



# Cookie or fruit? Relative reinforcing value of snack foods among preschoolers with overweight/obesity compared to healthy weight



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## ABSTRACT

The reinforcing value of food is an important determinant of food intake. Research has yet to examine the relative reinforcing value (RRV) of snack foods in young children with overweight and obesity (OW/OB). The current study compared the RRV of high-energy dense foods (cookies) to low-energy dense foods (fruits) between preschoolers with OW/OB and healthy weight (HW). RRV of cookies and fruits in preschoolers with OW/OB ( $n = 30$ ;  $M_{\text{age}} = 4.4 \pm 0.84$ ; 60% male) and HW ( $n = 30$ ;  $M_{\text{age}} = 4.5 \pm 0.85$ ; 70% male) was assessed with a developmentally-tailored computer program which used a progressive fixed ratio reward schedule. The results showed that the RRV of cookies was significantly higher for preschoolers with OW/OB compared to HW while the RRV of fruits was significantly higher for preschoolers with HW compared to OW/OB. These results suggest that cookies are more reinforcing for preschoolers with OW/OB and less reinforcing for preschoolers with HW. Finding ways to reduce the reinforcing value of high-energy dense snack foods and identify alternatives that are as reinforcing for preschoolers is a challenge for weight control treatments.

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## 1. Introduction

In the United States (US) approximately 20% of children between the ages of 2–5 years have a Body Mass Index (BMI)-for-age  $\geq$  85th percentile, classifying them as overweight or obese (OW/OB; Ogden, Carroll, Kit, & Flegal, 2014). Childhood obesity presents significant health consequences across the life course, including increased risk for cardiovascular disease, type II diabetes mellitus, musculoskeletal disease as well as a host of psychosocial complications (Mirza & Yanovski, 2014, pp. 55–74). Given that over 2 million children in the US are already OW/OB by the time they reach kindergarten (Ogden et al., 2014), it is important to examine factors that could be contributing to increases in weight gain among young children.

Although obesity results from a complex combination of individual- and environmental-level factors, an imbalance between energy consumed versus expended explains obesity at the most basic level (Butte, Christiansen, & Sørensen, 2007). Several trends in eating patterns have coincided with elevations in rates of

childhood obesity, including the contribution of snacking to daily energy intake (Larson & Story, 2013). Recent data indicate that 27% of preschooler's total daily energy is from snacking (Piernas & Popkin, 2010), with substantial increases reported in children's consumption of high energy-dense, nutrient-poor snacks over the last several years (e.g., cookies and sweets, Larson and Story, 2013).

To address this concerning increase in snacking, the American Academy of Pediatrics (AAP; Barlow, 2007) recommends that parents substitute high energy-dense snack foods, which are foods that have a high concentration of calories in each bite ( $\geq 4$  calories/gram), with healthier, lower energy-dense options such as fruits and vegetables ( $\leq 1$  calorie/gram; Center for Disease Control and Prevention, 2016). Parents of preschoolers with OW/OB report difficulty implementing these changes due to preschoolers rejecting new foods such as vegetables and throwing tantrums when preferred foods such as sweets are restricted (Phillips & Kolasa, 1980). This may be occurring because of how reinforcing children with OW/OB find high energy-dense foods (Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008). Research has shown that school-age children and adults with OW/OB prefer high energy-dense, less nutritive snacks to fruits and vegetables (Goldfield, Lumb, & Colapinto, 2011; Temple et al., 2008). Research, however,

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has yet to systematically examine these snack preferences in young children. Understanding these preferences during the preschool years in particular is important as this is when food habits are starting to emerge and may be easier to change (Birch, 1979).

### 1.1. Relative reinforcing value of food task

One approach to examining how individuals make food choices among alternatives is to use a relative reinforcing value (RRV) of food task (Epstein, Leddy, Temple, & Faith, 2007). These tasks have been used to test how hard one is willing to work to obtain one food over another food or non-food alternative (e.g., by pressing a computer mouse), and at what point individuals will switch to an alternative if one food is constrained (e.g., if it requires more mouse clicks to obtain). Research with adults has consistently shown that compared to healthy weight (HW), adults with OW/OB are more reinforced by high energy-dense foods (e.g., will press a computer mouse for a longer period of time) than an appealing lower energy-dense food (Goldfield et al., 2011) or non-food option (reading; Epstein et al., 2007). Research with children ages 8–12 years has been more mixed, though. Some studies have shown that children with OW/OB are more reinforced by high energy-dense foods compared to non-food alternatives (Temple et al., 2008) as well as lower-energy dense foods (Temple et al., 2008); however, others have found no differences between children with OW/OB and HW on reinforcement for high-energy dense foods and non-food alternatives (puzzles, videogames; Kral, Remiker, Strutz, & Moore, 2014).

Research with children younger than 8 years of age remains limited. One study established the validity of an RRV task in preschool-age children (3–5 years) (Rollins, Loken, Savage, & Birch, 2014) and one examined the RRV of food in infants (Kong, Fedra, Eiden, & Epstein, 2015). Rollins et al. (2014) compared two energy-dense foods against each other while Kong et al. (2015) compared infants' preferred food to a non-food alternative. Rollins and colleagues established the validity of their task with preschoolers but did not directly compare preschoolers with OW/OB and HW. Results showed that children with a higher response rate for both foods tended to have higher BMI z-scores and higher reward sensitivity. In line with Rollins et al. (2014), Kong demonstrated that lean infants found nonfood alternatives more reinforcing than infants with OW/OB (See the Methods section for more details on both studies). A gap still exists in the literature as studies have yet to examine the RRV of high energy-dense snacks compared to healthier, low energy-dense snacks in an OW/OB and HW preschool age group.

Food choice and eating behaviors have also been shown to be related to variables such as appetite and parental feeding behaviors. For example, Kong et al. (2016) demonstrated that measures of appetite, such as higher levels of food responsiveness and enjoyment of food, were associated with infants' choice of a favorite food over a non-food alternative. In addition, studies with older children have found that more restrictive and permissive parental feeding practices are associated with higher calorie intake as well as OW status (Ventura & Birch, 2008).

The goal of the present study is to examine whether the RRV of high-energy dense foods (cookies) and low-energy dense snack foods (fruits) differ between preschoolers with OW/OB and HW. Understanding how reinforcing young children find high energy-dense food will inform the recommendations provided to families of preschoolers with OW/OB regarding snacking behavior. Secondary analyses will also examine how factors associated with child eating behavior and OW status, including parental feeding practices (Birch & Fisher, 2000), child appetite (Sleddens, Kremers, & Thijs, 2008), and child dietary intake (Berkey et al., 2000) are

associated with the RRV of snack foods.

Based on previous research with older children and adults, we are hypothesizing that compared to preschoolers with HW, preschoolers with OW/OB will exhibit higher RRV of cookies and complete more trials to obtain cookies. We are also hypothesizing that preschoolers with OW/OB will consume more total energy from snacks, particularly from cookies, during the task compared to preschoolers with HW. As far as secondary analyses, we are hypothesizing that OW/OB status will be associated with more restrictive and permissive parental feeding practices (Ventura & Birch, 2008), higher scores on appetite measures (Rollins et al., 2014) as well as higher caloric intake (Deckelbaum & Williams, 2001) compared to HW.

## 2. Methods

### 2.1. Participants

Participants included 60 children aged 3–5 years, 30 OW/OB (BMI-for-age  $\geq$  85th percentile) and 30 HW (BMI-for-age between the 5th and 85th percentile) and one of their parents. Children were recruited through two study flyers sent to employee e-mail addresses at a children's medical center in the Midwest United States. One flyer generally invited parents of 3- to 5-year-old children to participate in a study examining children's snack choices. A second flyer sought to increase the likelihood that parents of children who met criteria for OW/OB would enroll in the study by stating "we are seeking preschool children 3–5 years who are bigger than most of the kids their same age to participate." Exclusion criteria included child diagnosed with a developmental disability, nut allergy or allergy to any of the study foods, or if child was using medicine that could influence appetite, taste, or olfactory sensory responsiveness (e.g., methylphenidate). Only one parent-child dyad per household was eligible to participate. Study visits took place in the morning, afternoon and evening and screening measures ensured that children did not eat any food or drink beverages other than water 2 h before the visit. The study was approved by the Institutional Review Board at the hospital and written informed consent was obtained prior to data collection.

### 2.2. Procedures

#### 2.2.1. Recruitment and screening

Parents who responded to the email were contacted by research staff. Those who were interested and met inclusion criteria were scheduled for a 1.5 h study visit at the hospital. Parents were asked to feed their child as usual on the day of testing but refrain from any food or beverage other than water 2 h before their appointment time. After parents signed the consent form, they completed the pre-RRV assessments as described below (i.e., dietary screening, hunger assessment, liking assessment) followed by height and weight measurements. These assessments were followed by children completing the RRV task individually while parents completed questionnaires. Consent and screening measures took approximately 30 min to complete. 126 families were reached by phone to determine eligibility, 76 met eligibility on the phone while 70 enrolled in the study. Out of these 70 families, 7 did not show on the day of testing while 3 participants did not meet eligibility criteria.

#### 2.2.2. RRV task

Children were taken to a separate room to complete the RRV task individually without their parent present. Each child was provided with verbal instructions on how to complete the task and a one-minute practice trial whereby they were trained to use a computer mouse and practiced using the computer program.

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