associated with obesity in a Swedish population. *Appetite*. 2009;52:21-26.

16. Shea S, Stein AD, Basch CE, et al. Variability and self-regulation of energy intake in young children in their everyday environment. *Pediatrics.* 1992;90(4):542-546.

17. Cecil JE, Palmer CNA, Wrieden W, et al. Energy intakes of children after preloads: adjustment, not compensation. *Am J Clin Nutr.* 2005;82(2):302-308.

18. Johnson SL. Improving Preschoolers' self-regulation of energy intake. *Pediatrics.* 2000;106(6):1429-1435.

19. Rolls BJ, Engell D, Birch LL. Serving portion size influences 5-year-old but not 3-year-old children's food intakes. *J Am Diet Assoc.* 2000;100(2):232-234.

20. Fisher JO. Effects of age on children's intake of large and self-selected food portions. *Obesity (Silver Spring).* 2007;15(2):403-412.

21. Spill MK, Birch LL, Roe LS, et al. Eating vegetables first: the use of portion size to increase vegetable intake in preschool children. *Am J Clin Nutr.* 2010;91(5):1237-1243.

22. Birch LL. Children's preferences for high-fat foods. *Nutr Rev.* 1992;50(9):249-255.

23. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. *Pediatrics*. 1998;101:539-549.

24. Fox MK, Condon E, Briefel RR, et al. Food consumption patterns of young preschoolers: are they starting off on the right path? *J Am Diet Assoc*. 2010;110:S52-S59.

25. Leahy KE, Birch LL, Fisher JO, et al. Reductions in entrée energy density increase children's vegetable intake and reduce energy intake. *Obesity (Silver Spring).* 2008;16(7):1559-1565.

26. Foland E, Graves L, Markle C. CACFP - What's in a meal? - Healthy Hoosier edition. Indiana Department of Education Web site. http://www.doe.in.gov/student-services/nutrition/cacfp-whats-meal-healthy-hoosier-edition. Published October 2008. Updated January 10, 2012. Accessed February 7, 2012.

27. Conklin MT, Lambert LG, Anderson JB. How long does it take students to eat lunch? A summary of three studies. *The Journal of Child Nutrition & Management*. 2002;26(1). Retrieved from: http://docs.schoolnutrition.org/newsroom/jcnm/02spring/conklin/.

Table 1 Sex and race sample characteristics by classroom (n=23)

	Classroom*			
	1	2	3	4
Sex*				
Boys	5	5	3	4
Girls	2	1	1	2
Race*				
Asian	3	1	1	2
Caucasian	3	4	3	3
Other	1	1	0	1

*No statistically significant associations were found between sex or race and classroom (Fisher exact test, P>0.25 for both).

Table 2 Means and standard deviations of main course intake, cookie intake, and total intake in kilocalories (kcals) when fish and pasta were served as a normal or large portion and when the cookie was served with or after the main course

Meal	Fish				Pasta			
Cookie	With Main Course		After Main Course		With Main Course		After Main Course	
Portion	Normal	Large	Normal	Large	Normal	Large	Normal	Large
Main Course Intake (kcals)*	47 ± 32	53 ± 36	62 ± 50	57 ± 34	94 ± 65	83 ± 68	91 ± 57	100 ± 57
Cookie Intake (kcals)**	84 ± 38	85 ± 36	97 ± 25	88 ± 31	82 ± 37	85 ± 35	87 ± 31	87 ± 26
Total Intake (kcals)***	131 ± 50	138 ± 44	159 ± 58	145 ± 40	176 ± 76	166 ± 78	172 ± 65	187 ± 67

*Meal ($P<0.0001$) and cookie ($P<0.04$) main effects are the only statistically significant effects.

**Cookie ($P<0.05$) main effect is the only statistically significant effect.

***Meal ($P<0.0001$) and cookie ($P<0.008$) are the only statistically significant effects.

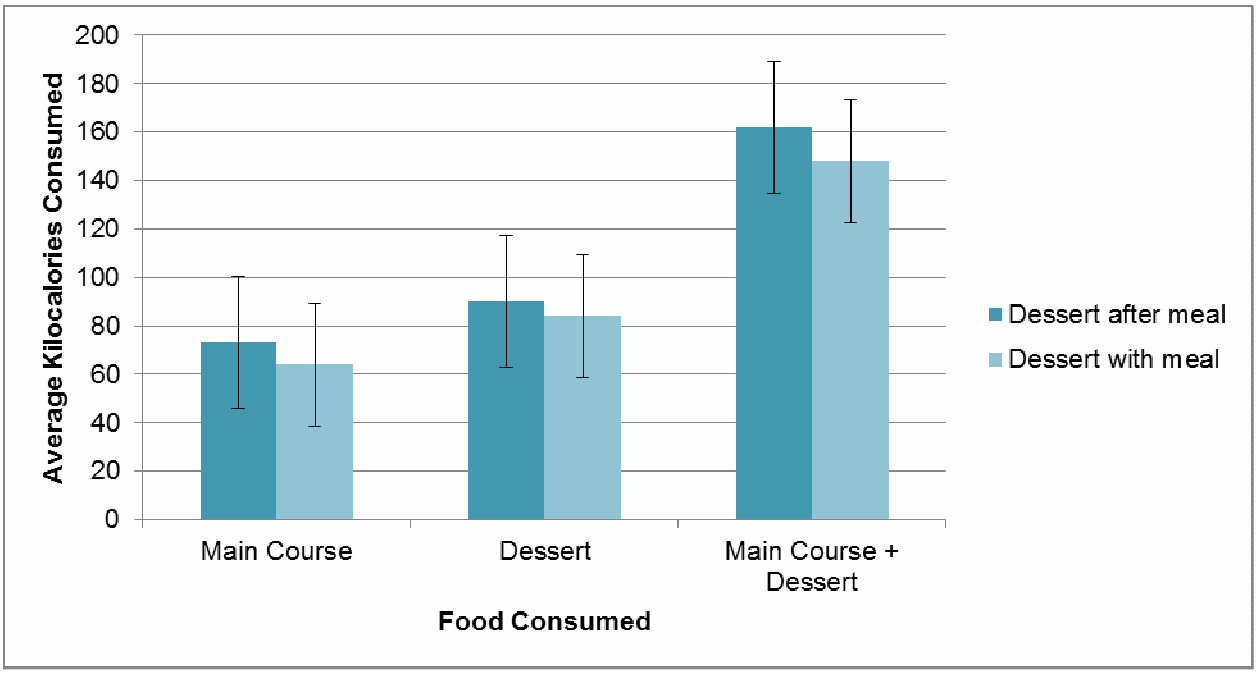

Figure 1 Comparison of average kilocalories consumed for main course, dessert, and main course + dessert when dessert is served after the meal versus with the meal to children (aged 2 to 5 y). In the study (n=23) interactions on both measures were significant at P<0.05. Portion sizes were collapsed together. Standard errors are adjusted for meal.