



# Is repeated exposure the holy grail for increasing children's vegetable intake? Lessons learned from a Dutch childcare intervention using various vegetable preparations



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## ABSTRACT

Children's failure to eat enough vegetables highlights the need for effective interventions encouraging this behaviour. The aim of this study was to investigate the effect of repeated exposure to three a priori unfamiliar vegetables, each prepared in two ways, on children's vegetable acceptance in a childcare setting. Two hundred fifty children (mean age 25 months; 57% boys) participated in a pre-test and a post-test, where they were offered pumpkin, courgette, and white radish. The intervention group (N = 125) participated in a 5-month exposure period, where they were exposed repeatedly (~12x) to the vegetables: pumpkin blanched and as a cracker spread; courgette blanched and as soup; white radish raw and as a cracker spread. The control group (N = 125) maintained their normal routine. Mixed model analyses were used to analyse intake data and Chi-square analyses for willingness to taste.

At pre-test, children ate about 20 g of pumpkin and courgette, whereas white radish intake was approximately 10 g. There was a significant positive effect of the intervention for pumpkin (+15 g;  $p < 0.001$ ) and white radish (+16 g;  $p = 0.01$ ). Results for willingness to taste were in the same direction. There was no repeated exposure effect for courgette ( $p = 0.54$ ); this may have been due to its less distinct taste profile or familiarity with boiled courgette.

From our findings, we conclude that repeated exposure to multiple unfamiliar vegetable tastes within the daily routine of a childcare setting is effective in improving children's willingness to taste and intake of some of these vegetables. However, repeated exposure may not be sufficient for more familiar or blander tasting vegetables. This implies that one size does not fit all and that additional strategies are needed to increase children's intake of these vegetables.

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## 1. Introduction

In The Netherlands, only one in five 2–3-year-old children meets the lower limit of the recommended vegetable consumption of 50–100 g (Ocke et al., 2008). Because of the health benefits of eating sufficient vegetables, identifying effective strategies to increase children's vegetable consumption is an important goal for improving public health.

A well-known strategy to increase children's vegetable acceptance is repeated exposure. Various studies have shown that repeated exposure is a robust mechanism to increase children's

liking and intake of an unfamiliar or disliked vegetable effectively, with effects stable for up to nine months (Caton et al., 2012; de Wild, de Graaf, & Jager, 2013; de Wild, de Graaf, & Jager, 2014; Fildes, van Jaarsveld, Wardle, & Cooke, 2014; Hausner, Olsen, & Møller, 2012; Maier, Chabanet, Schaal, Issanchou, & Leathwood, 2007; Remy, Issanchou, Chabanet, & Nicklaus, 2013). Between 8 and 14 exposures have been applied and effects have been found after 5 to 6 exposures (Anzman-Frasca, Savage, Marini, Fisher, & Birch, 2012; Caton et al., 2012; Hausner et al., 2012). However, it is recognized that, depending on the child and the vegetable, more exposures may be needed (Caton et al., 2014; Cooke, 2007). The majority of these studies have been done with one vegetable as target (Caton et al., 2012; Fildes et al., 2014; Hausner et al., 2012; Wardle et al., 2003). However, children would benefit from learning to like a variety of vegetables, but less is known about the effect of repeated exposure to a variety of unfamiliar vegetables,

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each presented singly.

O'Connell and colleagues investigated the effect of repeated exposure to a series of vegetables among 3–6-year-old children. In their study, 10 exposures to three different unfamiliar vegetables at lunchtime did not increase children's vegetable consumption. It was hypothesized that, because the vegetables were offered at lunchtime, there was too much competition from other foods (including other vegetables), thereby making it less likely for the vegetables to be tasted (O'Connell, Henderson, Luedicke, & Schwartz, 2012). In contrast, a parent-led exposure trial at home, where parents offered their child a disliked vegetable to taste for 14 days outside mealtimes, was effective in increasing liking and intake of this vegetable (Fildes et al., 2014). So, to prevent competition from other foods, it seems important to repeatedly offer vegetables outside main mealtimes.

This is especially true for the Dutch situation where vegetables are mainly eaten at the evening meal (Gubbels, Raaijmakers, Gerards, & Kremers, 2014; Ocke et al., 2008). It is challenging to consume the recommended vegetable intake during one eating occasion only. Moreover, this evening moment is not ideal, since both parents and children are tired at the end of a day; eating properly becomes a struggle and parents may pressure their children to eat vegetables, which is counterproductive for their vegetable eating (Blissett, 2011; Galloway, Fiorito, Francis, & Birch, 2006; Osborne & Forestell, 2012). Furthermore, although the message of repeated exposure seems relatively simple, it is not an easy task for parents to expose their child to a variety of vegetables in a persistent manner. After three to five refusals, parents believe that their child does not like that particular vegetable, and they give up offering it again (Carruth, Ziegler, Gordon, & Barr, 2004; Maier, Chabanet, Schaal, Leathwood, & Issanchou, 2007). In addition, parents do not offer vegetables that are unfamiliar to, or disliked by, themselves (Chambers et al., 2016; Skinner et al., 1998). This behaviour has a negative effect on the child's vegetable eating, as the range of potentially liked vegetable flavours is narrowed down. So, these challenges point to the need for other occasions and other locations to offer unfamiliar vegetables repeatedly to children.

The childcare setting seems an ideal place for this because children are used to eating and drinking in this setting, and there is room for fun learning activities. This helps to offer vegetables in a positive context, which may enhance vegetable acceptance (Birch, Zimmerman, & Hind, 1980; Wardle, 1995). Also the social influence of peers at childcare centres can promote healthy eating behaviour by setting a good example (Adnessi, Galloway, Visalberghi, & Birch, 2005; O'Connell et al., 2012). Finally, more than half of Dutch toddlers attend childcare or pre-school education facilities, for on average 17 h per week (CBS, 2016).

Therefore, the aim of our study was to investigate the effect of repeated exposure to three a priori unfamiliar vegetables presented singly in the daily routine of a childcare setting on children's vegetable acceptance. Our study adds to the current repeated exposure literature because 1) the study was executed with multiple vegetables as target, each one being presented in two preparations to avoid boredom, and 2) instead of being researcher led, the study was executed in the daily practice of childcare by the employees themselves. It was hypothesized that repeated exposure would enhance children's willingness to taste and increase their intake of these vegetables. Because children have an innate preference for sweet (Steiner, Glaser, Hawilo, & Berridge, 2001), and previous research indicates that fewer exposures may be needed for these 'easier' vegetables (Cooke, 2007), we hypothesized that the repeated exposure effect may be greater for a sweet-tasting vegetable than for a bitter one. A secondary objective was to explore the influence of individual child characteristics.

## 2. Materials & methods

### 2.1. Design

The protocol for this study was approved by the Medical Ethical Committee of Wageningen University. Parents were asked to sign an informed consent for participation of their child. A pre- and post-test design was used with two conditions (see Fig. 1). Two childcare locations served as intervention group (N = 125) and two locations formed the control group (N = 125). Three less frequently eaten vegetables were used as target vegetables: pumpkin, courgette (zucchini), and white radish. At pre- and post-test, pumpkin and courgette were offered blanched and white radish raw. One vegetable was offered per day as an afternoon snack and children's willingness to taste and their vegetable intake was measured. Children attend childcare on varying days of the week (some come on Tuesday and Wednesday, others on Monday and Thursday, for example), and children's vegetable intake varies a lot from day to day. Because of this, the pre- and post-test lasted four weeks each in order to cover all children and to enhance the validity of the intake data.

After the pre-test, the intervention group participated in a 5-month exposure period in which one vegetable taste was offered per day as an afternoon snack. To prevent boredom and encourage tasting, each vegetable was presented in two different preparations: pumpkin blanched and as a cracker spread; courgette blanched and as soup; white radish raw and as a cracker spread. The control group kept their regular eating routines during this period. After the exposure period, both conditions participated in a 4-week post-test, where willingness to taste and children's intake for the three vegetables was measured again.

### 2.2. Participants

Children aged 0–4 years were recruited via four childcare centres in Utrecht, The Netherlands. All four centres belonged to the same organization to ensure comparability concerning childcare policy and eating procedures. The habitual snack times were eating fruit in the morning and familiar raw snack vegetables (i.e. tomatoes, cucumber, red bell pepper) in the afternoon. Two childcare centres were randomly assigned to the intervention condition.

Healthy children without any allergies to the study products could participate. A sample size calculation ( $p = 0.05$ ; power 80%; SD of 35 g) aiming for a clinically relevant increase in children's vegetable consumption of 15 g (~40% of current intake) indicated that 67 children per condition would be sufficient. Because Dutch children leave childcare and move to primary school as soon as they turn four, we aimed to include 80 to 90 children per condition to

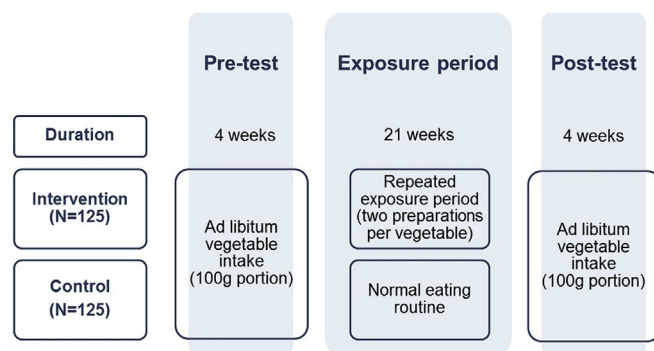


Fig. 1. Design of the repeated exposure study in the childcare setting with pumpkin, courgette, and white radish as target vegetables.

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