United States Department of Agriculture

Repeated exposure to foods and early food acceptance: A Systematic Review

The Pregnancy and Birth to 24 Months Project

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Nutrition Evidence Systematic Review
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Food and Nutrition Service
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This systematic review was conducted for the Pregnancy and Birth to 24 Months Project (P/B-24) by the Nutrition Evidence Systematic Review (NESR) team at the Center for Nutrition Policy and Promotion, Food and Nutrition Service, USDA. All systematic reviews from the P/B-24 Project are available on the NESR website: https://nesr.usda.gov.

Conclusion statements drawn as part of this systematic review describe the state of science related to the specific question examined. Conclusion statements do not draw implications, and should not be interpreted as dietary guidance.

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This systematic review has also been published in the *American Journal of Clinical Nutrition*: Spill MK, Johns K, Callahan EH, Shapiro MJ, Wong YP, Benjamin-Neelon SE, et al. Repeated exposure to food and food acceptability in infants and toddlers: a systematic review. *Am J Clin Nutr*. 2019;109(7):978S–89S. doi: 10.1093/ajcn/nqy308.

Related citations are published in the *American Journal of Clinical Nutrition*: TBD, in NLM format

- **P/B-24 Project overview:** Stoody EE, Spahn JM, Casavale KO. The Pregnancy and Birth to 24 Months Project: a series of systematic reviews on diet and health. *Am J Clin Nutr*. 2019;109(7):685S–97S. doi: 10.1093/ajcn/nqy372.
- **P/B-24 systematic review methodology:** Obbagy JE, Spahn JM, Wong YP, Psota TL, Spill MK, Dreibelbis C, et al. Systematic review methodology used in the Pregnancy and Birth to 24 Months Project. *Am J Clin Nutr*. 2019;109(7):698S–704S. doi: 10.1093/ajcn/nqy226.
- **Related systematic reviews from the P/B-24 Project:**

- Spill MK, Callahan EH, Shapiro MJ, Spahn JM, Wong YP, Benjamin-Neelon SE, et al. Caregiver feeding practices and child weight outcomes: a systematic review. *Am J Clin Nutr*. 2019;109(7):990S–1002S. doi: 10.1093/ajcn/nqy276.
- Spahn JM, Callahan EH, Spill MK, Wong YP, Benjamin-Neelon SE, Birch L, et al. Influence of maternal diet on flavor transfer to amniotic fluid and breast milk and children's responses: a systematic review. *Am J Clin Nutr*. 2019;109(7):1003S–26S. doi: 10.1093/ajcn/nqy240.

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All TEC and NESR team members, Project leads, and FEG-TEC liaisons participated in establishing the research questions, analytic framework, and study inclusion and exclusion criteria. MKS and KJ facilitated and conducted the review. YPW searched the databases. LB, MMB, RB, JTC, MSF, JAM, and SBN substantial input in all levels of the review including development of protocol, evidence synthesis, conclusion statement, grade, research recommendations. KOC provided project oversight. All

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INTRODUCTION

This document describes a systematic review conducted to answer the following question: What is the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance? This systematic review was conducted as part of the Pregnancy and Birth to 24 Months (P/B-24) Project by USDA's Nutrition Evidence Systematic Review (NESR).

The purpose of the P/B-24 Project was to conduct a series of systematic reviews on diet and health for women who are pregnant and for infants and toddlers from birth to 24 months of age. This project was a joint initiative led by USDA and HHS, and USDA's NESR carried out all of the systematic reviews. A Federal Expert Group (FEG), a broadly representative group of Federal researchers and program leaders, also provided input throughout the P/B-24 Project. More information about the P/B-24 Project has been published[ii] and is available on the NESR website: https://nesr.usda.gov/project-specific-overview-pb-24-0.

NESR, formerly known as the Nutrition Evidence Library (NEL), specializes in conducting food- and nutrition-related systematic reviews using a rigorous, protocol-driven methodology. To conduct each P/B-24 systematic review, NESR's staff worked with a Technical Expert Collaborative (TEC), which is a group of 7–8 leading subject matter experts.

NESR's systematic review methodology involves developing and prioritizing systematic review questions, searching for and selecting studies, extracting and assessing the risk of bias of data from each included study, synthesizing the evidence, developing a conclusion statement, grading the evidence underlying the conclusion statement, and recommending future research. A detailed description of the methodology used in conducting systematic reviews for the P/B-24 Project has been published[iii] and is available on the NESR website: https://nesr.usda.gov/pb-24-project-methodology-0. In addition, starting on page 35, this document includes details about the methodology as it was applied to the systematic review described herein. An analytic framework that illustrates the overall scope of the question, including the population, the interventions and/or exposures, comparators, and outcomes of interest, is found on page 35. In addition, the literature search plan that was used to identify studies included in this systematic review is found on page 35.

[ii] Stoody EE, Spahn JM, Casavale KO. The Pregnancy and Birth to 24 Months Project: a series of systematic reviews on diet and health. *Am J Clin Nutr*. 2019;109(7):685S–97S. doi: 10.1093/ajcn/nqy372.

[iii] Obbagy JE, Spahn JM, Wong YP, Psota TL, Spill MK, Dreibelbis C, et al. Systematic review methodology used in the Pregnancy and Birth to 24 Months Project. *Am J Clin Nutr*. 2019;109(7):698S–704S. doi: 10.1093/ajcn/nqy226.

List of abbreviations

Abbreviation	Full name
COI	Conflict of interest
HDI	Human Development Index
NEL	Nutrition Evidence Library
P/B-24 project	Pregnancy and Birth to 24 Months Project
SR	Systematic review
USDA	United States Department of Agriculture
TEC	Technical Expert Collaborative
COI	Conflict of interest

PLAIN LANGUAGE SUMMARY

What is the question?

- The question is: What is the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance?

What is the answer to the question?

- Moderate evidence from randomized controlled trials indicates that tasting a single or multiple vegetable(s) or fruit(s) 1 food per day for 8 – 10 or more days is likely to increase acceptability of an exposed food (indicated by an increase in food intake or faster rate of feeding after compared to before the exposure period) in infants and toddlers 4 to 24 months old. The effect of repeated exposure on acceptability is likely to generalize to other foods within the same food category but not to foods from a different food category. This evidence does not address the effect of repeated exposure of foods beyond vegetables and fruits on food acceptability in infants and toddlers.

Why was this question asked?

- This important public health question was identified and prioritized as part of the U.S. Department of Agriculture and Department of Health and Human Services Pregnancy and Birth to 24 Months Project.

How was this question answered?

- A team of Nutrition Evidence Systematic Review staff conducted a systematic review in collaboration with a group of experts called a Technical Expert Collaborative

What is the population of interest?

- Generally healthy infants and toddlers from ages 0-24 months were repeatedly exposed to a food(s) and their acceptability of one or more foods was tested

What evidence was found?

- 21 studies were included. However, due to issues with directness and generalizability, 16 studies (12 RCTs, 4 non-randomized controlled trials) contributed to the evidence synthesis.
- Repeated exposure to a single vegetable or fruit or multiple vegetables or fruits resulted in increased acceptance of an exposed food after 8 – 10 or more exposures.
    - Fewer than 8 exposures may be sufficient for some infants and toddlers to increase acceptability of an exposed food and there may be times when a child may never like a particular food regardless of the number of exposures.
- Repeated exposure of a food(s) may increase acceptability of similar foods but this is less likely to occur with foods that are not similar, like foods from a

different food category.

- In many cases, when infants demonstrated increased acceptability of a food, mothers were often unaware of the change in acceptability.
- Findings are limited to the effects of repeated exposure mostly to vegetables with fewer studies looking at the effects of repeated exposure to fruits. Most test foods were commercially-available purees, and studies did not focus on the transition to table foods.

How up-to-date is this review?

- This review includes literature from 01/1980 to 07/2017.

TECHNICAL ABSTRACT

Background

- In the development of early child food preferences, it is important to understand the basic relationship between repeated exposure to a food (or foods) and acceptability of an exposed food, as well as how repeated exposure to a food (or foods) generalizes to acceptability of a different food either within the same food category (e.g. fruit or vegetable) or in a different food category as the exposed food.
- Systematic reviews were conducted as part of the U.S. Department of Agriculture and Department of Health and Human Services Pregnancy and Birth to 24 Months Project.
- The goal of this systematic review was to examine the following question: What is the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance?

Conclusion Statement and Grades

- Moderate evidence from randomized controlled trials indicates that tasting a single or multiple vegetable(s) or fruit(s) 1 food per day for 8 – 10 or more days is likely to increase acceptability of an exposed food (indicated by an increase in food intake or faster rate of feeding after compared to before the exposure period) in infants and toddlers 4 to 24 months old. The effect of repeated exposure on acceptability is likely to generalize to other foods within the same food category but not to foods from a different food category. This evidence does not address the effect of repeated exposure of foods beyond vegetables and fruits on food acceptability in infants and toddlers. **Grade**: Moderate

Methods

- This systematic review was conducted by a team of staff from the Nutrition Evidence Systematic Review team in collaboration with a Technical Expert Collaborative.
- Literature search was conducted using 12 databases to identify articles that evaluated the intervention or exposure of repeated exposure to a food(s) and the outcomes of food acceptability. A manual search was conducted to identify articles that may not have been included in the electronic databases searched. Articles were screened by two authors independently for inclusion based on pre-determined criteria
- Data extraction and risk of bias assessment were conducted for each included study, and both were checked for accuracy. The body of evidence was qualitatively synthesized to inform development of a conclusion statement(s), and the strength of evidence was graded using pre-established criteria evaluating the body of evidence on internal validity/risk of bias, adequacy, consistency, impact, and generalizability.

Summary of Evidence

Twenty-one articles (14 RCTs, 5 non-randomized controlled trials, and 2 cohort studies) met criteria for inclusion that examined repeated exposure to a food(s) and food acceptability

- 5 of 21 articles had considerable issues with directness and generalizability and did not contribute to the evidence synthesis
- Repeated exposure to a single vegetable or fruit or multiple vegetables or fruits resulted in increased acceptance of an exposed food after 8 – 10 or more exposures.
- The goal of most of the studies was not to determine the minimum number of exposures that were necessary to see an effect on acceptability. Therefore, fewer than 8 exposures may be sufficient for some infants and toddlers to increase acceptability of an exposed food and there may be times when a child may never like a particular food regardless of the number of exposures.
- The effect of repeated exposure can generalize to similar foods. That is, repeated exposure of a food(s) may increase acceptability of similar foods but this generalization is less likely to occur with foods that are not similar, like foods from a different food category.
- In many cases, when infants demonstrated increased acceptability of a food, either by increased food intake or rate of feeding after compared to before repeated exposure, mothers were often unaware of the change in acceptability.
- Findings are limited to the effects of repeated exposure mostly to mostly vegetables with fewer studies looking at the effects of repeated exposure to fruits. Most test foods were commercially-available purees, and studies did not focus on a transition to table foods.

FULL REVIEW

Systematic review question

What is the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance?

Conclusion statement

Moderate evidence from randomized controlled trials indicates that tasting a single or multiple vegetable(s) or fruit(s) 1 food per day for 8 – 10 or more days is likely to increase acceptability of an exposed food (indicated by an increase in food intake or faster rate of feeding after compared to before the exposure period) in infants and toddlers 4 to 24 months old. The effect of repeated exposure on acceptability is likely to generalize to other foods within the same food category but not to foods from a different food category. This evidence does not address the effect of repeated exposure of foods beyond vegetables and fruits on food acceptability in infants and toddlers.

Grade

Moderate

Summary

- Twenty-one studies (19 controlled trials and 2 cohort studies) from 1980 to 2015 (mostly from healthy populations in the US and Europe) addressed the effect of repeated exposure to one food or multiple foods on the infants'/toddlers' acceptability of that food or different foods. Of these studies, two tested the effect of repeated exposure of a fruit or multiple fruits (Brown, 1980, Lundy, 1998), 10 tested repeated exposure of a vegetable or multiple vegetables (Ahern, 2014, Caton, 2013, Coulthard, 2014, Fildes, 2015, Gerrish, 2001, Hetherington, 2015, Maier, 2007, Paul, 2011, Remy, 2013, Sullivan, 1994), and four studies tested repeated exposure of both fruits and vegetables (Barends, 2013, Birch, 1998, Forestell, 2007, Mennella, 2008).

- A change in infant acceptance was defined as a change in at least one of the following outcomes measured during feeding sessions of a test food: food intake, duration of feed, rate of feeding, facial and/or body response indicating greater liking, and perceived liking by parent or researcher. The most commonly reported outcome was weighed food intake.

- Twelve studies reported perceived liking by mothers. Despite other measures indicating an increase in infant acceptability, mothers were often unaware of this change.

- Repeated exposure to a single vegetable or fruit or multiple vegetables or fruits resulted in increased acceptance of an exposed food after 8 or more exposures.

    - The goal of most of the studies was not to determine the minimum number of exposures that were necessary to see an effect on acceptability. However, based on the study design and number of exposures tested in this body of research, less than 8 exposures may be sufficient for some infants and toddlers to increase acceptability of an exposed food.
    - After 6-10 exposures to a vegetable with added sugar or salt, intake of the unsweetened or unsalted vegetable increased.
    - One study (Birch, 1998) tested the effect of repeated exposure of commercially-prepared baby foods (fruit or vegetable) on acceptability of the homemade version of that food; repeated exposure to the commercially prepared fruit or vegetable did not increase acceptability of a homemade version of the food.

- Repeated exposure to a single vegetable or fruit, or multiple vegetables or fruits, resulted in increased acceptance of a new food within that food category (i.e., fruit or vegetable).

- During the early period of being weaned to solid foods, eating vegetables or fruit is not likely to interfere with the initial acceptance of a new fruit or vegetable, respectively.
    - Four studies (Barends, 2013, Birch, 1998, Fildes, 2015, Gerrish, 2001) tested and found no effect of repeated exposure to a single or multiple vegetables on acceptance of a new fruit.
    - Three studies (Barends, 2013, Birch, 1998, Mennella, 2008) tested the effect of repeated exposure to a single or multiple fruits on acceptance of a new vegetable and had mixed results. One study (Mennella, 2008) found that 8 exposures to a single or a variety of fruits increased infants feeding rate of a new vegetable. Two studies found no impact on acceptability of a new vegetable after repeated exposure to a single fruit (Birch, 1998) or a variety of fruits (Barends, 2013).

- The majority of the evidence is high-quality from controlled trials using within-subject, before/after exposure measures of weighed food intake as the indicator of infant acceptance. The sample population is generalizable to the 4-24 month population in the US. Evidence is consistent in direction, with no detriment or harm associated with repeatedly exposing infants/children to fruits or vegetables.
- Findings are predominantly based on the effects of repeated exposure to mostly vegetables with some findings on repeated exposure to fruits. Most of the studies were done on commercial baby foods. There are methodological differences in repeated exposure procedures: food type(s), number of foods provided, number of exposures, frequency of exposures (number of exposures

per day or week), and duration of total repeated exposure period (days or weeks).

Description of the evidence

This systematic review included articles that address the relationship between repeated exposure to a food(s) on infant and toddler food acceptability. The search included articles from any country published from 1980 to 2017. Studies included generally healthy infants and toddlers from birth to 24 months old at the time of the repeated exposure intervention. Studies were not included if they specifically enrolled infants with gestational age <37 weeks or infants who were small for gestational age (<2500g). The independent variable was repeated exposure, and an exposure was defined as each time a child tasted a food. If a food was offered but not tasted, it did not qualify as an exposure. The dependent variable, acceptability, was defined as a change in any of one of five measures: food intake, duration of feeding session and rate of feeding within an infant-led feeding paradigm, positive facial or body responses, and perceived liking by a caregiver or researcher.

Twenty-one studies were included: 19 controlled trials (Ahern, 2014, Barends, 2013, Birch, 1998, Brown, 1980, Caton, 2013, Coulthard, 2014, Fildes, 2015, Forestell, 2007, Gerrish, 2001, Hausner, 2010, Hetherington, 2015, Maier, 2007, Maier, 2008, Mennella, 2008, Paul, 2011, Remy, 2013, Sullivan, 1994, Traore, 2005, Lundy, 1998,) and two prospective cohort studies (Harris, 1987, Stein, 2012). Nine studies were conducted in the US (Birch, 1998, Brown, 1980, Forestell, 2007, Gerrish, 2001, Mennella, 2008, Paul, 2001, Stein, 2012, Sullivan, 1994, Lundy, 1998), five studies were conducted in the UK (Ahern, 2014, Caton, 2013, Coulthard, 2014, Harris, 1987, Hetherington, 2015,), and one study from the following countries: Burkina Faso (Traore, 2005), Denmark (Hausner, 2010), France (Remy, 2013), Germany (Maier, 2007) and Netherlands (Barends, 2013). One study took place in both France and Germany (Maier, 2008) and one study spanned the UK, Greece, and Portugal (Fildes, 2015).

There was no inclusion criteria related to sample size because of the within-subject design typical for this research area. Sample sizes varied and ranged from 12 participants (Lundy, 1998) to 143 participants (Maier, 2008). Thirteen studies had < 50 participants (Ahern, 2014, Birch, 1998, Brown, 1980, Forestell, 2007, Gerrish, 2001, Harris, 1987, Hausner, 2010, Hetherington, 2015, Maier, 2007, Mennella, 2008, Sullivan, 1994, Traore, 2005, Lundy, 1998), six studies had 50 to 99 participants (Barends, 2013, Caton, 2013, Coulthard, 2014, Paul, 2011, Remy, 2013, Stein, 2012), and two studies had more than 100 participants (Fildes, 2015, Maier, 2008).

Mean age of participants at the start of the study ranged from 22 weeks (Sullivan, 1994) to 24 months (Caton, 2013). One study did not provide a mean, but the subject age ranged from 15 to 56 months (Ahern, 2014). The repeated exposure component of the Paul (2011) study occurred after parents reported that their infants were ready to begin consuming solids, at least four months of age; however, the authors didn't indicate the mean age at the time of the repeated exposure assessment. Studies with children older than 24 months were included in the body of evidence if they provided subgroup analyses looking specifically at children within the birth to 24 month range (Ahern, 2014, Caton, 2013), otherwise they were excluded.

Subject characteristics, namely, sex and race, were well distributed within the body of evidence. All but two articles reported sex (Ahern, 2014, Lundy, 1998), and girls and boys were fairly equally represented, ranging from 40.0% female (Remy, 2013) to 61.0% female (Stein, 2012). While only seven articles reported race and ethnicity for mothers and/or infants (Brown, 1980, Forestell, 2007, Gerrish, 2001, Mennella, 2008, Paul, 2011, Stein, 2012, Lundy, 1998), these studies included participants from several different racial/ethnic backgrounds.

Study foods

The majority of studies tested the effects of repeated exposure to fruits or vegetables. Two tested the effect of repeated exposure of a fruit or multiple fruits (Brown, 1980, Lundy, 1998), 10 tested repeated exposure of a vegetable or multiple vegetables (Ahern, 2014, Caton, 2013, Coulthard, 2014, Fildes, 2015, Gerrish, 2001, Hetherington, 2015, Maier, 2007, Paul, 2011, Remy, 2013, Sullivan, 1994), and four studies tested repeated exposure of both fruits and vegetables (Barends, 2013, Birch, 1998, Forestell, 2007, Mennella, 2008). Five studies tested other types of foods including vegetables and meat (Maier, 2008), gruel (Traore, 2005), dietary sodium (Harris, 1987, Stein, 2012), and maternal dietary exposure to caraway flavor (Hausner, 2010). The majority of study foods were manufactured baby foods.

Repeated exposure: type, number, frequency, and duration

The type of exposure (single food or multiple foods), number, frequency (number of exposures per day or week), and duration of exposure period differed among studies. Thirteen studies examined repeated exposure to a single food (Ahern, 2014, Birch, 1998, Caton, 2013, Coulthard, 2014, Forestell, 2007, Gerrish, 2001, Hausner, 2010, Mennella, 2008, Paul, 2011, Remy, 2013, Sullivan, 1994, Traore, 2005, Lundy, 1998) and twelve studies examined repeated exposure to a multiple foods (either fruits or vegetables) (Barends, 2013, Brown, 1980, Coulthard, 2014, Fildes, 2015, Forestell, 2007, Gerrish, 2001, Harris, 1987, Hetherington, 2015, Maier, 2007, Maier, 2008, Mennella, 2008, Stein, 2012). The number of repeated exposures to foods ranged from 6 times (Ahern, 2014, Paul, 2011) to 47 total times (Hetherington, 2015), with duration of exposure periods ranging from 6 days (Paul, 2011) to 3 months (Brown, 1980). Frequency of exposures varied from 2 times/day (Hetherington, 2015, Traore, 2005) to 2-3 times/week (Ahern, 2014, Remy, 2013), but the majority of studies tested 1 exposure/day.

Outcomes

For the purposes of this review, a change in acceptability was defined as a change in at least one of the following five behavioral measures: food intake (weighed amount of food consumed), caregiver or researcher perception of infants' liking of a food, duration of feeding session, rate of feeding, and facial and/or body responses during feeding. Facial/body responses included: frequency of facial expressions of distaste (Forestell, 2007); number of spoons accepted and refused (Hausner, 2010); and, body and facial reactions, eagerness verse refusal, and number of chewing cycles (Lundy, 1998). Studies had to include at least one of these measures to be included in the body of evidence and the combination of outcomes examined within studies varied.

Table 1. Outcomes measured by study

Study	Intake	Perceived liking	Duration of feed	Rate of feed	Facial/body response
8 studies: Ahern, 2014, Birch, 1998, Caton, 2013, Coulthard, 2014, Harris, 1987, Paul, 2011, Stein, 2012, Traore, 2005	X	.	.	.	.
7 studies: Barends, 2013, Brown, 1980, Fildes, 2015, Maier, 2007, Maier, 2008, Remy, 2013, Sullivan, 1994	X	X	.	.	.
1 study: Hetherington, 2015	X	X	.	X	.
2 studies: Gerrish, 2001, Mennella, 2008	X	X	X	X	.
1 study: Forestell, 2007	X	X		X	X
1 study: Hausner, 2010	X	X	X	.	X
1 study: Lundy, 1998	.	.	.	.	X
Total: 21 studies	19	12	3	4	3

Limitations

The NEL bias assessment summary table indicated certain areas that may be of concern for internal validity purposes; however it was determined that these were not considered to be significant limitations for the body of evidence. These included: lack of blinding of researchers, outcome assessors, or participants, limited reporting of randomization methods, validity/reliability of outcome measures, and not accounting for key confounders.

- Blinding is a common difficulty with feeding studies, given the nature of the exposure. Few studies indicated whether researchers or outcome assessors were blinded to the conditions. In this body of evidence, caregivers feeding infants may have been aware of the foods but were not likely aware of the research question or hypothesis. Caregiver blinding is less of a concern due to the infant-led feeding paradigm used to conclude feeding sessions.
- Few studies reported the method for randomization of participants to exposure/intervention. This was considered to be more of a reporting issue than a flaw of the design.
- Validity and reliability of outcome measures was identified as a risk of bias because over half of the studies measured perceived liking which was not consider to be a

valid/reliable measure. However, perceived liking was only one of several outcome measures and therefore does not limit the validity of the overall findings.

- All key confounders identified *a priori* by the collaborative were not accounted for consistently across studies.

There were other limitations and/or methodological differences that are important to consider when synthesizing the evidence. These include:

- Variations in target and test foods across studies;
- Variations in number, frequency, and duration of exposures;
- Study design: strongest design is within-subject design, with pre- and post-exposure measures, however this design was not used consistently across all studies;
- Age range: although age is limited to the birth to 24 month population, there can be significant variation in eating behaviors within this age range.

Assessment of individual studies prior to synthesis

Individual studies were reviewed and assessed based on internal validity, sufficiency of sample sizes, directness, and generalizability. While all studies in the body of evidence are considered in addressing this systematic review question, it was determined that five studies (3 controlled trials: Hausner, 2010, Maier, 2008, Traore, 2005; 2 cohort studies: Harris, 1987, Stein, 2012) should be weighed less heavily, mostly due to issues of directness of addressing the systematic review question, and lack of data. Thus, the evidence synthesis will focus on the remaining 16 studies. (Tables 2 and 3)

Evidence synthesis

Does repeated exposure increase acceptability of an exposed food?

Fourteen studies examined the relationship between repeated exposure to a single vegetable or fruit or multiple vegetables or fruits on acceptability of an exposed food (single vegetable or fruit: Ahern, 2014, Birch, 1998, Caton, 2013, Forestell, 2007, Gerrish, 2001, Lundy, 1998, Mennella, 2008, Paul, 2011, Remy, 2013, Sullivan, 1994; multiple vegetables or fruits: Barends, 2013, Brown, 1980, Forestell, 2007, Hetherington, 2015, Maier, 2007, Mennella, 2008). Each study showed an increase in at least one measure of food acceptability from before to after the exposure period.

Of the 10 studies that examined the relationship of repeated exposure to a *single* food on acceptability of that food, nine tested repeated exposure to a vegetable (Ahern, 2014, Birch, 1998, Caton, 2013, Forestell, 2007, Gerrish, 2001, Mennella, 2008, Paul, 2011, Remy, 2013, Sullivan, 1994) and three to a fruit (Birch, 1998, Mennella, 2008, Lundy, 1998). Again, all studies showed an increase in acceptability, and more specifically, eight of the 10 studies showed an increase in intake of the exposed food from before to after the exposure period. Two studies found an increase in other measures of acceptability, feeding rate (Mennella, 2008) and facial and body response (Lundy, 1998).

Five studies found that repeatedly exposing children to multiple vegetables or multiple

fruits led to increased acceptability of an exposed food after compared to before the exposure period (Barends, 2013; Forestell, 2007; Hetherington, 2015; Maier, 2007; Mennella, 2008). Four studies provided multiple vegetables (Barends, 2013; Hetherington, 2015; Maier, 2007; Mennella, 2008), 1 provided multiple fruits (Barends, 2013), and 1 provided a vegetable and fruit (Forestell, 2007). In these studies with the exception of Forestell (2007) and Mennella (2008), a single vegetable or fruit was served alone at an eating occasion and the type of vegetable or fruit varied across eating occasions, with one eating occasion per day at the same time each day (Table 1). In the study by Forestell (2007), green beans were served first, followed by peaches within 1 hour, and in Mennella (2008) one group of infants received two vegetables per eating occasion. All studies showed an increase in either intake or feeding rate of an exposed food after compared to before the repeated exposure period (Table 1). One study, however, had mixed findings (Barends, 2013). In Barends et al. (2013), four study groups were tested: two groups were exposed to different combinations of fruits (1 group was exposed to apples, bananas, pears; another group was exposed to plums, bananas, pears) and two were exposed to different combinations of vegetables (1 group was exposed to green beans, broccoli, cauliflower; another group was exposed to artichoke, broccoli, cauliflower). One group exposed to fruits (plums, bananas, pears) and 1 group exposed to vegetables (green beans, broccoli, cauliflower) had greater intake and perceived liking of an exposed food (plums and green beans, respectively) after the exposure period. Meanwhile, there was no change in intake or perceived liking within the group exposed to apples, bananas, and pears when tested for acceptability of apples or the group exposed to artichoke, broccoli, and cauliflower when tested for acceptability of artichokes.

Adding sugar, salt, fat, or changing the texture of the exposed food

Seven studies tested the effect of repeated exposure to a food with altered properties, specifically added sweetness (Ahern, 2014, Brown, 1980, Caton, 2013, Remy, 2013), salt (Sullivan, 1994), oil (Caton, 2013, Remy, 2013) or altered texture (Birch, 1998, Lundy, 1998), on acceptability of the plain version of that food. Results varied based on the sensory characteristics that were altered.

- Adding sweetness or salt to a vegetable enhanced acceptability of the plain version of that vegetable. Three studies showed that from before to after 6-10 exposures to a vegetable with added sweetness (Ahern, 2014, Caton, 2013, Remy, 2013) and in one study a vegetable with added salt (Sullivan, 1994), intake of the plain vegetable increased. However, in a study comparing a 3-month exposure of normally-sweetened fruits to unsweetened fruits, the group of infants exposed to sweetened fruits consumed less sweetened and unsweetened fruit during post-exposure testing than the group exposed to unsweetened fruit (Brown, 1980). There was no difference in intake between sweetened or unsweetened fruits within either group.

- When the exposure food was a vegetable with added oil, results were mixed. One study showed that intake of plain artichoke increased after 10 exposures to artichoke with added sunflower oil (Caton, 2013), while another study (Remy, 2013) did not find a change in intake of plain artichoke after 10 exposures to artichoke with

oil.

- Two studies tested the effect of repeated exposure on acceptability of foods with differing textures; it is important to note that altering the texture likely changes other sensory properties such as appearance and taste. In Birch, 1998, after 10 exposures to manufactured baby food (either banana or peas) there was no change in intake of a homemade version of that food compared to initial intake of the manufactured version. Lundy, 1998 found that children responded differently to pureed, lumpy, or diced apples depending on the versions to which they had been exposed. Compared to infants who were only exposed to pureed apples, those exposed to pureed and lumpy apples or just lumpy apples showed more positive responses (head movements) for pureed apples. Similarly, infants exposed to pureed, lumpy, and diced apples and those exposed to lumpy and diced apples showed more positive vocalizations to diced apples than infants exposed to only pureed and diced apples.

Does repeated exposure increase acceptability of a novel food?

Within the body of evidence, several studies examined if repeated exposure to a single or multiple foods impacted acceptance of a new food. Some studies looked at the impact on acceptance of a new food within the same category, i.e. exposure to fruit on acceptance of a new fruit, and some looked at the impact of exposure to a food on acceptance to a food from a different category, i.e. exposure to a fruit on acceptance of a novel vegetable and vice versa.

There were seven studies that examined the impact of repeated exposure of a single or multiple vegetables or fruits on acceptability of a new food from that category. All seven tested the impact of repeated exposure to one or more vegetables on a new vegetable (Barends, 2013, Birch, 1998, Caton, 2013, Coulthard, 2014, Fildes, 2015, Gerrish, 2001, Mennella, 2008), while three also tested the impact of repeated exposure to one or more fruits on a new fruit (Barends, 2013, Birch, 1998, Mennella, 2008). Most studies found that repeated exposure to one or more vegetables or fruits can increase acceptance to a new vegetable or fruit, respectively.

- **Repeated exposure of vegetables on acceptability of a new vegetable**

Of the five studies (Birch, 1998, Caton, 2013, Coulthard, 2014, Gerrish, 2001, Mennella, 2008) that tested the impact of repeated exposure to *a single vegetable* on acceptability of a new vegetable, results varied. Birch, 1998 found that 10 exposures to peas led to increased intake of carrots or corn. Caton, 2013 found that 10 exposures to either plain artichoke, sweetened artichoke, or artichoke with added oil increased intake of carrots. However, Gerrish, 2001 showed no change in acceptability of carrots after 9 exposures to potatoes, and Mennella, 2008 found no change in acceptability of carrots or spinach after 8 exposures to green beans. Coulthard, 2014 compared repeated

exposure to carrots or a variety of vegetables (parsnips, zucchini, and sweet potatoes) and the age of complementary food introduction on acceptability of peas. There was a significant interaction such that infants who were introduced to foods after 5.5 months and were exposed to a variety of vegetables consumed more peas than those introduced to foods before 5.5 months and were exposed to a single vegetable.

Five studies (Barends, 2013, Coulthard, 2014, Fildes, 2015, Gerrish, 2001, Mennella, 2008) that looked at the impact of repeated exposure to *multiple vegetables* on acceptability of a new vegetable all showed increased acceptability of a new vegetable in at least one study group. There was one group in Mennella, 2008 that did not increase acceptability of a novel vegetable. In this study, two groups were exposed to a variety of vegetables: one group received four vegetables (squash, spinach, peas, and carrots), 1/day over eight days; the other group was given the same four vegetables but 2 different vegetables at the test meal each day over eight days for a total of 16 exposures. The group that received one vegetable per day (8 exposures) did not increase acceptability of a new vegetable (green beans) but the group given two vegetables per day (16 exposures) increased intake and feeding rate of green beans. Also, in Fildes, 2015, one group of parents was instructed to introduce 5 vegetables to their infants (1/day for 5 days then repeat for a total of 15 days) while another group was not given specific instructions about introducing vegetables. After 15 days, there was no difference in intake or maternal perceived liking of a novel vegetable, artichoke, between groups. However, researchers that were not blinded to the intervention status rated liking of the new vegetable greater for the infants introduced to a variety of vegetables.

- **Repeated exposure of fruits on acceptability of a new fruit**

Fewer studies tested the impact of repeated exposure of a single or multiple fruits on acceptability of a new fruit. Only one study (Birch, 1998) tested the effect of repeated exposure to *a single fruit* on new fruits. This study found that 10 exposures to bananas increased intake of a new fruit, pears or peaches. Two studies (Barends, 2013, Mennella, 2008) tested the effect of repeated exposure to *multiple fruits* on a new fruit. Mennella, 2008 found that 8 total exposures to peaches, prunes, and apples (1/d for 8 days) increased intake of a new fruit, pears. Barends, 2013 had 2 groups of infants that were exposed to a different variety of fruits. After 14 total exposures to apples, bananas, and pears, there was no change in acceptability of a new fruit, plums. However, in another group, infants that received 14 total exposures to plums, bananas, and pears did increase their intake of a new fruit, apples, after the exposure period.

Seven studies tested the relationship between repeated exposure to one or more vegetables or fruits on a new food from a different food category. Four studies examined the impact of exposure to one or more vegetables on acceptance of a new fruit (Barends, 2013, Birch, 1998, Fildes, 2015, Forestell, 2007) and three studies examined the impact of exposure to one or more fruits on acceptance of a new

vegetable (Barends, 2013, Birch, 1998, Mennella, 2008). Additionally, two studies looked at the impact of repeated exposure to one or more vegetables on acceptance of chicken (Gerrish, 2001, Sullivan, 1994). Of the seven studies, three used a weaker analysis (between-group rather than within-subject) to address this relationship (Barends, 2013, Fildes, 2015, Gerrish, 2001). One study (Mennella, 2008), which used a within-subject analysis, found that repeated exposure to either a single fruit or multiple fruits led to a faster feeding rate of a new vegetable; the other studies did not support this finding. This body of evidence indicates that repeated exposure to a food(s) does not interfere with initial acceptance of a new food from a different food category. In other words, early eating experience with fruits is not likely to affect acceptability of a new vegetable, and vice versa.

- **Repeated exposure of vegetables on acceptability of a new fruit**

Four studies examined the impact of exposure to one or more vegetables on acceptance of a new fruit (Barends, 2013; Birch, 1998; Fildes, 2015; Forestell, 2007). Birch et al. (1998) and Forestell (2007) tested the effect of repeated exposure to a single vegetable (peas and green beans, respectively) on intake of a new fruit (bananas and peaches, respectively). Birch (1998) found no difference in banana intake after 10 exposures to peas, while Forestell (2007) found that babies ate peaches faster after having 8 exposures to green beans. Barends et al. (2013) investigated repeated exposure to multiple vegetables (artichokes, broccoli, cauliflower or green beans, broccoli, cauliflower) on acceptance of a new fruit (apples). Fildes et al. (2015) investigated repeated exposure to five vegetables (vegetables differed among participants) on acceptance of a new fruit (peaches). Neither of these studies showed that repeated exposure to a variety of vegetables affected acceptability of a new fruit (Barends, 2013; Fildes, 2015).

- **Repeated exposure of fruit on acceptability of a new vegetable**

Three studies examined the impact of exposure to one or more fruits on acceptance of a new vegetable (Barends, 2013, Birch, 1998, Mennella, 2008). Mennella, 2008 found that 8 exposures to either pears alone or 8 total exposures to peaches, prunes, and apples increased infants feeding rate of green beans. However, 10 exposures to peas did not change intake of a new fruit (Birch, 1998) and 14 total exposures to a variety of fruits (apples, bananas, and pears; or, plums, bananas, and pears) did not impact initial acceptability of a new vegetable (Barends, 2013).

How many exposures are needed to see an effect?

For the generally healthy, 4 to 24 month, US population, the evidence suggests that eight or more exposures will lead to an increase in at least one measure of food acceptability. The studies in this body of evidence were not necessarily designed to determine the minimum number of exposures required to see an effect on acceptability.

While the range of exposures was six to 30 across the studies, most designs provided infants and toddlers with 8 to 10 exposures and found a change in acceptability at the end of this period. Some studies found changes in food intake after as little as one (Birch, 1998), three (Ahern, 2014), five (Caton, 2013), or six (Paul, 2011) exposures.

When interpreting this data, it is important to consider individual differences in response to repeated exposure. Some children may require fewer or more exposures before changes in acceptability begin to emerge. Additionally, some children may never like a particular food regardless of the number of exposures. The type/quality of food provided may also impact whether or not a child's acceptability increases with repeated exposure.

Did caregivers perceive increases in child's acceptability after repeated exposures?

Acceptability was defined *a priori* as a change in one of the following outcome measures: food intake, length and rate of feeding, facial or body responses, and perceived liking as rated by caregiver or researcher. There were two measures, however, that were the predominant means of capturing a change in acceptability: weighed food intake and, to a smaller extent, feeding rate. Perceived liking was included to as an outcome to assess whether caregivers actually notice a change in their child's acceptance of a food. Interestingly, mothers/caregivers were unlikely to rate their child's liking of a food higher after repeated exposure despite a significant increase in intake or feeding rate.

Assessment of the body of evidence

The body of evidence was deemed to be moderate in strength mostly due to inconsistencies in study methods, specifically differences in study foods and number of exposures. However, the evidence was considered to be high quality due to the within-subject design used in many of the studies and the consistency of findings. Findings were mostly based on the effect of repeated exposure to vegetables (primarily) and fruits (secondarily); few studies tested repeated exposure to other types of foods. The body of evidence is both practically and clinically important because it addresses the critical issue of introduction of foods and the development of healthy eating habits.

- **Internal Validity (Quality):** the majority of the evidence is from controlled trials using within-subject pre-/post-exposure measures of weighed food intake as the indicator of acceptability. Five of the 21 studies were considered less strongly due to concerns of quality.

- **Adequacy (Quantity):** There were 21 studies in the body of evidence by multiple different research groups in the US and Europe. Some studies had small samples sizes (adequate for within-subject design) and only a few indicated power; over 1,100 infant/child participants were in the total analytic sample across the body of evidence.

- **Consistency/Impact**: Findings are consistent in direction such that there is a positive effect of repeated exposure or no effect of repeated exposure, but there was no decline in acceptability of fruits or vegetables after repeated exposure. Given the public health importance of increasing fruit and vegetable consumption in young children, even small increases are of practical significance.

- **Generalizability**: the majority of evidence included infants and children within the US and other developed (European) countries aged 4 to 24 months. There was a mix of race/ethnicities and an even split of boys and girls.

- **Limitations**: Findings are limited to the effects of repeated exposure to fruits and vegetables. Variation in study foods and repeated exposure methodology (number of exposures, frequency, and duration). Some study designs lacked pre-/post-exposure measurements; between-subject measurements are not as strong.

Table 2. Summary table of the 16 studies most strongly considered in the evidence synthesis

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
Ahern, 2014	15-56 mo n=29 UK	Plain veg (celeriac, swede, or turnip)	6-8 exp; 1/d, 2-3/wk; duration NR	Plain veg (celeriac, swede, turnip)	**Intake:** Increased (before/after exp)
		Sweetened veg (celeriac, swede, or turnip)	6-8 exp; 1/d, 2-3/wk; duration NR	Plain veg (celeriac, swede, turnip)	**Intake:** Increased (before/after exp)
Barends, 2013	5.4 mo n=99 The Netherlands	Apple, banana, pears	14 total exp (7 apple, 4 banana, 3 pears); 1/d; 14d	Apple	**Intake:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Plums	**Intake:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green bean	**Intake**: No diff (betw groups; compared to initial exposure of green beans in veg groups)
		Plums, bananas, pears	14 total exp (7 plums, 4 banana, 3 pears); 1/d; 14d	Plums	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp)
				Apple	**Intake:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green bean	**Intake:** No diff (betw groups; compared to initial exposure of green beans in veg groups)

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
		Artichoke, broccoli, cauliflower	14 total exp (7 artichoke, 4 broc, 3 caul); 1/d; 14d	Artichoke	**Intake:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green beans	**Intake:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Apple	**Intake:** No diff (betw groups; compared to initial exposure of apples in fruit groups)
		Green beans, broccoli, cauliflower	14 total exp (7 green beans, 4 broc, 3 caul); 1/d; 14d	Green beans	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp)
				Artichoke	**Intake:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Apple	**Intake:** No diff (betw groups; compared to initial exposure of apples in fruit groups)
Birch, 1998	24 wk n=39 US	Bananas (manufactured)	10 exp; 1/d; 10 d	Banana (manufactured, same and diff brand)	**Intake:** Increased (before/after exp)
				Homemade banana	**Intake:** No diff (post-exp vs target pre-exp)
				Pears, peaches	**Intake:** Increased (before/after exp)
				Peas	**Intake:** No change (before/after exp)
		Peas (manufactured)	10 exp; 1/d; 10 d	Peas (manufactured, same and diff brand)	**Intake:** Increased (before/after exp)
				Homemade peas	**Intake:** No diff (post-exp vs target pre-exp)
				Carrots, corn	**Intake:** Increased (before/after exp)
				Beef, bananas, other fruit	**Intake:** No change (before/after exp)

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
Brown, 1980	4 mo n=40 US	Intervention group: Unsweetened foods (pears, applesauce, peaches, water-packed fruits, unsweetened juice)	NR (3-mo period)	Applesauce, pears, peaches (unsweetened & 'normal sweetness' commercially available)	**Intake:** No diff betw swt & unswt foods (after exp, within group); Overall intake of swt & unswt foods: IG>CG (betw groups) **Parent-rated liking**: No diff betw swt & unswt foods (within and betw groups)
		Control group: Normally-sweetened foods	NR (3-mo period)		
Caton, 2013	23.6 mo n= 72 UK	Plain artichoke	10 exp; 1/d; 10d	Plain artichoke	**Intake:** Increased (before/after exp)
				Carrot	**Intake:** Increased (before/after exp)
		Artichoke + sucrose	10 exp; 1/d; 10d	Plain artichoke	**Intake:** Increased (before/after exp)
				Carrot	**Intake:** Increased (before/after exp)
		Artichoke + sunflower oil	10 exp; 1/d; 10d	Plain artichoke	**Intake:** Increased (before/after exp)
				Carrot	**Intake:** Increased (before/after exp)
Coulthard, 2014	5.2 mo n= 60 UK	Carrots	9 exp; 1/d; 9d	Peas	**Intake:** Interaction (betw grp: variety & older than 5.5mo > single & younger than 5.5mo)
		Parsnips, zucchini, sweet potatoes	9 total exp (3/veg); 1/d; 9d	Peas	**Intake:** Interaction (betw grp: variety & older than 5.5mo > single & younger than 5.5mo)
Fildes, 2015	5.2 mo n= 139 UK, Portugal, Greece	Intervention group (IG): guidance to introduce 5 vegetables (differed among participants; NR)	15 total exp; 1/d; 15 d	Artichoke (both groups)	**Intake:** No diff (betw groups) **Parent-rated liking:** No diff (betw groups) **Researcher-rated liking:** IG > CG (betw groups); Researchers not blinded
				Peaches (both groups)	**Intake:** No diff (betw groups) **Parent-rated liking:** No diff (betw groups) **Researcher-rated liking:** No diff (betw groups); Researchers not blinded
		Control group (CG): usual care guidance	N/A		

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
Forestell, 2007	5.8 mo n=34 US	Green beans **(alone)**	8 exp; 1/d; 8 d	Green beans	**Intake:** Increased (before/after exp) **Rate of feed:** Increased (before/after exp) **Facial/body response:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Peaches	**Intake:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Facial/body response:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Green beans **(then peaches**)	8 exp; 1/d; 8 d	Green beans	**Intake:** Increased (before/after exp) **Rate of feed:** Increased (before/after exp) **Facial/body response:** Change (before/after exp); fewer brow movements, squints, and upper-lip raises **Parent-rated liking:** No change (before/after exp)
				Peaches	**Intake:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Facial/body response:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
Gerrish, 2001	4.6 mo n=48 US	Carrot	9 exp; 1/d; 9 d	Carrot	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Chicken	**Intake:** Less than variety group; No diff compared to potato group (betw group) **Duration of feed:** No diff (betw groups) **Rate of feed:** No diff (betw groups) **Parent-rated liking:** No diff (betw groups)
		Potatoes	9 exp; 1/d; 9 d	Carrots	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
				Chicken	**Intake:** No diff (betw groups) **Duration of feed:** No diff (betw groups) **Rate of feed:** No diff (betw groups) **Parent-rated liking:** No diff (betw groups)
		Pea, potato, squash	9 total (3/veg); 1/d; 9d	Carrots	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp)
				Chicken	**Intake:** Increased compared to infants fed carrots; No change compared to infants fed potatoes (betw groups) **Duration of feed:** No diff (betw groups) **Rate of feed:** No diff (betw groups) **Parent-rated liking:** No diff (betw groups)
Hetherington, 2015	4.8 mo n= 36 UK	Carrots, green beans, broccoli, spinach, parsnip (Intervention: pre-exp to veg flavor via milk, cereal; Control: no pre-exposure to veg flavors via milk, cereal)	11 exp total (3 exp: carrots, green beans; 2 exp: spinach, broccoli; 1 exp: parsnip); 1/d; 11 d	Carrot, green beans	**Intake:** Increased (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp) **Researcher-rated liking:** No change (before/after exp)
Maier, 2007	7.0 mo n= 49 Germany	Initially disliked veg & liked veg (parents' choice)	16 total exp (8 /veg); 1/d, alternating each day; 16 d	Disliked veg	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp)
				Liked veg	**Intake:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
Mennella, 2008	6.5±0.3 mo n=39 (fruit)	Pears	8 exp; 1/d; 8 d	Pear	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
	n= 35 (veg) US			Green beans	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Peach, prune, apple	8 total exp (3 exp: peach, prune; 2 exp: apple); 1/d; 8 d	Pear	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green beans	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Green beans	8 exp; 1/d; 8 d	Green bean	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Spinach, carrots	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Squash, spinach, peas, carrots	8 exp total (2/veg); 1/d; 8d	Spinach, carrots	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green beans	**Intake:** No change (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Squash, spinach, peas, carrots	16 veg exp (6 exp: squash, peas; 2 exp: carrots, spinach); 2/meal, 1 meal/d; 8 d	Spinach, carrots	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
				Green beans	**Intake:** Increased (before/after exp) **Duration of feed:** No change (before/after exp) **Rate of feed:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
Paul, 2011	>4 mo n=52 US	Green beans	6 exp; 1/d; 6 d	Green beans	**Intake:** Increased (before/after exp)
		Peas	6 exp; 1/d; 6 d	Peas	**Intake:** Increased (before/after exp)
		Squash	6 exp; 1/d; 6 d	Squash	**Intake:** Increased (before/after exp)
		Carrots	6 exp; 1/d; 6 d	Carrots	**Intake:** No change (before/after exp)
Remy, 2013	6.4 mo n= 95 France	Plain artichoke	10 exp; 1/d; 2-3/wk	Plain artichoke	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp)
		Sweetened artichoke	10 exp; 1/d, 2-3/wk; duration NR	Plain artichoke	**Intake:** Increased (before/after exp) **Parent-rated liking:** No change (before/after exp)
		Energy-dense artichoke	10 exp; 1/d, 2-3/wk; duration NR	Plain artichoke	**Intake:** No change (before/after exp) **Parent-rated liking:** No change (before/after exp)
Sullivan, 1994	22 wks n= 36 US	Salted veg (green beans or peas)	10 exp; 1/d; 10-d	Salted exposed veg (exposed version)	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp) **Researcher-rated liking:** Increased (before/after exp)
				Unsalted exposed veg (unexposed version)	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp) **Researcher-rated liking:** Increased (before/after exp)
				Chicken	**Intake:** No change (before/after exp)
		Unsalted veg (green beans or peas)	10 exp; 1/d; 10 d	Unsalted exposed veg (exposed version)	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp) **Researcher-rated liking:** Increased (before/after exp)
				Salted exposed veg (unexposed version)	**Intake:** Increased (before/after exp) **Parent-rated liking:** Increased (before/after exp) **Researcher-rated liking:** Increased (before/after exp)
				Chicken	**Intake:** No change (before/after exp)
Lundy, 1998	6.3 mo n= 12 US	Apples (pureed, lumpy, diced)	30 exp (10 pureed, 10 lumpy, 10	20d: Apples (pureed, lumpy)	**Facial/body response:** Change (betw groups); more positive head & body movements for pureed texture compared to Group 3

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures ; Frequency ; Duration	Test food(s)	Outcomes
		(Group 1)	diced); 1/d; 30 d	30d: Apples (pureed, lumpy, diced)	**Facial/body response:** Change (betw groups); more positive vocalization for diced compared to Group 3
		Apples (lumpy, diced) (Group 2)	30 exp (20 lumpy, 10 diced); 1/d; 30 d	20d: Apples (pureed, lumpy)	**Facial/body response:** Change (betw groups); more positive head & body movements for pureed texture compared to Group 3
				30d: Apples (pureed, lumpy, diced)	**Facial/body response:** Change (betw groups); more positive vocalization for diced compared to Group 3
		Apples (pureed, diced) (Group 3)	30 exp (20 pureed, 10 diced); 1/d; 30 d	20d: Apples (pureed, lumpy)	**Facial/body response:** Change (betw groups); fewer positive head & body movements, more negative body movements compared to Groups 1 & 2
				30d: Apples (pureed, lumpy, diced)	**Facial/body response:** Change (betw groups); fewer positive vocalization for diced compared to Groups 1 & 2

Table 3. Studies considered less heavily during synthesis.

The following 5 studies met the inclusion criteria for this question; however, upon closer assessment certain factors from each study deemed it to be weighed less heavily by the expert group when synthesizing the evidence.

Article	Age (mean) n Country	Groups/ Exposure food(s)	No. of exposures; Frequency; Duration	Test food(s)	Rationale for low weighting
Harris, 1987	n=10 at 6 mo; n=28 at 12 mo UK	Dietary sodium intake and number of high sodium foods consumed week prior to testing	NA	6 mo: Salted and unsalted baby cereal; 12 mo: salted and unsalted mashed potatoes	**DIRECTNESS**: focus on nutrient not food

Hausner, 2010	6.7 mo n=48 Denmark	**Breast-fed, non-exposed (BF-Non)**: Part 1: lactating mothers consumed plain hummus (lab-made); Part 2: infants in each group fed the same caraway-flavored puree (lab-made), n=20 **BF, exposed (BF-E)**: Part 1: lactating mothers consumed caraway-flavored hummus (lab-made); Part 2: infants in each group fed the same caraway-flavored puree (lab-made), n=20 **Formula-fed (FF):** Part 1: mothers consumed caraway-flavored food (lab-made); Part 2: infants in each group offered the same caraway-flavored puree (lab-made), n=8	Part 2: 10 exp, 1/d, every other day, 19 d	caraway-flavored potato puree plain potato puree	**DIRECTNESS**: primary objective to examine the effect of flavor transfer via mothers milk on acceptability and how acceptance evolves with RE to similarly flavored foods
Maier, 2008	5.2 mo n=143 France, Germany	**Group 1: (No changes)**: Phase A: carrot puree for 9 days, Phase B & C: same for all infants, n=49 (Dijon n=24, Aalen n=25) **Group 2: (Low variety group; 4 changes)**: Phase A: artichoke puree, green bean puree, pumpkin puree, each for 3 consecutive days over 9 days, Phase B & C: same for all infants, n=45 (Dijon n=21, Aalen n=24) **Group 3 (High variety group; 10 changes):** Phase A: artichoke puree, green bean puree, pumpkin puree, rotating daily over 9 days, Phase B & C: same for all infants, n= 49 (Dijon n=24, Aalen n= 25)	Phase A: 8 exp; 1/d; 8 d Phase B: 10 exp; 1/d; 10 d Phase C: 10 exp; 1/d; 10 d	Several different “new” foods	**DIRECTNESS:** lack of data; reported data does not answer the SR question
Stein, 2012	2 mo and 6 mo n=61 US	Mothers reported data on infant’s salt intake and consumption of baby foods and table foods, specifically table foods including starch, fruit, vegetable, meat, dairy products, or eggs	NA	Intake of sodium solution; Maternal report of dietary intake; Child ranked preference at 36-48 mo	**DIRECTNESS:** focus on nutrient not food

Traore, 2005	6.3 mo n=30 Burkino Faso	**Group 1**: 10d of low energy-dense (ED) gruel (low ED - similar energy content as gruel typically prepared by mothers), 2 exposures/d, then 10d of high ED gruel, 2 exposures/d, n=15 **Group 2**: 10d of high ED gruel, 2 exposures/d, then 10d of low ED gruel, 2 exposures/d, n=15	20 exp of each ED gruel; 2/d; 10d	Low ED gruel; High ED gruel	**DIRECTNESS:** comparing intake of different energy dense gruels over time, focus on habituation of ED rather than focus on effect of RE **GENERALIZABILTY:** gruel not typically consumed in US

Research recommendations

This body of evidence had certain limitations that yield areas for further research, including:

- Characterize how repeated exposure to various textures (pureed vs diced/lumpy) affects food acceptance: most of this evidence is in younger infants using pureed foods; within-subject, cross-over design studies are needed to test textural differences (which can impact other sensory properties such as appearance and flavor) on food acceptance.

- Examine the relationship between repeated exposure to foods other than fruits and vegetables, specifically meats, on food acceptability: emerging research recommends pureed meats as a first food and therefore it is important to understand whether introducing meat first impacts acceptance of other food groups.

- Examine different modes of food preparation, with specific focus on homemade foods: this body of evidence was largely based on manufactured baby food purees. Research is needed to determine how to best facilitate transition to healthier tables foods. Of the limited evidence available, it appears the babies do not generalize from manufactured foods to homemade foods; thus research is needed to determine if there is difference in transition to healthier table foods after early exposure to homemade purees compared to commercial baby food purees.

- Conduct research on the mechanisms of flavor generalization: research is needed to determine what aspects of diverse flavor experiences impact acceptance of a novel flavor.

- Determine how mother-child interactions during feeding facilitate the acceptability of healthy foods.

- Research the impact of early feeding of added sugars and salt on food acceptability and dietary intake.

- Conduct a similar systematic review (repeated exposure to foods and acceptability) among toddlers older than 24 months, in order to summarize the available evidence base for this age group.

- Examine the pathway of flavor exposure from maternal diet during pregnancy and while breastfeeding on infant and child's food acceptability.

- Conduct research examining genetic variation in flavor detection in infants and young children.

Included articles

1. Ahern SM,Caton SJ,Blundell P,Hetherington MM. The root of the problem: increasing root vegetable intake in preschool children by repeated exposure and flavour flavour learning. Appetite. 2014;80(#number#):154-60. PMID:24814221. http://www.ncbi.nlm.nih.gov/pubmed/24814221
2. Barends C,de Vries J,Mojet J,de Graaf C. Effects of repeated exposure to either vegetables or fruits on infant's vegetable and fruit acceptance at the beginning of weaning. Food quality and preference. 2013;29(2):157-165. PMID:#accession number#. #URL#
3. Birch LL,Gunder L,Grimm-Thomas K,Laing DG. Infants' consumption of a new food enhances acceptance of similar foods. Appetite. 1998;30(3):283-95. PMID:9632459. http://www.ncbi.nlm.nih.gov/pubmed/9632459
4. Brown MS,Grunfeld CC. Taste preferences of infants for sweetened or unsweetened foods. Res Nurs Health. 1980;3(1):11-7. PMID:6901189. http://www.ncbi.nlm.nih.gov/pubmed/6901189
5. Caton SJ,Ahern SM,Remy E,Nicklaus S,Blundell P,Hetherington MM. Repetition counts: repeated exposure increases intake of a novel vegetable in UK pre-school children compared to flavour-flavour and flavour-nutrient learning. Br J Nutr. 2013;109(11):2089-97. PMID:23110783. http://www.ncbi.nlm.nih.gov/pubmed/23110783
6. Coulthard H,Harris G,Fogel A. Exposure to vegetable variety in infants weaned at different ages. Appetite. 2014;78(#number#):89-94. PMID:24685457. http://www.ncbi.nlm.nih.gov/pubmed/24685457
7. Fildes A,Lopes C,Moreira P,Moschonis G,Oliveira A,Mavrogianni C,Manios Y,Beeken R,Wardle J,Cooke L. An exploratory trial of parental advice for increasing vegetable acceptance in infancy. Br J Nutr. 2015;114(2):328-36. PMID:26063588. http://www.ncbi.nlm.nih.gov/pubmed/26063588
8. Forestell CA,Mennella JA. Early determinants of fruit and vegetable acceptance. Pediatrics. 2007;120(6):1247-54. PMID:18055673. http://www.ncbi.nlm.nih.gov/pubmed/18055673
9. Gerrish CJ,Mennella JA. Flavor variety enhances food acceptance in formula-fed infants. Am J Clin Nutr. 2001;73(6):1080-5. PMID:11382663. http://www.ncbi.nlm.nih.gov/pubmed/11382663
10. Harris, Gillian,Booth, David A.. Infants' preference for salt in food: Its dependence upon recent dietary experience. Journal of Reproductive and Infant Psychology. 1987;5(#number#):97-104. PMID:1989-25469-001. http://proxy.wexler.hunter.cuny.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=1989-25469-001&site=ehost-live
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2010;29(1):141-8. PMID:19962799. http://www.ncbi.nlm.nih.gov/pubmed/19962799
12. Hetherington MM,Schwartz C,Madrelle J,Croden F,Nekitsing C,Vereijken CM,Weenen H. A step-by-step introduction to vegetables at the beginning of complementary feeding. The effects of early and repeated exposure. Appetite. 2015;84(#number#):280-90. PMID:25453593. http://www.ncbi.nlm.nih.gov/pubmed/25453593
13. Lundy, Brenda,Field, Tiffany,Carraway, Kirsten,Hart, Sybil,Malphurs, Julie,Rosenstein, Marla,Pelaez-Nogueras, Martha,Coletta, Frances,Ott, Dana,Hernandez-Reif, Maria. Food texture preferences in infants versus toddlers. Early Child Development and Care. 1998;146(#number#):69-85. PMID:1999-08069-007.
14. Maier A,Chabanet C,Schaal B,Issanchou S,Leathwood P. Effects of repeated exposure on acceptance of initially disliked vegetables in 7-month old infants. Food Quality and Preference. 2007;18(8):1023-1032. PMID:#accession number#. http://www.sciencedirect.com/science/article/pii/S0950329307000523
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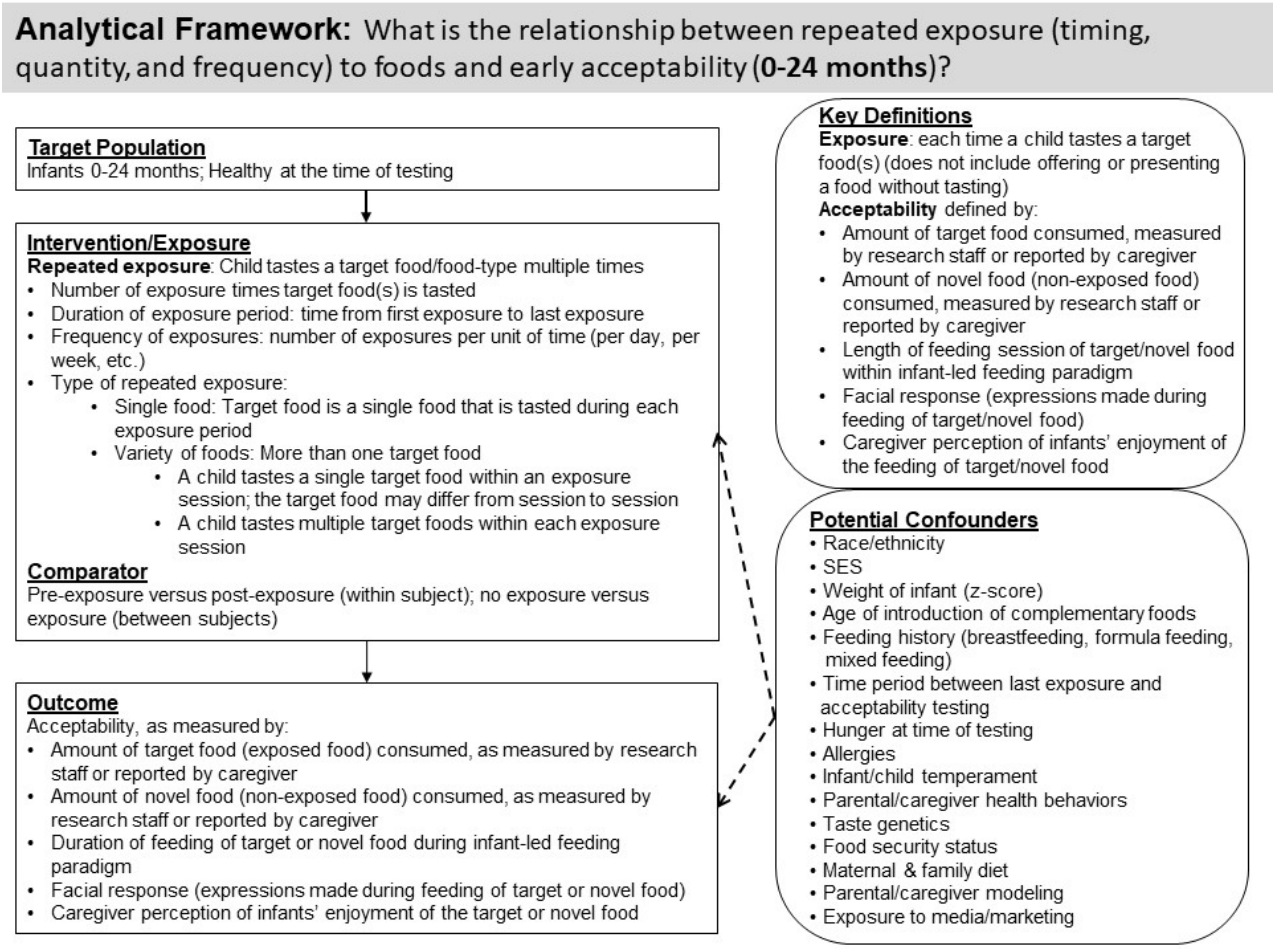
20. Sullivan SA,Birch LL. Infant dietary experience and acceptance of solid foods. Pediatrics. 1994;93(2):271-7. PMID:8121740. http://www.ncbi.nlm.nih.gov/pubmed/8121740
21. Traore T,Vieu MC,Alfred TS,Serge T. Effects of the duration of the habituation period on energy intakes from low and high energy density gruels by Burkinabe infants living in free conditions. Appetite. 2005;45(3):279-86. PMID:16126306. http://www.ncbi.nlm.nih.gov/pubmed/16126306

ANALYTIC FRAMEWORK

The analytic framework (Figure 1) illustrates the overall scope of the systematic review, including the population, the interventions and/or exposures, comparators, and outcomes of interest. It also includes definitions of key terms and identifies key confounders considered in the systematic review. This is the analytic framework for the systematic review conducted to examine the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance.

Figure 1: Analytic framework



SEARCH PLAN AND RESULTS

Inclusion and exclusion criteria

The inclusion and exclusion criteria are a set of characteristics to determine which studies will be included or excluded in the systematic review. This table provides the inclusion and exclusion criteria for the systematic review question(s): What is the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance?

Table 4. Inclusion and exclusion criteria

Category	Inclusion Criteria	Exclusion Criteria
Study Design	• Randomized controlled trials[iv] • Non-randomized controlled trials[v] • Prospective cohort studies • Retrospective cohort studies	• Cross-sectional studies • Before and after study[vi] • Uncontrolled studies • Case-control studies • Editorial, book chapters • Narrative reviews • Ecological studies (cross cultural studies; matching trends from different countries) • *Systematic reviews*[vii] • *Meta-analyses*[4]
Intervention/Exposure	**Include studies in which the intervention or exposure is:** **Repeated exposure[5] to a food**: • Length of Exposure Period • Frequency of Exposure, Number of exposures • Type of Repeated Exposure	• Exclude if doesn't meet inclusion criteria

[iv] Randomized Controlled trials include: factorial designs, cross-over designs

[v] Non-randomized controlled trials include quasi-experimental design (e.g. breastfed vs formula fed)

[vi] Before and after study involves collecting data before and after an exposure with two different populations (i.e., 2 cross-sectional data sets are compared)

[vii] *Will not be using existing SRs/MAs to address B24 SR questions*

[5] An exposure is defined as a single taste of a food; it does not include offering or presenting a food without tasting. "Repeated exposure" refers to a child tasting a target food or foods multiple times, typically once per day over several days

Category	Inclusion Criteria	Exclusion Criteria
Comparator	• Pre-exposure versus post-exposure (within subject); • No exposure versus exposure (between subjects)	• Exclude if doesn't meet inclusion criteria
Date Range	• 1980[6] to present	• Before 1980
Study Setting/Country	• Studies conducted in Very High, High, Middle, or Low Human Development Countries[7]	• n/a
Study Duration	• No criterion is needed for study duration	• No criterion is needed for study duration
Study Subjects	• Human subjects • Males • Females • Pregnant women • Lactating women • Non-lactating postpartum women	• Hospitalized patients, not including birth and immediate post-partum hospitalization of healthy mothers and babies • 100% pre-mature study population
Age of Study Subjects	• Infants (0-12 months) • Toddlers (12-24 months)[8]	• Child (2-5 years) • Child (6-12 years) • Adolescents (13-18 years) • Adults (19 and older) • Older adults (65 to 79 years) • Older adults (80+ years)

[6] 1980 is used across P/B-24 Project and will capture seminal research

[7] For this SR, should not have physiological differences based on culture or location

[8] Include studies with 0-24mo olds; include studies with age range exceeding 24mo if subgroup analysis was conducted on group </= 24 mo.

Category	Inclusion Criteria	Exclusion Criteria
Health Status of Study Subjects	• Studies done in generally healthy populations	• Studies that exclusively enroll subjects with a disease or with the health outcome of interest (intermediate or endpoint health outcomes) • Studies done in hospitalized or malnourished subjects • Studies exclusive to pre-term babies (gestational age <37 weeks) or babies that are small for gestational age (<2500g)
Food Acceptance	• Amount of target food (exposed food) consumed, as measured or reported by parent • Amount of novel food (non-exposed food) consumed, as measured or reported by parent • Duration of feeding of target or novel food during infant-led feeding paradigm • Facial response (expressions made during feeding of target or novel food) • Mother's perception of infants' enjoyment of target or novel food	• Exclude if doesn't meet inclusion criteria

Search terms and electronic databases used

Pubmed

- Date(s) Searched: 10/30/15; 3/10/2016; 6/29/2017
- Date range: 1980-6/29/2017
- Search Terms:

food accepta* OR food preference* OR food enjoy* OR food perception*[tiab] OR dietary preference*[tiab] OR dietary habit* OR food habits[mh] OR food choice*[tiab] OR eating preference*[tiab] OR eating habit* OR eating choice* OR dietary choice* OR food discriminat* OR beverage accepta* OR beverage preference* OR beverage choice* OR taste discrimination* OR taste preference* OR gustatory discrimination* OR gustatory preference* OR taste accepta* OR gustatory habit* OR taste habit* OR gustatory choice* OR gustatory accepta* OR food aversion* OR eating aversion* OR taste aversion* OR gustatory aversion* OR beverage aversion* OR flavor learning* OR flavor preference* OR flavour learning* OR flavour preference*

OR "Taste"[Mesh] OR gustation*[tiab] OR taste sense*[tiab] OR "Taste Threshold"[Mesh] OR "Taste Perception"[Mesh] OR distaste OR hedoni* OR palatable OR unpalatable

((food OR dietary OR diet OR eating OR beverage* OR taste OR gustatory OR flavor* OR flavor*) AND (accepta* OR preference* OR enjoy* OR choice* OR habit* OR discriminat* OR aversion* OR avert* OR neophobi* OR select*)) OR ((flavor OR flavor) AND learning*)

OR

("Facial Expression"[Mesh] OR ((facial[tiab] OR face[tiab]) AND (expression* OR response* OR react*)) OR reject* OR dislike* OR disliking OR neophobi*)

AND
(food*[tiab] OR "Food and Beverages"[Mesh] OR beverage*[tiab] OR Cereal*[tiab] OR bread*[tiab] OR whole grain*[tiab] OR juice*[tiab] OR milk[tiab] OR "Milk"[Mesh] OR dairy[tiab] OR "Dairy Products"[Mesh] OR meat[tiab] OR cheese[tiab] OR yogurt[tiab] OR yoghurt*[tiab] OR fruit*[tiab] OR "Fruit"[Mesh] OR vegetable*[tiab] OR "Vegetables"[Mesh] OR egg*[tiab] OR "Eggs"[Mesh] OR nut[tiab] OR nuts[tiab] OR peas[tiab] OR beans[tiab] OR legume*[tiab] OR snack*[tiab] OR meals OR meal)

OR

("Facial Expression"[Mesh] OR ((facial[tiab] OR face[tiab]) AND (expression* OR response* OR react*)) OR reject* OR dislike* OR disliking OR neophobi*) AND (food OR dietary OR diet OR eating OR beverage* OR taste OR gustatory OR flavor* OR flavor*)

OR

(accepta* OR preference* OR enjoy* OR choice* OR habit* OR discrimination* OR aversion* OR avert* OR neophobi*)

AND
(food*[tiab] OR "Food and Beverages"[Mesh] OR beverage*[tiab] OR Cereal*[tiab] OR bread*[tiab] OR whole grain*[tiab] OR juice*[tiab] OR milk[tiab] OR "Milk"[Mesh]

OR dairy[tiab] OR "Dairy Products"[Mesh] OR meat[tiab] OR cheese[tiab] OR yogurt[tiab] OR yoghurt*[tiab] OR fruit*[tiab] OR "Fruit"[Mesh] OR vegetable*[tiab] OR "Vegetables"[Mesh] OR egg*[tiab] OR "Eggs"[Mesh] OR nut[tiab] OR nuts[tiab] OR peas[tiab] OR beans[tiab] OR legume*[tiab] OR rice OR soup OR snack*[tiab] OR meals OR meal)

AND
infant* OR baby OR babies OR toddler* OR newborn*[tiab] OR "Child, Preschool"[Mesh] OR preschool*[tiab] OR pre-school*[tiab] OR “early childhood”[tiab] OR early year*[tiab] OR pre-k[tiab] OR pre-primary[tiab] OR under five*[ti] OR young child*[ti] OR “head start”[tiab] OR prekindergarten[tiab] OR pre-kindergarten[tiab] OR weanling*

("Study Characteristics" [Publication Type] OR “clinical trial”[ptyp] OR "Epidemiologic Studies"[Mesh] OR "Support of Research"[ptyp] OR cohort[tiab] OR observational[tiab] OR retrospective[tiab] OR longitudinal[tiab]) NOT (editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR letter[ptyp] OR review[ptyp] OR systematic[sb])

Update 3: 3/7/2016
NOT (editorial[ptyp] OR comment[ptyp] OR news[ptyp] OR letter[ptyp] OR review[ptyp] OR systematic[sb])

Embase

- Date(s) Searched: 11/2/2015; 6/29/2017
- Date range: 1980-6/29/2017
- Search Terms:

((food* OR diet* OR eating OR taste* OR gustatory OR flavo*r*) NEAR/7 (accepta* OR prefer* OR choice* OR habit* OR discrimination* OR select* OR liking OR like* OR enjoy* OR aver* OR reject* OR dislik* OR neophobi* OR react*)):ti,ab OR ('taste discrimination'/exp OR 'food preference'/exp OR 'taste aversion'/exp OR 'taste preference'/exp OR 'taste acuity'/exp OR palatab* OR unpalatab* OR 'palatability'/exp OR tasty OR tastiness)
OR
((food/exp OR 'baby food'/exp OR 'cereal'/exp OR 'dairy product'/exp OR 'egg'/exp OR 'fruit'/exp OR 'meat'/exp OR 'sea food'/exp OR 'milk'/exp OR fish/exp OR 'poultry'/exp OR 'beverage'/exp OR 'vegetable'/exp OR nut/exp OR pea/exp OR meal/exp) AND (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion OR reject* OR dislik* OR neophobic* OR react* OR distaste* OR hedoni* OR taste* OR tasty OR tastiness))

OR
((‘whole grain’ OR ‘whole grains’ OR dairy OR egg OR eggs OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR poultry OR beverage* OR vegetable

OR vegetable* OR pea OR peas OR nut OR nuts OR cereal OR bread* OR yog*urt* OR cheese* OR juice* OR rice OR soup OR snack* OR meal* OR beans OR legume*) NEAR/7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR avers* OR reject* OR dislik* OR neophobic* OR react* OR distaste* OR hedoni* OR taste* OR tasty OR tastiness)):ti,ab

OR
((facial OR face) NEAR/7 (expression* OR respons* OR react*))
AND ('whole grain' OR 'whole grains' OR dairy OR egg OR eggs OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR poultry OR beverage* OR vegetables* OR pea OR peas OR nut OR nuts OR cereal OR bread* OR yog*urt* OR cheese* OR juice* OR rice OR soup OR snack* OR meal OR meals OR beans OR legume*OR food/exp OR 'baby food'/exp OR 'cereal'/exp OR 'dairy product'/exp OR 'egg'/exp OR 'fruit'/exp OR 'meat'/exp OR 'sea food'/exp OR 'milk'/exp OR fish/exp OR 'poultry'/exp OR 'beverage'/exp OR 'vegetable'/exp OR nut/exp OR pea/exp OR meal/exp)

Embase only

OR ((nutrient* NEAR/3 dense*) OR (nutrient* NEAR/3 rich*)) AND (food* OR beverage*):ti,ab ?

AND

(infant*:ti,ab OR infant/exp) OR (baby OR babies OR toddler* OR newborn* OR nurser*):ti,ab OR 'newborn'/exp OR 'newborn care'/exp OR preschool*:ti,ab OR "early years":ti,ab OR pre-school:ti,ab OR 'preschool child'/exp OR 'infancy'/exp OR "early childhood":ti,ab OR pre-k:ti,ab OR 'nursery'/exp OR 'nursery school'/exp OR prekindergarten:ti,ab OR pre-kindergarten:ti,ab OR weanling:ti,ab (postnatal, perinatal?)

OR ([newborn]/lim OR [infant]/lim OR [child]/lim OR [preschool]/lim)

AND ([in process]/lim OR [article]/lim OR [article in press]/lim)
NOT [medline]/lim

'clinical article'/exp OR 'clinical trial':ti,ab OR 'controlled study':ti,ab OR 'clinical study':ti,ab OR 'randomized controlled':ti,ab OR 'clinical study':ti,ab OR 'cohort analysis'/exp OR cohort:ti,ab OR 'types of study'/exp

Cochrane

- Date(s) Searched: 11/4/15; updated 7/3/17
- Date range: 1980-7/3/2017
- Search Terms:

(food* OR beverage* OR diet* OR eating OR taste* OR tasty OR tastiness OR

gustatory OR flavo*r* OR distaste*) NEAR/3 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR avers* OR facial OR face OR reject* OR dislik* OR neophobi* OR hedoni*)

((Face OR facial) NEAR/4 (react* OR respons* OR expressi*)) need?

((‘whole grain’ OR ‘whole grains’ OR dairy OR egg OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR poultry OR vegetables* OR pea OR nut OR cereal OR beverage* OR bread* OR seafood OR yog*urt* OR cheese* OR juice* OR beans OR legume* OR snack* OR meal*) NEAR/7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion* OR facial OR face OR reject* OR dislik* OR neophobic* OR hedoni* OR distaste* OR taste* OR tasty OR tastiness)):ti,ab

(Palatab* OR unpalatab*):ti,ab

AND
infant* OR baby OR babies OR toddler* OR newborn* OR nurser* OR preschool* OR pre-school OR “early childhood” OR “early years” OR pre-k OR prekindergarten OR pre-kindergarten OR weanling*

NOT pubmed OR Embase

PsychNET

- Date(s) searched: 2/4/2016; updated 7/3/17
- Date range: 1980-7/3/2017
- Search Terms:

(food* OR beverage* OR diet* OR eating OR taste* OR tasty OR tastiness OR gustatory OR flavo*) NEAR/3 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR avers* OR facial OR face OR reject* OR dislik* OR neophobi* OR hedoni*) 520

((Face OR facial) NEAR/4 (react* OR respons* OR expressi*)):ti,ab need?

((‘whole grain’ OR ‘whole grains’ OR dairy OR egg* OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR vegetables* OR pea OR nut OR cereal OR beverage* OR bread* OR seafood OR yogurt* OR yoghurt* OR cheese* OR juice* OR beans OR legume* OR snack* OR meal*) NEAR/3 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion* OR facial OR face OR reject* OR dislik* OR neophobic* OR hedoni* OR distaste* OR taste* OR tasty OR tastiness)) 9 none selected

(Palatab* OR unpalatab*):ti,ab

AND

infant* OR baby OR babies OR toddler* OR newborn* OR nurser* OR preschool* OR pre-school OR "early childhood" OR "early years" OR pre-k OR prekindergarten OR pre-kindergarten OR weanling*

limits: peer review; 0-23 months

Index Terms: {Food Preferences} OR {Food Refusal} OR {Taste Buds} OR {Taste Perception} AND Year: 1980 To 9999 AND Peer-Reviewed Journals only

ERIC (Proquest)

- Date searched: 2/9/16
- Search terms:

SU.EXACT("Food") AND (SU.EXACT("Toddlers") OR SU.EXACT("Infants")) AND (SU.EXACT("Preferences") OR SU.EXACT("Motor Reactions") OR SU.EXACT("Emotional Response") OR SU.EXACT("Patterned Responses") OR SU.EXACT("Behavior") OR SU.EXACT("Responses")) 5 results 2/9/16; imported 1

(food* OR beverage* OR diet* OR eating OR taste* OR tasty OR tastiness OR gustatory OR flavo*) NEAR/3 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR avers* OR facial OR face OR reject* OR dislik* OR neophobi* OR hedoni*)

((whole PRE/1 grain*) OR dairy OR egg* OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR vegetables* OR pea* OR nut OR cereal OR beverage* OR bread* OR seafood OR yogurt* OR cheese* OR juice* OR bean* OR legume* OR snack* OR meal*) NEAR/3 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion* OR facial OR face OR reject* OR dislik* OR neophobic* OR hedoni* OR distaste* OR taste* OR tasty OR tastiness))

(Palatab* OR unpalatab*);

(Face OR facial) NEAR/4 (react* OR respons* OR expressi*));

infant* OR baby OR babies OR toddler* OR newborn* OR nurser* OR preschool* OR pre-school OR "early childhood" OR "early years" OR pre-k OR prekindergarten OR pre-kindergarten OR weanling*

limit to year/peer review;

CINAHL/PsychInfo/ERIC/SocINDEX with Full Text/PsycARTICLES/ Social Sciences Full Text

- Date(s) Searched: 11/4/15 (CINAHL) ; 1/16 (ERIC, PsychInfo, Social Sciences Full Text (H.W. Wilson), SocINDEX with Full Text)

- Search Terms:

((MH "Food and Beverages+") OR (MH "Food") OR (MH "Diet") OR (MH "Eating") OR (MH "Eating Behavior") OR (MH "Meals+") OR (MH "Taste") OR (MH "Taste Buds") OR (MH "Cereals") OR (MH "Dairy Products") OR (MH "Yogurt") OR (MH "Cheese") OR (MH "Milk") OR (MH "Eggs") OR (MH "Fruit") OR (MH "Fruit Juices") OR (MH "Meat") OR (MH "Seafood") OR (MH "Fish") OR (MH "Poultry") OR (MH "Vegetables") OR (MH "Nuts") OR (MH "Legumes") OR (MH "Bread") OR (MH "Facial Expression")) AND (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion* OR dislike* OR disliking OR hedoni* OR distaste* OR tasty OR tastiness)

OR (MH "Food Preferences") OR (MH "Food Habits") OR unpalatab* OR palatab*
Limiters - English Language; Peer Reviewed; Exclude MEDLINE records; Age Groups: All Infant 14

Limit to “all infant” OR
(MH "Infant") OR (MH "Infant, Newborn") OR (MH "Infant Behavior") OR (MH "Infant Feeding") OR (MH "Infant Feeding Schedules") OR (MH "Child, Preschool")

PsycARTICLES, Social Sciences Full Text (H.W. Wilson), SocINDEX with Full Text

- Search date: 1/28/16
- Search terms:

((food* OR beverage* OR diet* OR eating OR taste* OR gustatory OR flavo#r*) N7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR aversion* OR avert* OR face OR facial OR reject* OR dislik* OR neophobi* OR react* OR respons* OR expressi* OR hedoni* OR distaste* OR tasty OR tastiness)) 51 using N3 (240 (NOT whole grain..search string) and selected…; 114 with journal limits) Next time ck with PubMed journals! 24 in PsychArt, Soc Sci Full, SocIndex; 3 selected.

(‘whole grain’ OR ‘whole grains’ OR dairy OR egg OR eggs OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR poultry OR vegetables* OR pea OR peas OR nut OR nuts OR cereal OR beverage* OR bread* OR seafood OR yog#urt* OR cheese* OR juice* OR snack* OR meal OR meals) N7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR aversion* OR avert* OR face OR facial OR reject* OR dislik* OR neophobi* OR react* OR respons* OR expressi* OR distaste* OR taste* OR tasty OR tastiness) 15 using N3 (109 and selected 34); 6 for psych/soc databases;0 selected

Limit to selected PsychArt, Soc Sci Full, SocIndex journals
Narrow by Journal: - adolescence
Narrow by Journal: - child development
Narrow by Journal: - developmental psychology
Narrow by Journal: - family relations
Narrow by Journal: - food, culture & society

Narrow by Journal: - food, culture & society
Narrow by Journal: - health psychology
Narrow by Journal: - journal of applied psychology
Narrow by Journal: - journal of applied social psychology
Narrow by Journal: - journal of child & family studies
Narrow by Journal: - journal of comparative family studies
Narrow by Journal: - journal of family psychology
Narrow by Journal: - journal of health & social behavior
Narrow by Journal: - journal of marriage & family
Narrow by Journal: - journal of popular culture
Narrow by Journal: - social science journal

Limit to CINAHL only journals:
(accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR avert* OR aversion* OR dislike* OR disliking OR hedoni* OR distaste* OR tasty OR tastiness OR (DE "Likes & dislikes"))
AND
DE "Food" OR DE "Beverages (Nonalcoholic)" OR (DE "Diets") OR (DE "Eating Behavior") OR (DE "Mealtimes") OR DE "Food Intake" OR DE "Food Preparation" (psychInfo) 66 found.

Navigator: FSTA/BIOSIS/CAB

- Date(s) Searched: 11/4/15
- Search Terms:

((food* OR beverage* OR diet* OR eating OR taste* OR gustatory OR flavor* OR flavor*) NEAR/7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR aversion* OR avert* OR face OR facial OR reject* OR dislik* OR neophobi* OR react* OR respons* OR expressi* OR hedoni* OR distaste* OR tasty OR tastiness))

(“whole grain” OR “whole grains” OR dairy OR egg OR eggs OR meat OR poultry OR seafood OR fruit* OR milk OR fish* OR poultry OR vegetables* OR pea OR peas OR nut OR nuts OR cereal OR beverage* OR bread* OR seafood OR yogurt* OR yoghurt* OR cheese* OR juice* OR snack* OR meal OR meals) NEAR/7 (accepta* OR prefer* OR choice* OR habit* OR discriminat* OR select* OR liking OR like* OR enjoy* OR aversion* OR avert* OR face OR facial OR reject* OR dislik* OR neophobi* OR react* OR respons* OR expressi* OR distaste* OR taste* OR tasty OR tastiness)

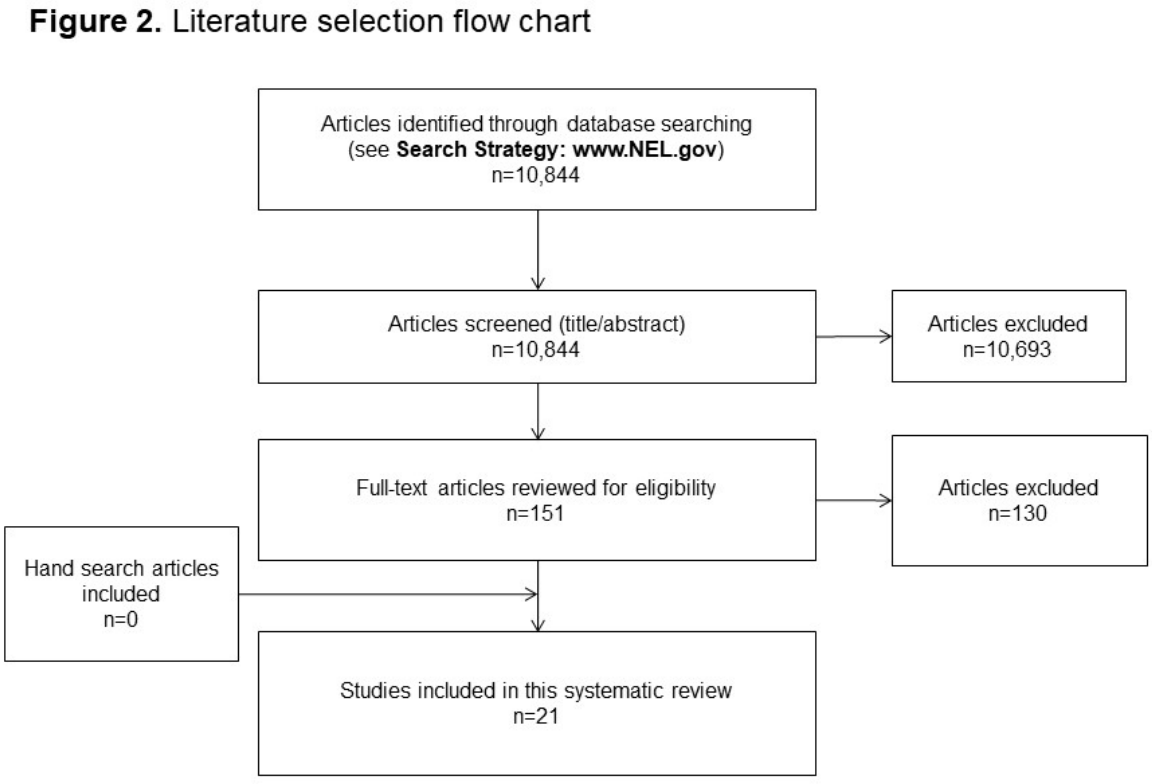
infant* OR baby OR babies OR toddler* OR newborn* OR nurser* OR preschool* OR pre-school OR “early childhood” OR “early years” OR pre-k OR prekindergarten OR pre-kindergarten OR weanling*

ScienceDirect or Web of science

- Date(s) Searched: 11/9/2015
- Search Terms:

((food OR beverage OR diet OR eating OR taste OR gustatory OR flavor) w/3 (accepta* OR prefer* OR choice OR habit* OR discriminat* OR select* OR like* OR enjoy* OR avert* OR aversion OR face OR facial OR dislike OR reject OR neophobi* OR respons* OR react*))
OR
('whole grain' OR 'whole grains' OR dairy OR eggs OR meat OR poultry OR seafood OR fruit OR milk OR fish OR poultry OR vegetables OR peas OR nuts OR cereal OR beverage OR bread OR seafood OR yogurt OR cheese OR juice) w/3 (accepta* OR prefer* OR choice OR habit* OR discriminat* OR select* OR like OR enjoy* OR avert* OR aversion OR face OR facial OR dislike OR distaste OR reject OR neophobi* OR respons* OR react*)
AND
(infant* OR (baby OR babies OR toddler OR newborn OR nurser*) OR preschool* OR pre-school OR "early childhood" OR pre-k OR prekindergarten OR pre-kindergarten OR "early years" OR weanling)

Figure 2: Flow chart of literature search and screening results



This flow chart illustrates the literature search and screening results for articles examining the relationship between repeated exposure (timing, quantity, and frequency) to foods and early food acceptance. The results of the electronic database

searches were screened independently by two NESR analysts in a step-wise manner by reviewing titles, abstracts, and full text articles to determine which articles met the criteria for inclusion. A manual search was done to ascertain articles not identified through the electronic database search. This systematic review included 21 articles.

Excluded articles

The table below lists the excluded articles with at least one reason for exclusion, and may not reflect all possible reasons.

Table 5. Excluded articles

Citation	Reason(s) for Exclusion
3rd Lamme AJ,Lamme LL. Children's food preferences. J Sch Health. 1980;50(7):397-402. PMID:6903691.	Independent variable, Age
Early exposure to starchy foods, preference for salty taste linked, study finds. Journal of the American Dental Association (JADA). 2012;143(2):112-112 1p. PMID:108165148.	Study design, Independent variable
Getting children to try new foods. Child Health Alert. 2003;21:2. PMID:12814090.	Study design
Manipulation of children's eating preferences. Nutr Rev. 1986;44:327-8. PMID:3796896.	Study design
Toddler nutrition: food for thought. Community Pract. 2010;83(1):20. PMID:20196304.	Study design, Independent variable
Ahearn WH,Kerwin ME,Eicher PS,Lukens CT. An ABAC comparison of two intensive interventions for food refusal. Behav Modif. 2001;25(3):385-405. PMID:11428246.	Health status, Non-human
Ahearn WH. Effect of two methods of introducing foods during feeding treatment on acceptance of previously rejected items. Behavioral Interventions. 2002;17(3):111-127.	Health status, Age
Ahern SM,Caton SJ,Bouhlal S,Hausner H,Olsen A,Nicklaus S,Moller P,Hetherington MM. Eating a rainbow. Introducing vegetables in the first years of life in 3 European countries. Appetite. 2013;71:48-56. PMID:23891674.	Study design
Albelbeisi, A.,Shariff, Z. M.,Mun, C. Y.,Rahman, H. A.,Abed, Y.. Use of micronutrient powder in at-home foods for young children (6-18 months): A feasibility study. Pakistan Journal of Nutrition. 2017;16:372-377.	Independent variable

Citation	Reason(s) for Exclusion
Alles-White, Monica L.,Welch, Patricia. Factors Affecting the Formation of Food Preferences in Preschool Children. Early Child Development and Care. 1985;21:265-276. PMID:63306525; EJ328517.	Study design
Alves, J. G.,Russo, P. C.,Alves, G. V.. Facial responses to basic tastes in breastfeeding and formula-feeding infants. Breastfeed Med. 2013;8:235-6. PMID:23390990.	Study design
Anderson CM,McMillan K. Parental use of escape extinctionand differential reinforcement to treat food selectivity. J Appl Behav Anal. 2001;34(4):511-5. PMID:11800192.	Independent variable, Health status
Anzman-Frasca S,Savage JS,Marini ME,Fisher JO,Birch LL. Repeated exposure and associative conditioning promote preschool children's liking of vegetables. Appetite. 2012;58(2):543-53. PMID:22120062.	Age
Armstrong, J. E.,Laing, D. G.,Jinks, A. L.. Taste-Elicited Activity in Facial Muscle Regions in 5-8-Week-Old Infants. Chem Senses. 2017;42:443-453. PMID:28531312.	Independent variable
Autio JT,Courts FJ. Acceptance of the xylitol chewing gum regimen by preschool children and teachers in a Head Start program: a pilot study. Pediatr Dent. 2001;23(1):71-4. PMID:11242737.	Independent variable, Age
Bagenholm G,Kristiansson B,Nasher AA. Child feeding habits in the People's Democratic Republic of Yemen. II. Supplementary foods and weaning patterns. J Trop Pediatr. 1987;33(5):278-83. PMID:3430673.	Independent variable
Beauchamp GK,Cowart BJ,Mennella JA,Marsh RR. Infant salt taste: developmental, methodological, and contextual factors. Dev Psychobiol. 1994;27(6):353-65. PMID:8001725.	Independent variable
Beauchamp GK,Cowart BJ,Moran M. Developmental changes in salt acceptability in human infants. Dev Psychobiol. 1986;19(1):17-25. PMID:3699249.	Independent variable
Beauchamp GK,Moran M. Acceptance of sweet and salty tastes in 2-year-old children. Appetite. 1984;5(4):291-305. PMID:6529258.	Independent variable
Beauchamp GK,Moran M. Dietary experience and sweet taste preference in human infants. Appetite. 1982;3(2):139-52. PMID:7137993.	Independent variable
Beauchamp, Gary K.,Cowart, Beverly J.. Preference for high salt concentrations among children. Developmental Psychology. 1990;26:539-545. PMID:1990-27895-001.	Independent variable, Age

Citation	Reason(s) for Exclusion
Birch LL,Birch D,Marlin DW,Kramer L. Effects of instrumental consumption on children's food preference. Appetite. 1982;3(2):125-34. PMID:7137991.	Age
Birch LL,Marlin DW. I don't like it; I never tried it: effects of exposure on two-year-old children's food preferences. Appetite. 1982;3(4):353-60. PMID:7168567.	Age
Birch LL,McPhee L,Steinberg L,Sullivan S. Conditioned flavor preferences in young children. Physiol Behav. 1990;47(3):501-5. PMID:2359760.	Age
Birch, L. L.,McPhee, L.,Shoba, B. C.,Pirok, E.,Steinberg, L.. What kind of exposure reduces children's food neophobia? Looking vs. tasting. Appetite. 1987;9:171-8. PMID:3435134.	Age
Blossfeld I,Collins A,Kiely M,Delahunty C. Texture preferences of 12-month-old infants and the role of early experiences. Food Quality and Preference. 2007;18(2):396-404.	Independent variable
Boateng, L.,Nyarko, R.,Asante, M.,Steiner-Asiedu, M.. Acceptability of Complementary Foods That Incorporate Moringa Oleifera Leaf Powder Among Infants and Their Caregivers. Food Nutr Bull. 2017:379572117708656. PMID:28535743.	Independent variable
Bouhlal S,Issanchou S,Chabanet C,Nicklaus S. 'Just a pinch of salt'. An experimental comparison of the effect of repeated exposure and flavor-flavor learning with salt or spice on vegetable acceptance in toddlers. Appetite. 2014;83:209-17. PMID:25171850.	Age
Caton SJ,Blundell P,Ahern SM,Nekitsing C,Olsen A,Moller P,Hausner H,Remy E,Nicklaus S,Chabanet C,Issanchou S,Hetherington MM. Learning to eat vegetables in early life: the role of timing, age and individual eating traits. PLoS One. 2014;9(5):e97609. PMID:24878745.	Age
Cattaneo, A.. Infant and young child feeding: solid facts. Breastfeed Rev. 2013;21:7-9. PMID:23957175.	Study design
Chernichovsky D,Coate D. The choice of diet for young children and its relation to children's growth. J Hum Resour. 1980;15(2):255-63. PMID:7229364.	Dependent Variable
Coulthard, H.,Harris, G.,Fogel, A.. Association between tactile over-responsivity and vegetable consumption early in the introduction of solid foods and its variation with age. Matern Child Nutr. 2016;12:848-59. PMID:26792423.	Independent variable

Citation	Reason(s) for Exclusion
Cowart, B. J.. Development of taste perception in humans: sensitivity and preference throughout the life span. Psychol Bull. 1981;90:43-73. PMID:7267897.	Study design
Cowbrough, K.. They are what they eat. J Fam Health Care. 2013;23:19-23. PMID:24020113.	Study design
Daniels LA,Magarey A,Battistutta D,Nicholson JM,Farrell A,Davidson G,Cleghorn G. The NOURISH randomised control trial: positive feeding practices and food preferences in early childhood - a primary prevention program for childhood obesity. BMC Public Health. 2009;9:387. PMID:19825193.	Study design
de Wild V,de Graaf C,Jager G. Efficacy of repeated exposure and flavour-flavour learning as mechanisms to increase preschooler's vegetable intake and acceptance. Pediatr Obes. 2015;10(3):205-12. PMID:24903730.	Age
De Wild VWT,De Graaf C,Boshuizen HC,Jager G. Influence of choice on vegetable intake in children: Anin-home study. Appetite. 2015;91:1-6.	Independent variable, Age
Edelson, L. R.,Mokdad, C.,Martin, N.. Prompts to eat novel and familiar fruits and vegetables in families with 1-3 year-old children: Relationships with food acceptance and intake. Appetite. 2016;99:138-48. PMID:26792770.	Independent variable
Edmondson, L.. What toddlers eat really matters. J Fam Health Care. 2011;21:33-41. PMID:21877395.	Study design
Fildes, A.,Cooke, L.. The munch bunch: healthy habits start at weaning. J Fam Health Care. 2012;22:30-2. PMID:22480022.	Study design
Fishbein M,Cox S,Swenny C,Mogren C,Walbert L,Fraker C. Food chaining: a systematic approach for the treatment of children with feeding aversion. Nutr Clin Pract. 2006;21(2):182-4. PMID:16556929.	Independent variable
Fisher JO,Mennella JA,Hughes SO,Liu Y,Mendoza PM,Patrick H. Offering "dip" promotes intake of a moderately-liked raw vegetable among preschoolers with genetic sensitivity to bitterness. J Acad Nutr Diet. 2012;112(2):235-45. PMID:22741167.	Age
Fomon, S. J.,Ziegler, E. E.,Nelson, S. E.,Edwards, B. B.. Sweetness of diet and food consumption by infants. Proc Soc Exp Biol Med. 1983;173:190-3. PMID:6866998.	Independent variable
Fomon, S. J.. Taste acquisition and appetite control. Pediatrics. 2000;106:1278. PMID:11061823.	Study design

Citation	Reason(s) for Exclusion
Fries, L. R.,Martin, N.,van der Horst, K.. Parent-child mealtime interactions associated with toddlers' refusals of novel and familiar foods. Physiol Behav. 2017;176:93-100. PMID:28315360.	Dependent Variable, Age
Fuentes-Aguilar L. Nutrition in Mexico. Geogr Med. 1983;13:10-8. PMID:6416926.	Study design
Gunaratna, N. S.,Bosha, T.,Belayneh, D.,Fekadu, T.,De Groote, H.. Women's and children's acceptance of biofortified quality protein maize for complementary feeding in rural Ethiopia. J Sci Food Agric. 2016;96:3439-45. PMID:26558600.	Independent variable
Haller, R.,Rummel, C.,Henneberg, S.,Pollmer, U.,Koster, E. P.. The influence of early experience with vanillin on food preference later in life. Chem Senses. 1999;24:465-7. PMID:10480683.	Study design
Haro-Vicente, J. F.,Bernal-Cava, M. J.,Lopez-Fernandez, A.,Ros-Berruezo, G.,Bodenstab, S.,Sanchez-Siles, L. M.. Sensory Acceptability of Infant Cereals with Whole Grain in Infants and Young Children. Nutrients. 2017;9. PMID:28098769.	Independent variable, Dependent Variable
Harris, Gillian,Thomas, Anna,Booth, David A.. Development of salt taste in infancy. Developmental Psychology. 1990;26:534-538. PMID:1990-27920-001.	Independent variable
Hausner H,Olsen A,Moller P. Mere exposure and flavour-flavour learning increase 2-3 year-old children's acceptance of a novel vegetable. Appetite. 2012;58(3):1152-9. PMID:22425616.	Age
Havermans RC,Jansen A. Increasing children's liking of vegetables through flavour-flavour learning. Appetite. 2007;48(2):259-62. PMID:17113192.	Age
Haycraft, E.,Witcomb, G.,Farrow, C.. Supporting families with a fussy eater. Community Pract. 2015;88:24, 27. PMID:26601431.	Study design
Holley CE,Haycraft E,Farrow C. 'Why don't you try it again?' A comparison of parent led, home based interventions aimed at increasing children's consumption of a disliked vegetable. Appetite. 2015;87:215-222.	Age
Horne PJ,Greenhalgh J,Erjavec M,Lowe CF,Viktor S,Whitaker CJ. Increasing pre-school children's consumption of fruit and vegetables. A modelling and rewards intervention. Appetite. 2011;56(2):375-85. PMID:21112361.	Independent variable

Citation	Reason(s) for Exclusion
Howard AJ,Mallan KM,Byrne R,Magarey A,Daniels LA. Toddlers' food preferences. The impact of novel food exposure, maternal preferences and food neophobia. Appetite. 2012;59(3):818-25. PMID:22940687.	Study design
Hunsaker, S. L.,Jensen, C. D.. Effectiveness of a Parent Health Report in Increasing Fruit and Vegetable Consumption Among Preschoolers and Kindergarteners. J Nutr Educ Behav. 2017;49:380-386.e1. PMID:28258819.	Independent variable, Age
Ikeda, J. P.. Creating the perfect little eater. J Nutr Educ Behav. 2014;46:155. PMID:24809864.	Study design
Issanchou, S.. Determining Factors and Critical Periods in the Formation of Eating Habits: Results from the Habeat Project. Ann Nutr Metab. 2017. PMID:28407627.	Study design, Independent variable
Iuel-Brockdorf, A. S.,Draebel, T. A.,Ritz, C.,Fabiansen, C.,Cichon, B.,Brix Christensen, V.,Yameogo, C.,Oummani, R.,Briend, A.,Michaelsen, K. F.,Ashorn, P.,Filteau, S.,Friis, H.. Evaluation of the acceptability of improved supplementary foods for the treatment of moderate acute malnutrition in Burkina Faso using a mixed method approach. Appetite. 2016;99:34-45. PMID:26752599.	Independent variable, Health status
Kampstra, N. A.,Van Hoan, N.,Koenders, Djpc,Schoop, R.,Broersen, B. C.,Mouquet-Rivier, C.,Traore, T.,Bruins, M. J.,de Pee, S.. Energy and nutrient intake increased by 47-67% when amylase was added to fortified blended foods-a study among 12- to 35-month-old Burkinabe children. Matern Child Nutr. 2017. PMID:28466569.	Independent variable
Kare MR,Beauchamp GK. The role of taste in the infant diet. Am J Clin Nutr. 1985;41(2 Suppl):418-22. PMID:3969948.	Study design
Kothari G,Bhattacharjee L,Marathe M. Food acceptance and selection: Activities for promoting pro-vitamin A foods among young children in urban slums. Journal of Community Eye Health. 2001;14(37):11-12.	Independent variable, Age
Kuriakose JR. Nutritional status and feeding practices of infants. Nurs J India. 2010;101(8):184-6. PMID:23520824.	Independent variable, Dependent Variable
Lam, J.. Picky eating in children. Front Pediatr. 2015;3:41. PMID:26000268.	Study design

Citation	Reason(s) for Exclusion
Laureati M,Bergamaschi V,Pagliarini E. School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruits and vegetables. Appetite. 2014;83:26-32.	Age
Liem DG,Mennella JA. Sweet and sour preferences during childhood: role of early experiences. Dev Psychobiol. 2002;41(4):388-95. PMID:12430162.	Study design
Madrelle, J.,Lange, C.,Boutrolle, I.,Valade, O.,Weenen, H.,Monnery-Patris, S.,Issanchou, S.,Nicklaus, S.. Development of a new in-home testing method to assess infant food liking. Appetite. 2017;113:274-283. PMID:28274649.	Independent variable, Dependent Variable
Maier-Noth, A.,Schaal, B.,Leathwood, P.,Issanchou, S.. The Lasting Influences of Early Food-Related Variety Experience: A Longitudinal Study of Vegetable Acceptance from 5 Months to 6 Years in Two Populations. PLoS One. 2016;11:e0151356. PMID:26968029.	Independent variable, Age
Mallan KM,Fildes A,Magarey AM,Daniels LA. The Relationship between Number of Fruits, Vegetables, and Noncore Foods Tried at Age 14 Months and Food Preferences, Dietary Intake Patterns, Fussy Eating Behavior, and Weight Status at Age 3.7 Years. J Acad Nutr Diet. 2015. PMID:26198582.	Independent variable
Mauch, C.,Magarey, A.,Byrne, R.,Daniels, L.. Serve sizes and frequency of food consumption in Australian children aged 14 and 24 months. Aust N Z J Public Health. 2017;41:38-44. PMID:27960228.	Independent variable
Mennella JA,Beauchamp GK. Developmental changes in the acceptance of protein hydrolysate formula. J Dev Behav Pediatr. 1996;17(6):386-91. PMID:8960567.	Independent variable
Mennella JA,Beauchamp GK. Experience with a flavor in mother's milk modifies the infant's acceptance of flavored cereal. Dev Psychobiol. 1999;35(3):197-203. PMID:10531532.	Independent variable
Mennella JA,Beauchamp GK. Flavor experiences during formula feeding are related to preferences during childhood. Early Hum Dev. 2002;68(2):71-82. PMID:12113993.	Study design
Mennella JA,Beauchamp GK. Mothers' milk enhances the acceptance of cereal during weaning. Pediatr Res. 1997;41(2):188-92. PMID:9029637.	Study design

Citation	Reason(s) for Exclusion
Mennella JA,Beauchamp GK. The effects of repeated exposure to garlic-flavored milk on the nursling's behavior. Pediatr Res. 1993;34(6):805-8. PMID:8108198.	Independent variable
Mennella JA,Beauchamp GK. Understanding the origin of flavor preferences. Chem Senses. 2005;30 Suppl 1:i242-3. PMID:15738136.	Study design
Mennella JA,Castor SM. Sensitive period in flavor learning: effects of duration of exposure to formula flavors on food likes during infancy. Clin Nutr. 2012;31(6):1022-5. PMID:22652361.	Independent variable
Mennella JA,Forestell CA,Morgan LK,Beauchamp GK. Early milk feeding influences taste acceptance and liking during infancy. Am J Clin Nutr. 2009;90(3):780s-788s. PMID:19605570.	Study design
Mennella JA,Griffin CE,Beauchamp GK. Flavor programming during infancy. Pediatrics. 2004;113(4):840-5. PMID:15060236.	Independent variable
Mennella JA,Jagnow CP,Beauchamp GK. Prenatal and postnatal flavor learning by human infants. Pediatrics. 2001;107(6):E88. PMID:11389286.	Independent variable
Mennella JA,Kennedy JM,Beauchamp GK. Vegetable acceptance by infants: effects of formula flavors. Early Hum Dev. 2006;82(7):463-8. PMID:16469455.	Study design
Mennella JA,Lukasewycz LD,Castor SM,Beauchamp GK. The timing and duration of a sensitive period in human flavor learning: a randomized trial. Am J Clin Nutr. 2011;93(5):1019-24. PMID:21310829.	Independent variable
Mennella JA,Trabulsi JC. Complementary foods and flavor experiences: setting the foundation. Ann Nutr Metab. 2012;60 Suppl 2:40-50. PMID:22555188.	Study design
Mennella, Julie A.,Beauchamp, Gary K.. The human infants' response to vanilla flavors in mother's milk and formula. Infant Behavior & Development. 1996;19:13-19. PMID:1996-01751-002.	Independent variable
Mettlin C. Nutritional habits of blacks and whites. Prev Med. 1980;9(5):601-6. PMID:7433421.	Study design, Dependent Variable
Milazzo VL. Hedonic damages. Natl Med Leg J. 1992;3(4):5. PMID:1420607.	Study design, Independent variable, Dependent Variable

Citation	Reason(s) for Exclusion
Moding, K. J.,Stifter, C. A.. Temperamental approach/withdrawal and food neophobia in early childhood: Concurrent and longitudinal associations. Appetite. 2016;107:654-662. PMID:27622985.	Independent variable, Age
Morin, K. H.. Toddlers: start off on the right foot. MCN Am J Matern Child Nurs. 2007;32:122. PMID:17356420.	Study design
Mueller MM,Piazza CC,Patel MR,Kelley ME,Pruett A. Increasing variety of foods consumed by blending nonpreferred foods into preferred foods. J Appl Behav Anal. 2004;37(2):159-70. PMID:15293635.	Age
Mullan LM,Holton EE,Vickers ZM. Preference for and consumption of fat-free and full-fat cheese by children. J Am Diet Assoc. 1996;96(6):603-4. PMID:8655911.	Age
Nayyar G,Ramzan A,Khan MA,Billoo AG. Comparative clinical trial of acceptability of flavoured vs non-flavoured ORS (WHO formula). J Pak Med Assoc. 1987;37(7):167-70. PMID:3118071.	Independent variable, Health status
Nicklaus S. The role of food experiences during early childhood in food pleasure learning. Appetite. 2015.	Study design
Northstone K,Emmett P,Nethersole F. The effect of age of introduction to lumpy solids on foods eaten and reported feeding difficulties at 6 and 15 months. J Hum Nutr Diet. 2001;14(1):43-54. PMID:11301932.	Independent variable
Oram N. Children's eating experiences could differ from those of adults. Appetite. 1994;22(3):283-7. PMID:7979347.	Study design
Paine, Patricia A.,Spegiorin, Clodomir. Prolonged breast feeding related to later solid food acceptance. Child: Care, Health and Development. 1983;9:321-326. PMID:1984-17613-001.	Independent variable
Passehl B,McCarroll C,Buechner J,Gearring C,Smith AE,Trowbridge F. Preventing childhood obesity: establishing healthy lifestyle habits in the preschool years. J Pediatr Health Care. 2004;18(6):315-9. PMID:15523425.	Study design, Independent variable
Paul C,Williams KE,Riegel K,Gibbons B. Combining repeated taste exposure and escape prevention: an intervention for the treatment of extreme food selectivity. Appetite. 2007;49(3):708-11. PMID:17920728.	Health status, Age
Persson LA,Samuelson G. From breastmilk to family food. Infant feeding in three Swedish communities. Acta Paediatr Scand. 1984;73(5):685-92. PMID:6485788.	Independent variable, Dependent Variable

Citation	Reason(s) for Exclusion
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Stein LJ,Cowart BJ,Epstein AN,Pilot LJ,Laskin CR,Beauchamp GK. Increased liking for salty foods in adolescents exposed during infancy to a chloride-deficient feeding formula. Appetite. 1996;27(1):65-77. PMID:8879420.	Independent variable, Age
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Wharton, B.. Taste and appetite in infancy: possible topics for research. Pediatrics. 2000;106:1278a-1278. PMID:11061824.	Study design
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Yuan, W. L.,Lange, C.,Schwartz, C.,Martin, C.,Chabanet, C.,de Lauzon-Guillain, B.,Nicklaus, S.. Infant Dietary Exposures to Sweetness and Fattiness Increase during the First Year of Life and Are Associated with Feeding Practices. J Nutr. 2016;146:2334-2342. PMID:27733527.	Independent variable, Dependent Variable