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Parental feeding practices to manage snack food intake: associations with energy intake regulation in young children

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Abstract

**Background:** Little attention has been directed to understanding the relationship between restriction and regulation of snack food intake in toddlers.

**Objective:** The aim of this study was to examine the effects of parental restriction of toddlers' eating of snacks in the absence of hunger (EAH) and to examine the impact of three contextual factors; snack food access, frequency of snack food consumption, and attraction to snack food.

**Design:** 64 parents and toddlers (aged 22 to 36 months) took part in a protocol to measure EAH (defined as kJ of energy-dense snack foods consumed). Mean EAH was 199kJ (SD = 299), with 43 children consuming at least some snacks. Restriction was measured with the Child Feeding Questionnaire Restriction subscale. Snack food access was measured with Allow Access from the Toddler Snack Food Feeding Questionnaire (TSFFQ), snack food consumption was measured with a short snack food frequency questionnaire, and attraction to snack foods was measured with Child’s Attraction from the TSFFQ. Moderated regression analyses tested interactions between Restriction and contextual factors in predicting EAH.

**Results:** EAH was associated with Restriction (r = .25, p = .05, 95% CI .004 - .47). There was an interaction between Restriction and accessibility of snack foods (R² change = .08, p = .025); restriction was associated with EAH only when access to snack foods in the home was, on average, higher. The effect of Restriction on EAH was not moderated by frequency of snack food consumption or Child’s Attraction. **Conclusions:** These finding have practical relevance and reinforce the importance of the home food environment for managing young children’s snack food intake.

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Introduction

The ways in which parents manage their children’s intake of palatable energy-dense nutrient poor foods (hereafter referred to as snack foods) can influence the development of children’s capacity to self-regulate energy intake in response to those foods [1]. Poor self-regulation has been associated with overeating and greater weight gain in some children [2]. Experimental and observational studies in school-aged children have suggested that, paradoxically, when parents restrict their child's intake of snack foods children are more likely to overeat when those foods are freely available, suggesting that those foods become more desirable [2]. This highlights concerns about long term implications for self-regulation of food intake and weight that may flow from restriction of certain foods.

The literature on restriction, children’s snacking and weight has produced some mixed findings. Some studies have found a positive or null relationship with snacking [3]. Further, some longitudinal and cross-sectional studies have found that parental restriction is not associated with BMI in children [4, 5], or is associated with BMI only in sub-populations [2, 6]; occurs mainly in response to child eating or weight characteristics rather than influencing these [7, 8]; or supports a bi-directional relationship [9]. These line of research have stimulated interest and debate on whether restriction is problematic at all or, if it is, in what contexts restriction might be problematic. Findings from this have important implications for advice to caregivers when introducing and managing intake of typically restricted foods. Further research is needed to be able to offer parents clear advice regarding managing intake of snack foods. This is important throughout childhood and especially when parents are first introducing snack foods to their children in the interests of promoting helpful feeding practices from the beginning.

Laboratory investigations have focused mainly on parental restriction and children’s consumption of snack food in the absence of hunger (EAH) in preschool and school-aged children [10-17]. Restriction is measured with the Child Feeding Questionnaire (CFQ), a parent-report scale that identifies concerns about children overeating snack foods and coercive control that involve deliberate restriction of those
foods [18]. An example is *I have to be sure that my child does not eat too many sweets.* Restriction was designed to measure highly controlling feeding practices in preschool and older children but it has also been used in younger children [12]. EAH is measured using a protocol whereby children are provided with free-access to typically restricted foods after a standard pre-load meal and the amount consumed is an indicator of self-regulation. The more children consume the greater their tendency to eat in the absence of hunger in response to snack food cues. Given that snack food consumption is well established by the age of two [19, 20], measuring EAH and the association with parental control in the toddler period is appropriate and would expand the evidence for restriction as a counterproductive strategy or not in an early developmental period. This is important because snack foods are prolific in children’s diets and the wider environment and restriction could be viewed by parents as a useful and appropriate way to manage children’s intake, even for very young children. Restriction tends to decrease from the preschool years to middle childhood [8]. The toddler period is therefore an ideal opportunity to examine whether effects of restriction are the same as reported in older children and build our understanding of the counterproductive nature, or otherwise, of restriction early in life.

There is increasing recognition that contextual factors are important to consider when examining the influence of feeding practices on children’s eating behaviour [21, 22]. One important contextual factor in the context of Restriction and EAH is the child’s food environment. Restriction measures parent’s beliefs that their children should not eat too many of certain foods but does not speak to the environment in which the restriction occurs. The relationship between restriction and EAH may vary depending on the extent to which the restricted foods are plentiful or accessible in the child’s environment. Parents of toddlers arguably have greater control over the child’s food environment than they do for older children but they report similar levels of Restriction [23]. It is not known whether higher levels of Restriction would be associated with higher EAH amongst children who have (relatively) higher access to snack foods. Accessibility is a separate construct from restriction and identifies context influences on EAH.
Examining aspects of the food environment, such as access to foods and frequency of snack food intake, as potential moderators may elucidate the context in which Restriction is counterproductive or not.

Studies that examine the influence of food accessibility on EAH are lacking. A study by Rollins et al. [6] used the Restricted Access Questionnaire to describe and identify profiles of feeding practices related to limit setting practices in mothers of girls aged 5 years. There were four profiles; one profile corresponding to unlimited access and three profiles corresponding to limit setting. The findings suggested parents who set limits tended to be very similar on certain limit setting practices such as when and how much snack food is offered and purchased but were differentiated by the proportion of snacks kept out of reach, and the latter corresponded with scores on Restriction. EAH was higher amongst girls whose mothers set limits and restricted all snacks compared with mothers who provided unlimited access but there was no difference amongst three limit setting groups. The findings suggest that both access and restriction need to be considered to understand the effects on EAH.

Children’s characteristics are also likely to be important for parent’s choice of strategy and may affect the relationship between restriction and EAH. One relevant characteristics is a toddler’s attraction to palatable foods [24]. Attraction to snack foods has been shown to be related to parent-reported child snack food intake [24]. The degree to which a child is attracted to palatable foods may affect how they respond to restriction. For example, restriction could arguably have a more detrimental effect on a child who is naturally more attracted to the restricted foods and finds the foods more desirable to begin with, compared with a child who is less attracted to snack foods. Or put another way, lower levels of attraction may buffer the negative effects of Restriction. In the study by Rollins et al., described earlier, change in BMI percentile from age 5 to 7 was found only amongst girls with low inhibitory control whose parents provided unlimited access to snack foods. Inhibitory control is an aspect of temperament that refers to “the capacity to plan and to suppress inappropriate approach responses under instruction or in novel or
uncertain situations” and was measured with a validated parent report tool [25]. We do not currently know whether child’s attraction to snack foods moderates the effect of Restriction on EAH.

This study aims to examine the association between Restriction, as measured by the Restriction scale of the Child Feeding Questionnaire [18], and EAH in toddlers. We hypothesise that Restriction will be positively associated with EAH. We then explore whether the relationship between Restriction and EAH is moderated by accessibility to snack foods in the home environment, frequency of snack food consumption and child’s attraction to snack food. We predict that there will be a stronger association between parental restriction and EAH when snack foods accessibility is higher, frequency of snack food intake is higher, and when the child’s attraction for snack food is greater.
Materials and Methods

Participants and design

Participants were sought from the general community in metropolitan Adelaide via advertisements in local parenting magazines (April – July 2007); no incentives were offered. Parents were invited to participate in a study about parent feeding practices and their influence on toddlers’ snack food choices. Although the toddler period ranges from 12 and 36 months of age [26], we recruited parents or primary caregivers with children between the ages of 22 and 36 months, to ensure ability to comply with the study procedures. Eligibility criteria for parents were; (a) at least 18 years of age and (b) the person who was mainly responsible for feeding the child. Exclusion criteria for toddlers were; (a) a congenital or metabolic abnormality that affected their growth and eating, (b) a serious food allergy or food sensitivity, or (c) birth weight less than 2500g.

Sixty-six parents registered for the study, which involved completing questionnaires about feeding practices and allowing their toddlers’ food intake in the absence of hunger to be examined in the laboratory. The testing sessions were completed by 64 parents (63 mothers and 1 father) and their toddlers (29 boys, 35 girls). Two sessions were abandoned due to difficulties with the child’s behaviour resulting in a final sample of 62.

Free Access Procedure

The free access procedure described by Fisher and Birch [14] was adapted for younger children. Children were given free access to a range of snack foods following a standard meal. The standard meal comprised a breakfast offered by the parent in the home because it was considered impractical to offer a standard preload meal in the laboratory. It was not possible to reliably determine if the child was full prior to the free-access procedure. Sessions were scheduled at 9:30am and 10:30am.
We provided the parents with three possible breakfast menus (but not the foods) for them to prepare and offer at home. The options were equivalent in energy (approx. 1233 kJ) and macronutrient composition. Menu items included wheat biscuits, bread, spreads, yoghurt, milk, cheese and fruit. Parents recorded each of the foods (g) and drinks (mL) offered and estimated how much the child consumed (e.g., 70% of the milk, ½ slice toast) and we used this to estimate approximate energy intake at breakfast.

To prepare the children for the study a simple picture story was provided to the parents which included a photos of the researcher, the laboratory building and the study room. Parents were asked to show their child the pictures before attending the session. Parent and toddler weight and height were measured on arrival and prior to commencing the free access procedure.

During the free access procedure, children were given ad libitum access to 6 snack foods and a wide variety of toys in a small room with the parent and the researcher present. The child’s food intake was recorded for a 15 minute period that started when the child entered the room. A small camera connected to a computer in the room recorded the child’s behaviour. Standardised instructions were given before entering the study room; “Let’s go inside, there are some toys to play with and food to eat if you like”. To minimise parent-child interaction, the parent and researcher sat at a desk facing away from the child while the parent completed a series of questionnaires. Parents were told to ignore the child if possible and to keep comments neutral with respect to the food and play options if the child initiated interaction.

A selection of energy-dense sweets and snack foods and less energy-dense snack foods were placed in separate bowls evenly spaced along the centre of a low rectangular table. The energy dense foods were small, plain, salty biscuits (Mini-Ritz, 2062 kJ/100g), small teddy-bear shaped plain, sweet biscuits (Tiny Teddies, 1960 kJ/100g), and mini cinnamon doughnuts (1520 kJ/100g). The less energy dense options were watermelon (96 kJ/100g), banana (371 kJ/100g) and wholemeal bread with margarine
and vegemite (1098 kJ/100g). The fruit was cut into small pieces uniform in size. The bread was cut into 6 pieces with the crust removed.

Children’s intake of the energy-dense snack foods was used to measure eating in the absence of hunger (EAH). These are foods that are typically restricted and most similar to the foods used in EAH studies with preschool children. The less energy-dense options were included because these foods are likely to be available with energy-dense options in a real-world setting. Energy intake was determined by converting the weight of food consumed by the child into kJ, based on the manufacturer’s nutritional information.

**Restriction**

The Restriction subscale from the CFQ [18] was used to measure parental restriction. Restriction is a widely used and validated scale that comprises 8 items that measure the degree to which parents try to limit their child’s intake of sweets, snacks and high-fat foods, and use these foods to reward good behaviour. Example items are *I have to be sure that my child does not eat too many sweets* and *If I did not guide or regulate my child’s eating, he/she would eat too much of his/her favourite foods.* Items are scored on a rating scale with 5 categories ranging from disagree (1) to agree (5) and averaged to create the scale score. Restriction scores obtained for mothers of children under the age of two have been reported to be similar to preschool children [27]. There is evidence that Restriction is similar psychometrically across age groups [28]. Cronbach’s alpha in the current sample was .73.

**Allow Access**

The extent to which parents allow access to snack foods was measured with the Allow Access scale from the Toddler Snack Food Feeding Questionnaire (TSFFQ) [24]. Allow Access comprises 12 items that measures the tendency for parents to allow and offer sweets and snacks to their toddler. Parents are asked to think about sweets and snack foods when responding to items. To ensure consistent interpretation of the phrase ‘sweets and snack foods’ parents are shown a collage of popular packaged
high-energy nutrient-poor foods. Example items include *Thinking about sweets and snacks like those in the picture, I would allow my toddler to eat... and I would give my toddler a sweet or snack food....* Responses to questionnaire items are scored on a rating scale with 5-categories. Depending on the item, response categories vary from: never (1) to always (5); unaware of all (1) to aware of all (5); none of these (1) to all of these (5); and never (1) to at least once a day (5). The scale score is computed by taking the average item score. The validity of Allow Access is supported by research that shows it is negatively associated parental rules, CFQ Restriction and parent-reported snack food intake, and good internal consistency and test-retest reliability has also been reported [24]. Cronbach’s alpha in the current study was .83.

**Children’s Frequency of Snack Food Consumption.**

Toddlers’ usual consumption of sweets and snack foods was measured with a Food Frequency Questionnaire adapted from the Anti-Cancer Council Dietary Questionnaire [29]. Parents were asked to indicate how frequently their child had consumed different types of snack foods including biscuits, cakes, chips and high-fat dairy snacks over the past 3 months. Ten responses categories were used that ranged from never to three-or-more times per day. Each response was converted to a daily equivalent frequency. The daily equivalent frequencies for each snack food type were summed and the score was used to approximate Frequency of Snack Food Consumption.

**Child’s Attraction**

Toddler’s attraction to sweets and snack foods was measured with the Child’s Attraction scale from the TSFFQ [24]. Child’s Attraction comprises 5 items that are scored on a rating scale with 5 response categories; (1) not at all true of my toddler to (5) completely true of my toddler. An example item is *If my toddler was to see these foods he/she would want them.* Validation research provides evidence that Child’s Attraction has good internal consistency and test-retest reliability, and its validity is
supported by its positive association with parent-reported intake of sweet and snack foods [24]. Cronbach’s alpha in the current study was .86.

**Parent and Toddler BMI.**

Parents’ height was measured to the nearest centimetre using a stadiometer and weight was measured to one tenth of a kilogram using an electronic scale. BMI was calculated [(weight (kg) / height (m²)]. Parent weight status was defined as not overweight (BMI < 25, n = 35), overweight (BMI 25 – 30, n = 18), and obese (BMI >30, n = 10).

Children’s standing height was measured to the nearest centimetre using a fixed wall chart, and weight was measured to one tenth of a kilogram using an electronic scale. Due to the age of the children and practical considerations, children were weighed with shoes on and each measure was only taken once.

Children’s weight-for-height was calculated using the U.S. Centre for Disease Control and Prevention’s growth charts [30]. For children 2 years of age or older, weight status was defined as not overweight or overweight according to the IOTF age- and sex-specific BMI cut-offs (Cole et al., 2000). For children under the age of 2 years, overweight was defined as weight-for-height above the 95th percentile and not overweight was defined as weight-for-height below the 95th percentile.

**Statistical Analyses**

Data for weight status was missing for 1 child and 1 parent. All analyses are based on the complete sample (N = 64) and are conducted using IBM SPSS Statistics Version 20.

Initially, independent-samples t-tests were conducted to determine if EAH differed by child gender, child weight status and parent weight status. Bivariate correlations were run to test the prediction that parental restriction (CFQ Restriction) was positively correlated with EAH.

Three moderated hierarchical multiple regression analyses were run to test whether the following moderated the effect of Restriction on EAH; Allow Access (Moderation 1), Frequency of Snack Food
Consumption (Moderation 2), and Child’s Attraction (Moderation 3). Regression assumptions were checked. Energy intake was significantly positively skewed but this could not be improved with statistical transformation. There was no evidence of multicollinearity. The normality of residuals was imperfect however homoscedascity was acceptable, Cook’s Distance was below 1, standardised residuals were in the accepted range (with 3 to -3 in Models 1, 2; 3.3 to -1.3 in Model 3) and there were no multivariate outliers based on Mahalanobis Distance. The predictor variables (e.g., Allow Access and Restriction) were entered in the first step and the interaction term in the second step. Following the recommendations of Aiken and West [31], all variables were centred by taking the mean score for the predictor from each raw score. The interaction term was computed by multiplying the two centred predictors.
Results

Sample Characteristics

Parents were aged between 24 and 48 years, with a median age of 35 years. The level of educational attainment of the sample was high, with more than half the sample having completed university (57.8%); a further 26.6% had attained a vocational education qualification, and 15.6% had completed high school or less. Based on BMI cut-offs for overweight and obesity, 35 parents (55.6%) were normal weight, 18 were overweight (28.6%), and 10 were obese (15.9%). One parent was not measured. Toddlers were aged between 22 months and 36 months of age ($M = 27$ months, $SD = 3.6$).

According to the International Obesity Task Force (IOTF) age- and sex-specific BMI cut-offs for overweight and obesity (excluding children aged under 2 years), 11 children (19%) were overweight and 1 child was obese (1.7%) [32]. This is comparable with prevalence data for overweight and obesity for 4 year old children in South Australia, of which 21.4% are overweight or obese according to the IOTF criteria [33]. One child in the study was unable to be weighed due to behaviour difficulties.


Snack foods were consumed by 43 of 64 children. Consumption of energy-dense snacks (EAH) ranged from 0 to 1200kJ ($M = 199, SD = 299$), equivalent to 0 to 28.2 individual food items ($M = 4.03, SD = 5.40$), and consumption of other foods (watermelon, bananas and bread) ranged from 0 to 604kJ ($M = 36, SD = 88$), equivalent to 0 to 11.5 servings ($M = 1.72, SD = 88$). An individual food item used in the free access procedure was equivalent to: doughnut hole (1 doughnut, 11.02g), Mini-Ritz (1 biscuit, 1.06g), Tiny Teddies (1 biscuit, 1.77g), watermelon (small cube, 10g), banana (thin slice, 5g) bread (1/6 slice without crusts, 4.84g).

There were no significant differences in energy intake between boys ($M = 219.73, SD = 316.50$) and girls ($M = 181.81, SD = 287.93; t(62) = .50, P = .62$); between overweight ($M = 153.28, SD = 283.60$) and non-overweight children ($M = 210.43, SD = 308.19; t(61) = .95, P = .42$); and between children with
overweight parents ($M = 170.16, SD = 265.96$) and non-overweight parents ($M = 227.74, SD = 327.41$; $t(62) = .27, p = .22$).

Amount of food consumed at breakfast ($M = 909kJ, SD = 313kJ$) was not associated with intake of energy-dense snacks ($r = -.05, p > .05$) or less energy-dense snacks ($r = .16, p > .05$). There was no difference in snack food intake at the 9:30am session ($M = 243, SD = 334; n = 25$) and the 10:30am session ($M = 171, SD = 276; n = 39; t(62) = 0.94, p > .05$).

**Descriptive Statistics and Inter-correlations between Measures**

As shown in Table 1, Restriction was negatively skewed with the mean score indicating that parents reported moderate to high levels of restriction (Table 1). Allow Access was positively skewed, with the majority of scores indicating low to moderate levels of access. EAH was negatively skewed due to the number of children not consuming any high energy snacks. Allow Access was positively correlated with all other measures except EAH. As predicted, Restriction was positively correlated with EAH. Child’s Attraction was also positively correlated with EAH and Restriction. Child’s Frequency of Snack Consumption was 1.2 snacks per day ($SD = 1.25$), ranging from .06 to 6.28 snacks per day. When entered together in a regression, Attraction and Restriction explained 12% of the variance in EAH ($p < .05$) and Attraction was the only predictor explaining unique variance (5.8%) in EAH ($p < .05$) (results not shown in Table 1).
**Table 1**

*Pearson’s inter-correlations (r) and means (SD) for feeding measures, frequency of snack consumption, and eating in the absence of hunger (95% CI)*

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Allow Access</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Child’s Attraction</td>
<td>.48**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.32, .65)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Restriction</td>
<td>.46**</td>
<td>.43**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.24, .63)</td>
<td>(.21, .61)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>4. Frequency of Snack Consumption</td>
<td>.53**</td>
<td>.30*</td>
<td>.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(.37, .67)</td>
<td>(.06, .51)</td>
<td>(-.20, .29)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Eating in the Absence of Hunger (EAH)</td>
<td>.18</td>
<td>.33**</td>
<td>.25*</td>
<td>.04</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-.07, .41)</td>
<td>(.09, .53)</td>
<td>(.004, .47)</td>
<td>(-.21, .28)</td>
<td></td>
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<tr>
<td>Scale M</td>
<td>2.66</td>
<td>3.18</td>
<td>3.50</td>
<td>1.19</td>
<td>199</td>
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<tr>
<td>Scale SD</td>
<td>0.56</td>
<td>0.80</td>
<td>0.69</td>
<td>1.25</td>
<td>299</td>
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<tr>
<td>Min, Max scores</td>
<td>1.58, 3.83</td>
<td>1.60, 5.00</td>
<td>2.13, 5.00</td>
<td>0.06, 6.28</td>
<td>0, 1200</td>
</tr>
</tbody>
</table>

Note. Allow Access, Child’s Attraction, and Rules are subscales from the Toddler Snack Food Feeding Questionnaire (Corsini et al., 2010). Restriction is from the Child Feeding Questionnaire (Birch et al., 2001).

p < 0.05**  p < 0.01  *
Testing Three Moderators of the Relationship between Restriction and EAH

Three moderated regression analyses were run to test whether the effect of Restriction on EAH varies depending on Allow Access (Moderation 1), Frequency of Snack Food Consumption (Moderation 2) and Child’s Attraction (Moderation 3). Table 2 presents the results from step 2 of the hierarchical multiple regression models which tests the effects of the interaction with the main effects removed. In Moderation 1 we found that the interaction of Restriction and Allow Access was a significant predictor of EAH, as indicated by the significant $R^2$ change and regression coefficient for the interaction term. Frequency of Snack Food Consumption (Moderation 2) and Child’s Attraction (Moderation 2) did not significantly moderate the effect of Restriction on EAH as indicated by a non-significant $R^2$ change and regression coefficient for the interaction term. The findings for Moderation 1 and Moderation 2 did not change when Child’s Attraction was controlled for in the models.

To understand the nature of the significant interaction, the regression of EAH on Restriction was plotted for low (defined as 1 SD below the mean), moderate (defined as the mean), and high levels of Allow Access (defined as 1 SD above the mean) (see Figure 1). To determine whether the slopes were significantly different from 0, t-tests for simple slopes were calculated. Increasing parental restriction was associated with increases in EAH at high levels of Allow Access.
Table 2. Moderated Multiple Regressions to Predict EAH from the Interaction of Restriction and Allow Access (Moderation 1), Frequency of Snack Consumption (Moderation 2), and Child’s Attraction (Moderation 3)

<table>
<thead>
<tr>
<th>Predictor variable</th>
<th>B</th>
<th>SE</th>
<th>ΔR²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderation 1</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allow access</td>
<td>58.22</td>
<td>71.99</td>
<td></td>
</tr>
<tr>
<td>Restriction</td>
<td>85.12</td>
<td>58.42</td>
<td></td>
</tr>
<tr>
<td>Allow access x Restriction</td>
<td>220.76*</td>
<td>95.81</td>
<td>.08*</td>
</tr>
<tr>
<td><strong>Moderation 2</strong></td>
<td></td>
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<tr>
<td>Consumption frequency</td>
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<td>30.54</td>
<td></td>
</tr>
<tr>
<td>Restriction</td>
<td>111.56*</td>
<td>55.34</td>
<td></td>
</tr>
<tr>
<td>Consumption frequency x restriction</td>
<td>34.73</td>
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<td>.01</td>
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<td><strong>Moderation 3</strong></td>
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<tr>
<td>Restriction</td>
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<td>57.91</td>
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</tr>
<tr>
<td>Attraction</td>
<td>81.55</td>
<td>54.89</td>
<td></td>
</tr>
<tr>
<td>Restriction x attraction</td>
<td>56.40</td>
<td>68.12</td>
<td>.01</td>
</tr>
</tbody>
</table>

Note: Statistics presented are from Step 2 of the regression model.

*p < .05
Discussion

The first aim of this study was to examine the association between Restriction scores and eating in the absence of hunger (EAH) in toddlers (22 – 36 months) to determine if the positive association reported in older children is also found in an earlier developmental period. The second aim was to determine if the relationship between Restriction and EAH in toddlers was moderated by access to snack foods in the home (Allow Access), Frequency of Snack Consumption, and Child’s Attraction to snacks. The findings related to the first aim indicated that there was a small but statistically significant positive association between Restriction and EAH. Child’s Attraction was also positively associated with EAH. In relation to the second aim, this study found that the relationship between parental restriction and EAH was moderated by Allow Access scores. That is, Restriction was associated with EAH at high levels of Allow Access but not at low and moderate levels. This study strengthens our understanding of the contextual influences on the acquisition of eating behaviours in young children.

A number of studies in pre-schoolers and school-aged children have shown that restriction is associated with EAH but this is the first study to examine the moderating effects of access to those foods. A major finding in this study was that Restriction was positively associated with EAH only when scores on Allow Access were high. To address the issue of what the interaction between Restriction and Allow Access might mean it is firstly important to recognise that greater Restriction was associated with higher levels of Allow Access. The positive association between Restriction and Allow Access scores could be explained in terms of there being a greater need to restrict when access is high. (e.g., “I have to be sure that my child does not eat too many…” may be necessary when access is high). The interaction of Restriction and Allow Access could indicate that there is a negative impact of parents sending mixed messages to children by allowing access to foods at times and restricting the foods at other times, or perhaps allowing access while imposing certain limits at the same time. The effect of restriction in high access environments could be to increase the desirability of the restricted foods or impair self-regulation. This effect was shown in an experimental study with 5 – 6 year olds that involved manipulating
restriction by allowing one group of children to access all snacks and prohibiting only red snacks in another group [34]. In this study, children in both groups could eat as much food as they liked but the desirability and relative intake of the prohibited food increased when the prohibition was lifted amongst the restricted group.

Having unhealthy food in the home (even if it is out of reach) may encourage greater preoccupation with the food and demands for the food [35]. Considered differently, the interaction effect suggests that the negative effects of Restriction are buffered at lower levels of Accessibility to snack foods. The most likely explanation is that the parent is using other strategies that are less coercive to control intake. This explanation is consistent with a causal model (restriction in a particular context leads to EAH) but evidence from prospective and experimental designs are needed to support it. Although there are a number of prospective studies that examine parental feeding practices and weight gain, there are limited investigations apart from the early laboratory studies by Birch and colleagues that include repeated measurement of EAH, the child’s food environment, and weight gain. Importantly, there is a call for research in this field to better distinguish between controlling and coercive practices and structure-based practices, as the former impact negatively on regulatory abilities [36]. Furthermore, operationalising and understanding the effects of structure-based practices provides practical alternatives to restriction to manage children’s intake of palatable foods [36].

The finding that Allow Access moderates the effect of Restriction on EAH has practical implications. Where it is possible for parents to control the environment, it may be beneficial to avoid buying snack foods rather than attempting to manage children’s intake via restrictive strategies [37]. This is likely to be a good general strategy for parents when children are young, and particularly in the confines of the home environment, but may be more difficult to implement as children get older. Home availability of snacks is associated with non-core food intake in children aged 2-5 years [38] but results have been mixed in older children [39, 40], suggesting other factors become important. Even in young children there will be unavoidable situations such as shopping trips, parties, in which children will have
access or potential access to snack foods. An investigation of how parents respond in these particular situations and how this affects the child’s self-regulation in the future is a worthwhile area of investigation [41].

Frequency of Snack Food Consumption, another indicator of amount of snacks the child has access to, did not have the same moderating influence as Allow Access. This result is surprising as the frequency with which snacks are consumed are an indicator of access of snack foods and might be expected to operate in the same way as a moderator. Indeed, Frequency of Snack Food Consumption was moderately correlated with Allow Access in the expected directed. One explanation for the inconsistent finding is that it that the context and the decisions that parents make in structuring the child’s food environment, measured by Allow Access, are more influential than the amount of snack food typically consumed by the child. The findings suggest that the effect of Restriction on EAH is not affected by how much snack food that toddlers typically consume as reported by parents.

Child’s Attraction did not significantly moderate the relationship between Restriction and EAH contrary to expectation. Thus, the degree to which a child is attracted to snack foods does not appear to affect how parental restriction is related to EAH in toddlers. This result is inconsistent with studies that show children with poor inhibitory control appear to be more sensitive to restriction [6, 42]. Child’s Attraction does however appear to be an important correlate of EAH in its own right. Although this has not been demonstrated before using this particular measure, it is not a surprising finding and is consistent with research showing that parents influence and are influenced by their children’s preferences and appetite characteristics [1, 43, 44] including very young children [45].

The findings of this study should be considered in light of some limitations. The sample size may have been too small to detect real effects. Replication of findings would provide further evidence of robustness of results. EAH was assessed with a standard protocol that we adapted for a younger age group. Although we were able to successfully adapt the free access procedure developed by Fisher & Birch [14] to measure EAH in a very young sample, we were unable to control for prior hunger with as
much certainty as is possible with older children. It is possible that some children could have been hungry prior to the session. A pre-load meal should ideally be provided just prior to the free access session, at the same location. If this is not possible the time between last eating occasion and the free access session should be recorded and controlled for in the analyses.

Another limitation concerns the lack of any food intake by 33 percent of children. Children’s typical dietary behaviour may have been affected by the unfamiliar environment. We do not know what effect, if any, the information given to parents about the study had on children’s behaviour. Parents were told that the purpose of the study was to find out what foods children would choose in a free access environment and therefore it seems unlikely that parents would have discouraged their child from eating. It is possible however, that parents may have influenced their children’s choices via messages to children prior to the study but we did not collect any information to support or refute this. Researchers using the free access methodology should try to collect some information about parent instructions to children.

**Conclusion and study implications**

In conclusion, this study suggests that the influence of parental restriction on EAH varies depending on the toddler’s level of access to snack foods, measured by Allow Access from the TSFFQ. Implications are that environments with lower access to snack foods are helpful to parents because they enable them to manage their child’s consumption of high energy foods. Parents that have a tendency towards restrictive practices should be encouraged to modify their toddlers’ food environment rather than try to control their intake. This type of advice is not new. It supports the philosophy of the division of responsibility in feeding that suggests that the parent is responsible for the food that is provided (and by default, the foods that are *not* provided) and the child is responsible for deciding what and how much to eat [46]. Parents could be advised to minimise access to unhealthy foods by not having the food in the home environment or, where practical, other environments where the child spends the majority of their time.
Acknowledgments

We thank the families that participated in the study and Pennie Taylor for designing the breakfast options.

References


Legends for Figures

*Figure 1.* Regression slopes depicting the relationship between Restriction and energy intake for different levels of Allow Access: high availability (1 SD above the mean); mean; and low availability (1 SD below the mean).

** Regression slope is significantly different from 0.
Figure 1