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Preschool children's sensitivity to teacher-served portion size is linked to age related differences in leftovers

Keri McCrickerd, Claudia Leong, Ciaran G. Forde*

*Clinical Nutrition Research Centre (CNRC), Singapore Institute for Clinical Sciences (SICS), Agency for Science, Technology and Research (A*STAR) and National University Health System, Centre for Translational Medicine, 14 Medical Drive #07-02, MD 6 Building, Yong Loo Lin School of Medicine, 117599, Singapore*

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ABSTRACT

A strong predictor of children's food intake at a meal is the amount they are served, and with a high percentage children attending preschool, there is a need to consider the relationship between portion size and intake in this context. In a two-part repeated measures study we investigated whether the portions teachers serve to children i) differ from those children would serve themselves and ii) impact food intake at a local preschool in Singapore. Part 1 (n = 37, 20 boys, 3.0–6.8 years) compared the quantity of food served, consumed and leftover across three serving methods: 'regular' teacher-serving; child self-served portions; and a deliberately large portion served by the teacher (150% of each child's average previous gram intake). Part 2 (n = 44, 23 boys, 2.4–6.2 years old) consisted of three additional observations of school-based servings outside of the experimental manipulation and enhance external validity of the study findings. Results indicated that serving size and intake was similar when the children and teachers served their 'regular' portions, but children consumed most overall when the teacher served the larger 150% portion. This was dependent on the child's age, with the oldest children being most responsive to the large portions while the youngest children tended to serve and consume a similar weight of food, regardless of the serving method. Though the younger children were generally served less than the older children, they consistently had more leftovers across all of the study observations. These data suggest that younger preschool children moderated food intake by leaving food in their bowl, and emphasise the unique influence of caregivers over children's eating behaviours outside of the home environment.

1. Introduction

Children develop eating behaviours in the context of a number of different meal and snack-time settings, and whether at home, in childcare or out at restaurants, adults influence the quality and quantity of a child's food provisions. This is particularly relevant in countries with high rates of preschool and childcare attendance. In Singapore, for instance, the Early Childhood Development Agency (ECDA, 2016) report that 99% of 2–6 year old children attend preschool, which provide class-based care and developmental programs for children below the compulsory school age of six. Similar trends exist in other countries such as the US (ECPP-NHES, 2005). Importantly, children can consume up to two thirds of their meals and snacks in preschool every day, placing food decisions made by a range of caregivers, not just parents, at the centre of understanding the development of children's eating behaviours.

One way adults can influence a child's food intake is through portion control. Laboratory based experiments with adults and children have established a robust relationship between large portion sizes and increased energy intake across a range of foods and beverages, in both western societies (Roe, Kling, & Rolls, 2016; Zlatevska, Dubelaar, & Holden, 2014) and in Asia (Smith, Conroy, Wen, Rui, & Humphries, 2013). In adulthood, sustained exposure to super-sized foods can lead to consistent overconsumption (Kelly et al., 2009; Livingstone & Pourshahidi, 2014; Rolls, Roe, & Meengs, 2006, 2007) and eventual weight gain through a lack of sufficient compensatory eating behaviours (French et al., 2014). This implies that children who are repeatedly exposed to large portions are also at risk of positive energy balance, and emphasises the need for a better understanding of the link between adult-determined

* Corresponding author.
E-mail address: Ciaran_Forde@sics.a-star.edu.sg (C.G. Forde).

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portion sizes and child intake outside of controlled laboratory studies.

It is possible that young children become more susceptible to overeating in response to large portions during their preschool years. Though children as young as two years have been shown to eat more when presented with larger portions (Fisher, 2007), children under four may be less sensitive to this portion size effect (Rolls, Engell, & Birch, 2000; Smith et al., 2013) compared to 5–7 year old children who show a particularly robust response (Fisher, 2007; Fisher, Arreola, Birch, & Rolls, 2007; Fisher, Liu, Birch, & Rolls, 2007; Fisher, Rolls, & Birch, 2003; Kling, Roe, Sanchez, & Rolls, 2016; Looney & Raynor, 2011; Rolls et al., 2000; Smith et al., 2013; Spill, Birch, Roe, & Rolls, 2010). This supports the hypothesis that preschool-age children attend less to internal appetite sensations to guide appetite regulation (Johnson, 2000), and increasingly rely on external cues to guide food selection and/or intake, such as portion size, but also the size of dishware or serving spoon used at a meal (DiSantis et al., 2013; Fisher, Birch, Zhang, Grusak, & Hughes, 2013), and prompts to plate clean (Birch, McPhee, Shoba, Steinberg, & Krehbiel, 1987). Encouraging children to select their own portions from a communal dish has been suggested as one way to reduce portion bias and promote self-regulation in a 'supersized' food environment (Birch, Johnson, Andresen, Peters, & Schulte, 1991). Yet children do not necessarily eat less at self-served meals compared to those presented to them in a fixed portion (Branen, Fletcher, & Myers, 1997; Fisher, 2007; Savage, Haisfield, Fisher, Marini, & Birch, 2012), and the protective power of self-serving may only be apparent when the alternative portion is inappropriately large (Fisher et al., 2003).

It is currently unclear whether the usual portions served by preschool staff are likely to differ from the portions children would choose to serve and eat themselves. The practice of self-serving is not explicitly promoted amongst parents and carers in Singapore, who usually serve portions to children from a number of communal dishes. A strong predictor of how much a child will consume for a given meal or snack, both at home and in childcare, is the amount of food they are served, regardless of whether this is determined by a parent, non-parent caregiver, or themselves (Branen et al., 1997; DiSantis et al., 2013; Johnson et al., 2014; Mrdjenovic & Levitsky, 2005; Savage et al., 2012), which means that when a child is served more they tend to eat more. Presumably this occurs because children often finish, or almost finish the food in a serving, through this is currently unknown.

This two-part study investigated whether teacher-served portions i) differ from those preschool children would serve themselves and ii) impact food intake. To do this we measured the quantity of food served, consumed and leftover across multiple lunch time meals in a local preschool, depending on whether the children were served by their teachers or themselves. Three serving conditions were tested in Part 1 (n = 37): a 'regular' teacher serving; a deliberately large teacher-served portion; the child's self-serving. The regular teacher-served portions were determined by the teachers to represent the usual servings they gave to each child, while the purpose of the deliberately large teacher-served portion was to demonstrate the potential impact of increasing the teachers 'regular' serving-size on children's food intake in the school setting. It was unclear whether intake would differ when children were served by their teachers or themselves, but it was anticipated that children would consume most when their teacher served a deliberately 'large' portion, which was calculated as 150% of the average weight of food each child consumed in the previous teacher-and self-served conditions. In Part two (n = 44), we returned to the school for three further lunch observations with no specific serving instructions, with the aim to better understand the usual serving sizes and children's food intake outside of the experimental manipulation. Given the importance of preschool years in the development of eating behaviours, a better understanding of the link between the quantity of food served, consumed and leftover in preschools could help identify possible targets to support children's energy balance outside of the home.

2. Part 1: The impact of teacher-served portions on children's food intake

2.1. Method

2.1.1. Design

In Part 1, a repeated-measures design was used to contrast the effect of three serving methods (teacher's serving *vs* child self-serving *vs* a large teacher-served 150% portion) on children's intake and leftovers across six lunch time meals at a preschool in Singapore. The three serving methods were replicated to check that the novelty of these procedures did not strongly influence eating behaviours. The child's age, sex and BMI percentile (adjusted for age and sex) were recorded as possible covariates for all outcomes.

2.1.2. Participants

Thirty seven children (20 boys and 17 girls, 3.0–6.8 years old) took part. The children were enrolled at a local preschool where they consume a morning snack (9.30 a.m.), lunch (11.30 a.m.) and an afternoon snack (2.00 p.m.) each day. The children were recruited across six different classes, who eat their meals together in their respective classrooms. Each class was no larger than 18 children and all children were taught in English and Mandarin (standard practice in Singapore). Informed consent from a parent was obtained for all children taking part and the study activities were authorised by the school principal and approved by the Singapore National University Hospital Domain Specific Review Board in accordance with the Declaration of Helsinki.

2.1.3. Lunch foods

The study lunches were prepared daily on site by the school cook and were taken directly from the rotating school menu. This improved ecological validity, minimised disruption and ensured the lunches were familiar and liked. To standardise composition of the meals, it was agreed that the cook would prepare similar foods on the days that the study was running. Consequently, the study meals were very similar and comprised of a mix of rice (white and brown) with either vegetable broth with a protein (fish/chicken/egg/tofu), or steamed vegetables with a protein (fish/chicken/egg/tofu). Examples of the meals are presented in Fig. 1. The cook prepared extra food on the study days to ensure that the children could eat *ad libitum*. As the meals were prepared by the school, an accurate estimation of the meal energy density was obtained in triplicate for a representative serving of each of the lunch meals, using near infrared spectrometry (Calorie Answer™; CA-HM, JWP, Japan) following a standardised procedure described recently by (Lau, Goh, Quek, Lim, & Henry, 2016). The average estimated energy density of the foods consumed in Part 1 is presented in Table 1 and indicated that the meals were equivalent in energy density across three of the serving days and varied in energy density across the rest of the sessions. This was not deliberate and resulted from the subtle variation in the composition and energy density of the foods within each meal. To account for these differences, the effects of the serving method on children's serving size and intake were considered separately for meals of 'equal energy density' or 'varied energy density'.

2.1.4. Serving method

The usual school practice was for teachers to serve each child