Scientific Advisory Committee on Nutrition

‘Feeding young children aged 1 to 5 years’

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Annex 9

Contents

Annex 9: Extracted data from primary studies included in the systematic reviews

Energy

Table A9.1 Dietary energy

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Effect of portion sizes on child food consumption										
	Ward et al (2015) AMSTAR 2 confidence rating: moderate									
Effect of self-selection (compared to restrictive feeding) and food intake	Pre-post study (Branen and Fletcher, 1994) (40) USA	Age 3 to 4 years	54-day period	Children either given 1 standard portion of a snack (for 29 days)* compared with allowed to self-select the amount (for another 25 days)*	Child food consumption at snack time	Children increased their consumption of snacks when teachers allowed children to self-select compared with when they pre-portioned food Self-selection compared with pre-portioning	NR	See 'Measure of association or effect'	NR	School setting

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(a) portions of snack eaten: MD 0.87 (p<0.01) (b) portions of snacks wasted: MD 0.03 (p≥0.05) (c) grams of snacks wasted: MD 2.7 (p≥0.05)				
	Mikkelsen et al (2014) AMSTAR 2 confidence rating: low									
Portion sizes and food consumption	Quasi-experimental study (Ramsey et al, 2013) (235) USA	2 to 7 years	5 days	Children served a portion size of 4 chicken nuggets during school lunch (standard amount) or given the choice to self-select smaller portion sizes of 2, 3 and 4 nuggets.	Food consumption (measured by plate waste)	Children's consumption of chicken nuggets was greater when they were not given a choice of nugget portion size. This demonstrates that serving	NR	NR	NR	Quantitative data not reported by SR Consumption measured at school canteen not individual level

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						larger portion sizes in preschools increase children's consumption.				
Portion sizes and food consumption	Quasi-experimental study (Leahy et al, 2008) (77) USA	2 to 5 years	6 weeks (1 day per week)	Children were served two versions of a macaroni and cheese dish with the same palatability; one was energy dense and the other a calorie-reduced version. Each version was served 3 times. Other foods served during lunch were 2% milk, steamed broccoli and unsweetened	Children: preference assessment of the two dishes Height and weight. Lunch consumption of the two different dishes. Parents: Child feeding questionnaire Socio-demographic variables.	Decreasing the energy density of the macaroni and cheese by 30% significantly decreased children's energy intake from the dish by 25% and total lunch energy intake by 18%. Children consumed significantly more of the lower-energy-dense version.	NR	NR	NR	Within-subject crossover*

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				applesauce.*All lunch times were consumed ad libitum.*						
	Osei-Assibey et al (2012) AMSTAR 2 confidence rating: low									
Portion sizes and food consumption	Within-subject crossover design (Fisher et al, 2003) (35) USA	2 to 5 years	3 months	Exposure to large portion of an entrée (macaroni and cheese*) – main component of the lunch meal* Other foods served (the standard lunch menu) were milk, applesauce, carrots, sugar cookies*	Food consumption (and weight status)	Doubling an age-appropriate portion of the entrée increased the amount of entrée eaten (g) by 25% (± SEM 7%) ($p<0.001$) and total energy intake by 15% (± SEM 5%) ($p<0.01$) at lunch	NR	See 'Measure of association or effect'	NR	Preschool setting
Portion sizes and food consumption	Non-randomised controlled trial (Rolls	3 to 6 years Younger children (mean age 3.6	3 lunch sessions, once a week for 3 weeks*	Children offered portions of lunch foods that were larger than, smaller than, or about	Food consumption (kcal, grams)*	Children aged 4.3–6.1 years (mean age 5.0 years) had higher total	NR	See 'Measure of association or effect'	NR	Preschool setting

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	et al, 2000) (32) USA	years) analysed separately from older children (mean age 5.0 years)*		equal to the USDA recommended serving sizes*		energy intake when served larger portions (p<0.002) but this effect was not seen in children aged 3.0–4.3 years (mean age 3.6 years) No results reported on food consumption in grams				
Portion sizes and food consumption	Within-subject crossover design (Looney et al 2011) (17) USA	3 to 5 years	4 sessions* across 2 months	Sessions 1 and 2: children received higher-energy-dense snack (small then large portion)* Sessions 3 and 4: children received the lower-energy dense snack (small then large portion)*	Food consumption (kcal, grams*)	There was a significant impact of portion size on snack consumption (small portion size 84.2 ±30.8 kcal, large portion size 99.0 ±52.5 kcal; p<0.05)	NR	See 'Measure of association or effect'	NR	Pre-school setting Unclear whether the measure of uncertainty is SD or SE

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Results on impact of portion size on snack consumption (g) was not reported				
Dietary energy intake and BMI										
	Rouhani et al (2016) AMSTAR 2 confidence rating: critically low									
Energy dense foods and BMI	PCS (Durao et al, 2014) (589) Portugal	2 years*	Age 4 years *	Consumption of energy dense foods (EDF) (average daily frequencies of consumption)* FFQ questionnaire completed at interview with primary caregiver EDF included carbonated SSBs, non-carbonated SSBs, crisps, pizza, hamburgers, cakes,	BMI z-score	No association between consumption of EDF at age 2 years and BMI z-score at age 4 years	NR	Not significant (p-value NR)	Child's exact age in months at 2 years, maternal characteristics (education, age, pre-pregnancy BMI)	None

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				chocolate, sweets						
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
Energy intake and BMI	PCS (Deheeger et al, 1996) (112) France	10m, 2, 4, 6, 8 years	Age 8 years	Energy intake (kcal) Dietary history collected in an interview with mothers of the children*	BMI Height and weight obtained from medical files for first 3 ages (10m to 4 years); then measured at home at ages 6 and 8 years	Increase in energy intake (per day*) between the ages 4 to 6 years was greatest in children in the highest tertile of BMI at age 8 years compared with groups who were in the middle or lowest tertile of BMI; the increase in energy intakes before age 4 years and after	NR	0.01	None*	Analyses on same cohort as Rolland-Cachera (1995) 60% drop out

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						age 6 were not predictive of BMI tertile at age 8				
Energy intake and BMI	PCS (Griffiths et al, 1990) (37) UK	3 to 4 years	Age 15 years	Energy intake per kg of body weight Dietary assessment method NR	BMI Assessment of height and weight NR	Correlation coefficient -0.73 In girls only (n=10) No association in boys (data NR)	NR	<0.0118	None*	None
Energy intake and BMI	PCS (Klesges et al 1995) (146) USA	3 to 5 years	2 years	Energy intake (kcal) Willett FFQ for children*	Change in BMI Height and weight measured by trained research assistants*	NR	NR	Not significant (p-value NR)	Sex, age, baseline BMI, family risk (parental weight status), baseline % intake of carbohydrate and dietary fat, change in intakes from baseline to follow-up (1 y and 2 y), physical activity*	No power calculation*

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Energy intake and BMI	PCS (Rolland-Cachera et al, 1995) (112) France	2 years	8 years	Energy intake (kcal) Interviews conducted by dietitian to assess diet history – a typical day's eating pattern*	BMI	(1) Energy intake at 2 years correlated with BMI at 8 years (r=0.20) (2) After adjustment for SES, energy intake remained correlated with BMI (r=0.20)*	NR	(1) 0.049 (2) 0.044*	SES	Analyses on same cohort as Deheeger et al 1996 60% drop out
Energy intake and body fat										
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Energy intake (from milk) and body fat	PCS (Kral et al 2008) (49) USA	3 to 5 years	3 years	Energy intake from milk (change in calories consumed at ages 3 to 5 years)	Waist circumference (cm)	Increase in calories consumed from milk was associated with 0.01 (SE 0.004) decrease in waist circumference	NR	0.04	Change in waist circumference from ages 3 to 5 years and total energy intake at 3 years	None
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									

Exposure and outcome	Study type (n participants) Country	Base-line age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Energy intake and body fat	PCS (Griffiths et al, 1990) (37) UK	3 to 4 years	Age 15 years	Energy intake per kg of body weight	Body fat mass index (BFMI) (fat mass or height^2)	Correlation coefficient -0.77 In girls only (n=10) No association in boys (data NR)	NR	<0.009	None*	None

Macronutrients – carbohydrates

Table A9.2 Carbohydrate intake

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Carbohydrate (CHO) intake and BMI										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Carbohydrate (CHO) intake and BMI	PCS (Skinner et al 2004) (70) USA	2 to 8 years	Age 8 years	Total CHO (% energy) 24h recalls age 20 months and earlier; 3 day records (2 food records and 1 24 hour recall) at age 2 to 3 years	BMI Measurements by dietician*	Mean CHO intake from age 2 to 8 years (longitudinal intake) associated with lower BMI at 8 years	NR	NR	Sex, baseline BMI, birthweight, age at adiposity rebound, age at cereal introduction, breastfeeding duration, dietary variety, sedentary activity, mother's perceptio	None

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									n of child as picky eater at age 6, parental BMI*	
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
CHO intake and BMI	PCS (Klesges et al 1995) (146) USA	3 to 5 years	2 years	Total CHO intake (% energy) Willett FFQ for children*	Change in BMI Measurements by trained research assistants*	NR	NR	Not significant (p-value NR)	Sex, age, baseline BMI, family risk (parental weight status), baseline energy intake, % intake of carbohydrate and dietary fat, change in intake	None

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									from baseline to follow-up (1 year and 2 year), physical activity*	
CHO intake and BMI	PCS (Rolland-Cachera et al, 1995) (112)	2 years	Age 8 years	Total CHO intake (% energy) Interview survey of diet history*	BMI Objectivity of assessment NR*	Correlation coefficient (r) -0.07*	NR	0.5*	Baseline BMI, energy intake, parental BMI, SES*	60% drop out
CHO intake and body fat										
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
CHO intake and body fat	PCS (Rolland-Cachera et al, 1995) (112)	2 years	Age 8 years	Total CHO intake (% energy)	Triceps skinfold Subscapular skinfold	No association (data NR)	NR	NR	Baseline BMI, energy intake, parental BMI, SES	60% drop out

Macronutrients – dietary fat

Table A9.3 Dietary fat intake and obesity outcomes

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total fat intake and body weight										
	Naude et al (2018) AMSTAR 2 confidence rating: high									
Total fat and change in body weight (1 to 2 years later)	PCS (Niinikoski et al 1997) (740) Finland	7 to 36 months	1.5 and 2 years	Low fat (LF) group (27.7 to 28.7% energy) compared with high fat (HF) group (>28.7% energy) 4-day dietary	Change in body weight	No difference in weight gain from age 7 months to 36 months (no effect size)	NR	0.81	None	Convenience sample, sample size justification accurately described Significant imbalance in participant numbers between groups LF: n=35; HF: n=705
Total fat and change in body weight (2 years later)	PCS (Shea et al 1993) (215) USA (predominantly Hispanic population)	3 to 4 years	2 years (mean)	LF (≤30% energy) HF (>30% energy) 4 x 24h dietary recall 3 x semi-quantitative	Change in body weight (kg per year) Height and weight measured by balance	MD 0.2kg per year	-0.26 to 0.66	NR	Unadjusted results presented in Naude as adjusted results (for sex, ethnicity, baseline body	Convenience sample No sample size justification

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				FFQs at baseline – averaged to a single estimate of nutrient intake	scale and stadiometer*				weight, total energy intake) didn't alter results	
Total fat intake and BMI										
	Naude et al (2018) AMSTAR 2 confidence rating: high									
Total fat and change in BMI (2 years later)	PCS (Klesges et al 1995) (146) USA	3 to 5 years	2 years	Total fat intake (% energy) Willett FFQ for children	Change in BMI Height and weight measured by trained research assistants*	Every 1% increase in energy from dietary fat associated with beta coefficient 0.034kg/m^2	NR	0.05	Sex, age, baseline BMI, baseline energy intake, parental BMI, physical activity	Convenience sample No sample size justification
Total fat and change in BMI (2 years later)	PCS (Shea et al 1993) (215) USA (predominantly Hispanic population)	3 to 4 years	2 years (mean)	LF (≤30% energy) HF (>30% energy) 4 x 24h dietary recall 3 x semi-quantitative FFQs (Willett FFQ) at baseline – averaged to a single estimate	Change in BMI (kg/m^2 per year) Height and weight measured by balance scale and stadiometer*	MD 0.02kg/m^2 per year between LF compared with HF	-0.26 to 0.30	>0.05	Unadjusted results reported in Naude as adjusted results (for sex, ethnicity, baseline BMI, total energy intake) didn't alter results	Convenience sample No sample size justification

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				of nutrient intake						
Total fat and change in BMI (3 years later)	PCS (Jago et al 2005) (133) USA	3 to 4 years	3 years	Total fat intake (% energy) 4 day observed dietary intake –recorded by trained observers	Change in BMI Height and weight measured by stadiometer and balance-beam scale*	Dietary factors were not associated with BMI across the 3 study years	NR	NR	Sex, ethnicity, baseline BMI, parental overweight, sedentary behaviour, physical activity, dietary behaviours, total energy intake	Convenience sample No sample size justification
Total fat and change in BMI (6 years later)	PCS (Skinner et al 2004) (70) USA	2 to 8 years	Age 8 years	Total fat intake (g) Interviews conducted by 2 dieticians: 24 hour dietary recall and 2-day food records (dietary assessment included 3 non-consecutive days) at 9 time points. Intakes	Change in BMI Assessed by dietician (weight, standard scale; height, steel tape)*	Every 1g increase in total fat intake associated with beta coefficient 0.01kg/m^2	NR	0.0039	Baseline BMI, birthweight, age at cereal introduction, breastfeeding duration, dietary variety, sedentary activity	Purposely selected sample from 2 metropolitan areas No sample size justification

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				from each time point averaged to provide 9 daily intakes						
Total fat and change in BMI z-score (14 years later)	PCS (Alexy et al 2004) (112) Germany	3.2 years	Age 17 years	Lower fat (LF) group (32% energy) Higher fat (HF) group (40% energy) 3-day weighed dietary record	Change in BMI z-score Accuracy of assessment NR	BMI z-score decreased by 0.13 BMI z-score in the LF group while BMI z-score increased by 0.04 in the HF group	NR	NR	None	Convenient sample No sample size justification
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
Total fat and BMI (6 years later)	PCS (Rolland-Cachera et al, 1995) (112)	2 years	6 years	Total fat intake (% energy) Dietician conducted interview of diet history – a typical day's eating pattern*	BMI Accuracy of assessment NR	Correlation coefficient (r) 0.02*	NR	0.77*	Baseline BMI, energy intake, parental BMI, SES	60% drop out
Total fat intake and body fat										
	Naude et al (2018) AMSTAR 2 confidence rating: high									

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total fat and body fat	PCS (Skinner et al 2004) (53) USA	2 years	4 years	Total fat intake (g per day)	(1) % body fat (2) body fat (g)	(1) Every 1 unit increase in total fat intake, associated with beta coefficient 0.619% (SE 0.261%) (2) Every 1 unit increase in fat intake associated with beta coefficient 179g (SE 70.1)	NR	(1) 0.02 (2) 0.01	Baseline BMI, parental BMI, sex, dietary variables (protein, monounsaturated fat intakes g per day; calcium mg per day)	No sample size justification Data from Carruth and Skinner, 2001*
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
Total fat and body fat	PCS (Rolland-Cachera et al, 1995) (112) France	2 years	Age 8 years	Total fat intake (% energy)	Body fat (1) subscapular skinfold (2) triceps skinfold	Correlation coefficient (r): (1) 0.02* (2) -0.05*	NR	(1) 0.79* (2) 0.65*	Baseline BMI, energy intake, parental BMI, SES*	60% drop out
Polyunsaturated fatty acids (PUFA) intake and BMI										
	Voortman et al (2015) AMSTAR 2 confidence rating: low									

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
PUFA and odds of overweight	PCS (Heppe et al 2013) (3610) Netherlands	14 months	Age 4 years	PUFA intake (energy-adjusted g per day)	BMI	OR of preschool overweight (undefined) * 0.77	0.62 to 0.96	<0.05	Sex, birth weight, age of introduction to solid foods, intakes of SFA and MUFA (units unclear), parental BMI, maternal smoking, SES*	None
PUFA and BMI cut-off	PCS (Scaglioni et al 2000) (147) Italy	1 year	Age 5 years	PUFA intake (% energy)	BMI A child was defined to be overweight if their BMI was over the 90th centile of the age and sex-adjusted Rolland-Cachera curves.	No difference in intakes at age 1 year between children ≤90th BMI centile compared with >90th BMI centile at age 5 years*	NR	0.60	None (results cited in Voortman were not adjusted, even though the study did perform multiple regression analyses)	None
PUFA intake and body fat										
	Voortman et al (2015) AMSTAR 2 confidence rating: low									

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
PUFA and body fat	PCS (Carruth and Skinner, 2001) (53) USA	2 to 5 years	Age 5.8 years	PUFA intake (g per day)	% body fat	NR	NR	Not significant (p-value NR)	Sex, BMI (age unspecified), dietary variables (including longitudinal daily intakes of protein and micronutrient intake – units unclear), parental BMI	None
n3-PUFA intake and BMI										
	Voortman et al (2015) AMSTAR 2 confidence rating: low									
n-3 PUFA and BMI z-score	RCT (Andersen et al 2011) (133) Denmark	9 to 18 months	9 months	DHA + EPA supplementation (1.6g fish oil) versus control (sunflower oil)	BMI z-score	No effect (effect size NR)	NR	0.85	Not applicable	None
n-3 PUFA and BMI	RCT (Ayer et al 2009) (100) Australia	6 months to 5 years	Age 8 years	Rapeseed and fish oil supplementation (500mg) compared with control (sunflower oil)	BMI	No effect (effect size NR)	NR	Not significant (p-value NR)	Not applicable	None

Exposure and outcome	Study type (n participants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
n-3 PUFA and BMI z-score	PCS (Standl et al 2014) (388) Germany	2 years	Age 6 and 10 years	Plasma phospholipids	BMI z-score	No association	NR	NR	Birthweight, breastfeeding duration, maternal BMI	None

Table A9.4 Dietary fat intake and blood lipids

Exposure X outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
PUFA intake and total cholesterol (TC)										
	Voortman et al (2015) AMSTAR 2 confidence rating: low									
PUFA and TC	PCS (Ohlund et al 2008, 2011) (127) Sweden	6 months to 4 years	Age 4 years	PUFA (% energy)	TC (adjusted for gender)	NR	NR	Not significant (p-value NR) in univariate analysis	Not applicable	None
PUFA and TC	PCS (Cowin et al 2001) (496) UK	18 months	Age 31 months	Energy-adjusted PUFA (g per day) Natural log of PUFA intake entered into models	TC	NR	NR	Not significant (p-value NR)	Sex, ethnicity, energy intake, energy-adjusted intake of saturated fat and PUFA, starch, sugar, dietary fibre (NSP) and vitamin C*	None
PUFA intake and low density lipoprotein cholesterol (LDL-C)										

PUFA and LDL-C	PCS (Ohlund et al 2008, 2011) (127) Sweden	6 months to 4 years	Age 4 years	PUFA (% energy)	LDL-C (adjusted for gender)	NR	NR	Not significant (p-value NR)	Not applicable	
PUFA intake and high density lipoprotein cholesterol (HDL-C)										
PUFA and HDL-C	PCS (Cowin et al 2001) (496) UK	18 months	Age 31 months	Energy-adjusted PUFA (g per day) Natural log of PUFA intake entered into models	HDL-C	NR for all outcomes except for HDL-C. For every unit increase in the natural log of PUFA intake, there is a 0.15 decrease in HDL-C in girls only	-0.29 to -0.01	0.036	Sex, ethnicity, energy-adjusted intake of saturated fat and PUFA, starch, sugar, dietary fibre (NSP) and vitamin C*	None
PUFA and HDL-C	PCS (Ohlund et al 2008, 2011) (127) Sweden	6 months to 4 years	Age 4 years	PUFA (% energy)	HDL-C (adjusted for gender)	NR	NR	Not significant (p-value NR)	Not applicable	None

n-3 PUFA intake and HDL-C										
n-3 PUFA and HDL-C	RCT (Ayer et al 2009) (100) Australia	6 months to 5 years	Age 8 years	Fish oil supplementation compared with placebo (NR)	HDL-C	No effect (effect size NR)	NR	Not significant (p-value NR)	Not applicable	None
n-3 PUFA intake and triacylglycerol (TG)										
PUFA and TG	RCT (Ayer et al 2009) (100) Australia	6 months to 5 years	Age 8 years	Fish oil supplementation compared with placebo (NR)	TG	No effect (effect size NR)	NR	Not significant (p-value NR)	Not applicable	None

Table A9.5 Dietary fat intake and blood pressure

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
PUFA intake and blood pressure										
	Voortman et al (2015) AMSTAR 2 confidence rating: low									
PUFA and systolic blood pressure (SBP)	PCS (van den Hooven, 2013) (2882) Netherlands	14 months	Age 6 years	PUFA (g per day)	SBP (mm Hg)	Highest tertile of intake (>8.6g per day)* compared with lowest tertile of intake (<7.0g per day)* associated with beta coefficient 0.26mmHg	-0.41 to 0.93	Not significant (p-value NR)	Sex, ethnicity, birth weight, BMI at age 6, energy intake, macronutrient intake, sedentary behaviour, maternal smoking and educational level	None
PUFA and diastolic blood pressure (DBP)	PCS (van den Hooven, 2013) (2882) Netherlands	14 months	Age 6 years	PUFA (g per day)	DBP (mm Hg)	Highest tertile of intake (>8.6g per day)* compared with lowest	-0.46 to 0.66	Not significant (p-val	Sex, ethnicity, birth weight, energy intake, macronutrient intake, sedentary behaviour,	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						tertile of intake (<7.0g per day)* associated with beta coefficient 0.10mmHg		ue NR)	maternal smoking and educational level	
n-3 PUFA intake and blood pressure										
n-3 PUFA and SBP	RCT (Ayer et al 2009) (100) Australia	6 months to 5 years	Age 8 years	Rapeseed and fish oil supplementation (500mg) compared with control (sunflower oil)	SBP (mm Hg)	No effect (effect size NR)	NR	0.66	Not applicable	None
n-3 PUFA and DBP	RCT (Ayer et al 2009) (100) Australia	6 months to 5 years	Age 8 years	Rapeseed and fish oil supplementation (500mg) compared with control (sunflower oil)	DBP (mm Hg)	No effect (effect size NR)	NR	0.93	Not applicable	None

Table A9.6 Dietary fat intake and linear growth

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total fat intake and age at peak growth										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Total fat and age at peak growth velocity (PGV)	PCS (Berkey et al 2000) (67 girls) USA	1 to 2 years	Age 6 to 8 years	Total fat (g per day) age and energy-adjusted, expressed as log residuals entered into models*	PGV	Every 1 SD increase in total fat intake associated with reduction in age at peak growth (-0.63 years)	NR	<0.05*	Baseline height and BMI, age-adjusted total energy intake at age 1 to 2, and age or energy-adjusted intakes of vegetable protein and total fat (g per day)*	Study conducted in the women born in the 1930s-1940s High drop-out rate (43%)
Total fat intake and height										
	Naude et al (2018) AMSTAR 2 confidence rating: high									
Total fat and height	PCS (Niinikoski et al 1997) (740) Finland	7 to 36 months	1.5 and 2 years	Low fat (LF) group (27.7 to 28.7% energy) compared with high fat (HF) group (>28.7% energy)	Change in height (%)	At 1 year: LF = 0.18 (1.0)% ; HF = 0.16 (0.9)%	NR	0.93	None	Significant imbalance in participant numbers between groups LF: n=35; HF: n=705

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total fat and height	PCS (Shea et al 1993) (215) USA (predominantly Hispanic population)	3 to 4 years	2 years (mean)	LF (≤30% energy) HF (>30% energy)	Change in height (cm per year)	MD 0.2	-0.24 to 0.64	NR	Unadjusted results presented in Naude as adjusted results (for sex, ethnicity, baseline BMI, total energy intake) didn't alter results	Convenience sample No sample size justification

Macronutrients – protein

Table A9.7 Protein intake and obesity outcomes

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total protein intake and BMI										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein and Odds of overweight	PCS (Gunther et al 2007) (203) Germany	12 months, 18 to 24 months	Age 7 years	Median protein intake % energy (25th to 75th percentiles) at age 18-24m Median low intake: 13.3% (11.8 to 14.7%) Median high intake: 13.8% (12.9 to 15.2%) 3-day weighed records at 12, 18 and 24m	Standardised BMI (BMI SDS) Measurements performed by trained nurses* Overweight defined as BMI >75th percentile of German reference curves*	Those children with consistently high protein intakes from age 12 months, 18 to 24 months versus children with lower protein intakes: a) BMI SDS 0.37 (95% CI 0.12 to 0.61) compared with 0.08	See previous column	See previous column	Sex, baseline BMI SDS, total energy intake, fat intake (% energy), firstborn status, maternal weight, educational attainment, gestational age, maternal smoking, breastfeeding, siblings in dataset*	Power calculation DONALD cohort

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(95% CI -0.09 to 0.26); p=0.04 b) OR for overweight at age 7: 2.39 (1.14 to 4.99) p=0.02				
Protein and BMI	PCS (Ohlund et al 2010) (127) Sweden	17 to 18 months	Age 4 years	Mean protein intake (% energy) 13.6% (SD 1.6) Monthly 5-day food records	BMI Weight measured using digital scale and height measured by infantometer (at 18m) and stadiometer (at 4 years)	Higher protein intake associated with higher BMI (details NR)	NR	NR	Total energy intake, macronutrient intake (absolute intake in grams), parental BMI when child was aged 4 years*	No power calculation Loss to follow up >20%
Protein and BMI	PCS (Scaglioni et al 2000) (147) Italy	1 year	Age 5 years	Mean protein intake (% energy) Age-adjusted FFQ and 24h recalls at baseline and follow-up	BMI Overweight defined by BMI over the 90th centile of the age- and sex-adjusted Rolland-	(a) Children aged 5 years with overweight had a higher intake of protein (%	NR	(a) 0.024 (b) 0.05	Sex, weight and length at birth and 1 year, other macronutrients (% energy), parental age	Measurement errors in dietary reporting not considered No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
					Cachera curves (Rolland-Cachera et al 1982)* Measurements performed by 2 paediatricians	energy) at age 1 year than children with healthy weight (22% compared with 20%) (b) Protein intake at 1 year of age was associated with overweight at 5 years after adjustment			and weight status*	
Protein and BMI	PCS (Skinner et al 2004) (70) USA	2 to 8 years	Age 8 years	Mean longitudinal protein intake at age 2 to 8 years (14% energy) 24 hour recalls until age 20 months; 3-day records (2	BMI Measurements performed by dietician	Mean longitudinal protein intake (in g)* at age 2 to 8 years was a predictor of BMI at 8 years	NR	0.017*	Sex, baseline BMI, birthweight, age at adiposity rebound, age at cereal introduction, breastfeeding duration, dietary variety,	No power calculation Most of sample from upper SES families; a single racial group was selected

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				food records and a 24h recall) at ages 24 to 36 months		0.01 (SE 0.01)*			sedentary activity, mother's perception of child as picky eater at age 6, parental BMI*	
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
Protein and BMI	PCS (Rolland-Cachera et al, 1995) (112) France	2 years	Age 8 years	Protein intake (% energy) Interviews conducted by dietician – diet history, capturing usual eating patterns	BMI Objectivity of assessment NR	Correlation coefficient (r) 0.28*	NR	0.008*	BMI and energy intake at 2 years, parental BMI, SES*	60% drop out
Total protein and body fat										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein and body fat	PCS (Gunther et al 2007) (203) Germany	12 months, 18 to 24 months	Age 7 years	Median protein intake % energy (25th to 75th percentiles) Median low intake: 13.3%	Body fat % The 75th percentile of body fat reference curves based on % body fat values	Those children with consistently high protein intakes from age 12 months,	1.06 to 4.88	0.03	Sex, child baseline BMI % body fat, total energy intake fat intake (% energy), firstborn status, maternal weight,	DONALD cohort Power calculation reported

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(11.8 to 14.7%) Median high intake: 13.8% (12.9 to 15.2%)	measured by bioelectric impedance analysis in British children; McCarthy et al, 2006	18 to 24 months had a OR for % body fat >75th percentile: 2.28 (1.06 to 4.88) than children with a low protein intake			educational attainment, gestational age, maternal smoking, breastfeeding, siblings in dataset*	
	Parsons et al (1999) AMSTAR 2 confidence rating: critically low									
Protein and body fat	PCS (Rolland-Cachera et al, 1995) (112) France	2 years	Age 8 years	Protein intake (% energy)	(1) Subscapular skinfold (total body fat) (2) Triceps skinfold (body fat %)	Correlation coefficient (r) (1) 0.20* (2) 0.11*	NR	(1) 0.004* (2) 0.30*	BMI and energy intake at 2 years, parental BMI, SES *	60% drop out
Animal protein intake and BMI										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Animal protein and BMI	PCS (Gunther et al 2007) (203) Germany	12 months, 5 to 6 years	Age 7 years	Median protein intake % energy (25th to 75th percentiles) at age 18-24m 13.8% (12.9 to 15.2%)	BMI SDS	(1) Animal protein at 12 months associated with higher BMI at 7 years (data NR) (2) Dairy intake at 12m but not meat or cereal intake associated with BMI (data NR)	NR	(1) 0.002 (2) 0.02	Sex, child baseline BMI SDS, total energy intake fat intake (% energy), firstborn status, maternal weight, educational attainment, gestational age, maternal smoking, breastfeeding*	DONALD cohort Power calculation reported
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Animal protein (dairy) and BMI	PCS (Braun et al 2016) (3564) USA	12 months (1 year)	8 years	Dairy protein (g per day)	(1) BMI (2) Body weight	A 10g higher dairy protein intake (per day) at age 1 year associated with	(1) 0.02 to 0.11 (2) 0.03 to 0.12	(1 and 2) <0.05	Birth weight z-score, breastfeeding, playing sports, household income, maternal BMI at study enrolment, education, folic	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(1) 0.07 SD increase in BMI (2) 0.07 SD increase in body weight However, there was no difference in effect sizes between dairy and non-dairy sources of protein.			acid use during pregnancy, smoking during pregnancy and non-dairy animal protein	
Animal protein intake and body fat										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Animal protein and body fat	PCS (Gunther et al 2007) (203) Germany	12 months, 5 to 6 years	Age 7 years	Median protein intake % energy (25th to 75th percentiles) at 12 months 13.3% (11.7 to 14.8%)	Body fat %	(1) Animal protein at 12 months and 5 to 6 years associated with higher % body fat	NR	(1) 0.01	Sex, child baseline BMI SDS, total energy intake fat intake (% energy), firstborn status, maternal weight,	DONALD cohort

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(2) Dairy intake but not meat or cereal intake associated with BMI		(2) 0.07	educational attainment, gestational age, maternal smoking, breastfeeding*	
Vegetable protein intake and BMI										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Vegetable protein and BMI	PCS (Gunther et al 2007) (203) Germany	12 months, 5 to 6 years	Age 7 years	Median protein intake % energy (25^{th} to 75^{th} percentiles) 13.8% (12.9 to 15.2%)	BMI SDS	Vegetable protein intake at 12 months not associated with BMI at 7 years (data NR)	NR	Not significant (p-value NR)	Sex, child baseline BMI SDS, total energy intake, fat intake (% energy), fibre intake (g per kcal), firstborn status, maternal weight, educational attainment, gestational age, maternal smoking, breastfeeding*	DONALD cohort
Vegetable protein intake and body fat										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vegetable protein and body fat	PCS (Gunther et al 2007) (203) Germany	12 months, 5 to 6 years	Age 7 years	Median protein intake % energy (25th to 75th percentiles) at 12 m 13.3% (11.7 to 14.8%)	% body fat	Vegetable protein intake at 12 months not associated with % body fat at 7 years (data NR)	NR	Not significant (p-value NR)	Sex, child baseline % body fat, total energy intake, fat intake (% energy), fibre intake (g per kcal), firstborn status, maternal weight, educational attainment, gestational age, maternal smoking, breastfeeding, *	DONALD cohort

Table A9.8 Protein intake and growth outcomes

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total protein intake and adiposity rebound (AR)										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein and age at AR	PCS (Dorosty et al 2000) 772 UK	18 months	Variable	Protein (g per day)	Timing of AR	No association between protein intake and timing of AR (data NR)	NR	Not significant (p-value NR)	Analyses stratified by sex*	ALSPAC cohort Parental BMI and having at least 1 obese parent predictive of very early (≤43 months) or early (49 to 60 months) AR
Protein and age at AR	PCS (Gunther et al 2006) (313) Germany	12 to 24 months	Up to age 7 years	Protein (% energy)	Timing of AR	No association between habitual protein intake and timing of	NR	p>0.05*	Gestational age, breastfeeding, energy intake, maternal BMI, siblings in data set*	DONALD cohort No power calculation

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						AR (data NR)				
Protein and BMI at AR	PCS (Gunther et al 2006) (313) Germany	12 to 24 months	Up to age 7 years	Protein (% energy)	BMI-SDS at AR	Girls in highest tertile of protein intake had a significantly higher BMI-SDS at AR than those in the lowest tertile of protein intake (mean difference NR)	NR	<0.05*	Gestational age, breastfeeding, energy intake, maternal BMI, siblings in data set*	DONALD cohort No power calculation

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Animal protein intake and peak linear growth velocity (PLGV)										
Animal protein and PLGV	PCS (Berkey et al 2000) (67 girls) USA	3 to 5 years	Variable	Animal protein (g per day) age and energy-adjusted, expressed as log residuals entered into models*	PGV	Higher animal protein intake associated with higher PLGV (data NR)	NR	<0.05*	Baseline height and BMI, age-adjusted total energy intake at age 1 to 2, and age or energy-adjusted intakes of vegetable protein and total fat (g per day)*	Study conducted in the women born in the 1930s-1940s High drop-out rate (43%) No power calculation*

Table A9.9 Protein intake and timing of puberty

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Protein (total, animal and vegetable) intake and age of menarche or voice break										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein intake and age of menarche	PCS (Rogers et al 2010) (3298 girls) UK	3 years, 7 years	By age 12 years and 8 months	Total protein (g per day) Baseline dietary data collected by FFQ; validated by comparison with 3-day food records taken on 10% sample of the cohort*	Age at menarche (AAM) (defined as before or after age 12 years and 8 months) Data collected at research clinics when the girls were around age 11.5 to 12.5 years*	Total protein intake at 3 years associated with AAM ≤ 12 years and 8 months.	NR	NR	Unclear	ALSPAC cohort No power calculation* Analyses restricted to white girls from singleton births due to differences in outcome between white and non-white girls, and small number of non-white girls*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Animal protein intake and age of menarche	PCS (Berkey et al 2000) (67 girls) USA	3 to 5 years	Variable	Animal protein (g per day) age and energy-adjusted, expressed as log residuals entered into models* Diet history covering past 6 months – method internally validated – strong correlation between daily protein intake and child's rate of growth of muscle in lower leg (correlation coefficient 0.46 in girls and 0.68 for boys)*	Age at menarche (mean age at menarche 12.83, SD 1.09 years)*	Higher animal protein intake at age 3 to 5 years associated with earlier menarche (for every 1 SD increase in intake, menarche occurred 0.63 years earlier)	NR	<0.05*	Baseline height and BMI, age-adjusted total energy intake at age 1 to 2, and age or energy-adjusted intakes of vegetable protein and total fat (g per day)*	No power calculation* Study conducted in the women born in the 1930s-1940s High drop-out rate (43%)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Animal protein intake and age of menarche or voice break	PCS (Gunther et al 2010) (92) Germany	3 to 4 years, 5 to 6 years	Variable	Animal protein intake (% energy; age- and sex-standardised) Meat and dairy protein (% energy) 3-day weighed records at age 3, 4, 5, 6 years Urinary samples for urinary nitrogen excretion for validating dietary data collected from 57 children	Age at menarche or voice break	Higher animal protein intake (especially from cows' milk) tended to be associated with earlier menarche per voice break (data NR)	NR	0.06	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain 0-2y, total energy intake, fat intake (% energy), total protein (% energy) and vegetable protein (% energy), maternal overweight, paternal education*	Power calculation performed*
Animal protein intake and age of menarche	PCS (Rogers et al 2010) (3298 girls) UK	3 years, 7 years	By age 12 years and 8 months	Animal protein Meat protein (g per day) Baseline dietary data collected by FFQ; validated by comparison with 3-day	Age at menarche (AAM) (defined as before or after age 12 years and 8 months)	Animal protein intake at 3 years associated with AAM ≤ 12 years and 8 months.	NR	NR	Unclear	ALSPAC cohort No power calculation* Analyses restricted to white girls from singleton

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				food records taken on 10% sample of the cohort*	Data collected at research clinics when the girls were around age 11.5 to 12.5 years*	Meat intake at 3 years strongly associated with reaching menarche by 12 years and 8 months.				births due to differences in outcome between white and non-white girls, and small number of non-white girls*
Vegetable protein intake and age of menarche	PCS (Berkey et al 2000) (67 girls) USA	3 to 5 years	Variable	Vegetable protein (g per day) age and energy-adjusted, expressed as log residuals entered into models*	Age at menarche (mean age at menarche 12.83, SD 1.09 years)*	Higher vegetable protein intake at age 3 to 5 years associated with later menarche (data NR)	NR	<0.05*	Baseline height and BMI, age-adjusted total energy intake at age 1 to 2, and age or energy-adjusted intakes of vegetable protein and total fat (g per day)*	No power calculation* Study conducted in the women born in the 1930s-1940s High drop-out rate (43%)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vegetable protein intake and age of menarche or voice break	PCS (Gunther et al 2010) (92) Germany	3 to 4 years, 5 to 6 years	Variable	Vegetable protein (% energy, age standardised)	Age at menarche or voice break	Higher vegetable protein intake was associated with later menarche or voice break (data NR)	NR	0.02	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain 0-2y, total energy intake, fat intake (% energy), total protein (% energy) and animal protein (% energy) intake, fibre intake (g per day) maternal overweight, paternal education*	Power calculation performed*
Protein (animal and vegetable) intake and age at onset of pubertal growth spurt										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Animal protein and age at onset of pubertal growth spurt	PCS (Gunther et al 2010) (112) Germany	3 to 4 years	Variable	Animal protein (% energy)	Age at onset of pubertal growth spurt	Children in the highest tertile of animal protein intake at age 3 to 4 years experience	NR	<0.05*	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain 0-2y, total energy intake, fat intake (% energy), total protein (%	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						d earlier onset of pubertal growth at mean age 9.0 (95% CI 8.7 to 9.3) compared with age 9.7 (95% CI 9.4 to 10.0) in children in the lowest tertile*			energy) and vegetable protein (% energy), maternal overweight, parental education*	
Vegetable protein and age at onset of pubertal growth spurt	PCS (Gunther et al 2010) (112) Germany	3 to 4 years, 5 to 6 years	Variable	Animal protein (% energy)	Age at onset of pubertal growth spurt	Children in the highest tertile of vegetable protein intake at age 3 to 4 years experienced later onset of pubertal growth spurt at age 9.6 (95% CI	See previous column	p-trend =0.01	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain 0-2y, total energy intake, total protein (% energy) and animal protein (% energy) intake, fibre intake (g per day), maternal overweight,	None

Exposure and outcome	Study type **(n partici-pants)** **Country**	**Baseline age**	**Follow up**	Exposure	Outcome	**Measure of association or effect**	95% CI	**p-value**	**Variables adjusted for**	Comments
						9.2 to 9.9) compared with age 9.1 (95% CI 8.8 to 9.4) in children in the lowest tertile*			parental education*	
Protein (animal and vegetable) intake and age at peak linear growth velocity (PLGV)										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Animal protein and age at PLGV	PCS (Gunther et al 2010) (112) Germany	3 to 4 years	Variable	Animal protein (% energy)	Age at PLGV	Children in the highest tertile of animal protein intake at age 3 to 4 years experienced PGV at mean age 12.0 (95% CI 11.7 to 12.3) compared with age 12.5 (95% CI 12.2 to	NR	<0.05	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain at 0 to 2 years, total energy intake, fat intake (% energy), total protein (% energy) and vegetable protein (% energy), maternal overweight, parental education*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						12.9) in children in the lowest tertile				
Vegetable protein and age at PLGV	PCS (Gunther et al 2010) (112) Germany	3 to 4 years	Variable	Vegetable protein (% energy)	Age at PLGV	Children in the highest tertile of vegetable protein intake at age 3 to 4 years experienced PLGV at mean age 12.6 (12.3 to 13.0) compared with age 12.1 (11.8 to 12.5) in children in the lowest tertile	NR	p-trend =0.02	Sex, birth year, birth weight, breastfeeding duration, rapid weight gain at 0 to 2 years, total energy intake, total protein (% energy) and animal protein (% energy) intake, fibre intake (g per day), maternal overweight, parental education*	None

Table A9.10 Protein intake and other health outcomes

Exposure and outcome	Study type (n **partici-pants)** Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total protein intake and blood lipids										
	Voortman et al (2015b) AMSTAR 2 confidence rating: low									
Protein and blood lipids	PCS (Cowin et al 2000) (389) UK	18 months	Age 31 months	Protein intake (% energy) Mean protein intake 15% (males) and 15.1% (females)	(1) TC (2) LDL-C (3) HDL-C (4) TAG	(1) 0.00 (M), -0.07 (F) (2) -0.04 (M), -0.17 (F) (3) -0.07 (M), 0.06 (F) (4) NR	NR	Not significant (all >0.05)	Analysis stratified by sex, non-white children were excluded from the analysis Total energy intake and intakes of saturated fat and PUFA (unclear if % energy or absolute intake)	None
Total protein intake and bone health										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein and bone health	PCS (Bounds et al 2005) (52) USA	2 to 8 years	Age 8 years	Protein intake (g)	Bone mineral content (BMC)(g) Bone mineral density (BMD) (g per cm²)	Longitudinal intakes of protein (from age 2 to 8 years) correlated with BMC and BMD	NR	≤0.05	NR – not clear	Analysis in white children only

Exposure and outcome	Study type (n **participants)** Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total protein intake and neurodevelopment										
	Hornell et al (2013) AMSTAR 2 confidence rating: moderate									
Protein intake and neurodevelopment	PCS (Rask-Nissila, 2002) (496) Finland	8 months to 5 years	Age 5 years	Protein intake (% energy)	Speech and language skills Gross motor performance Perception	Protein intake at age 4 years predicted gross motor function and perception at age 5 years*	NR	NR	Analyses stratified by sex*	STRIP cohort

Micronutrients – iron

Table A9.11 Iron fortification of food and iron status

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron fortification of food and serum haemoglobin (Hb)										
	Athe et al (2013) AMSTAR 2 confidence rating: low									
Iron fortification and Hb	MA of 18 trials (6 were double blind, 2 were cluster randomised trials and the remaining 10 were randomised trials) (5142) Mainly LMIC	Mean age 4.7 years (SD 3.0 years)	Mean duration: 6.5 months (SD 4.2 months)	Iron-fortified foods (milk, orange juice, cereal-based staple foods, water). Main fortificant: ferrous sulphate	Hb	Mean change from baseline significantly higher in the Fe-fortified group than in the control: Weighted mean difference (WMD) 5.09 g/l	3.23 to 6.95g/l	<0.0001	Meta-regression: duration of intake of fortified food is an effective confounder. After removal of confounders (including study duration): WMD 4.74g/l (95% CI 3.08 to 6.40).	I^2=90% Random-effects model No information provided on type of analysis conducted by studies (Intention to treat [ITT] or per protocol [PP]) Probable absence of publication bias.

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										Findings not stratified by baseline iron status
	Matsuyama et al (2017) AMSTAR 2 confidence rating: moderate									
Iron fortification and Hb	MA of 8 trials (RCTs) (NR) 5 of 8 trials in HIC including 3 in UK (% weighting in MA NR)	Up to 5 years (5 of 8 trials in children aged 1 to 5 years; % weighting in MA NR)	NR Minimum 4 months' duration	Fortification of milk or formula with iron (with or without other micronutrients, principally zinc or vitamin D) Control group: non-fortified milk or formula	Hb	MD 5.89g/l Change from baseline	-0.25 to 12.02g/l	0.06	Not applicable	I^2 NR Random-effects model Findings not stratified by baseline iron status No information provided on type of analysis conducted by studies (ITT or PP) One review author partially funded by

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										Danone Nutricia. Funding source bias of the 8 RCTs was either unclear or low risk
	Pratt (2015) AMSTAR 2 confidence rating: critically low									
Iron fortification and Hb	Randomised trial (Rosado et al 2010) (2666) Mexico	36 months	4 months	4 intervention groups: - 10mg iron in micronutrient-fortified complementary food (also fortified with zinc, vitamin A and folic acid) - 20mg iron in iron supplement group - 12.5mg in iron and folic	Hb	All treatments significantly increased Hb (no control group)	NR	NR	NR	43 to 44% anaemia prevalence* PP analysis* Power calculation*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				supplement group -10mg in multiple micronutrient supplement group - 6.7mg iron in fortified water group						
Iron fortification and Hb	Cluster-randomised trial (Lundeen et al 2010) (2283) Kyrgyz Republic	6 to 36 months	2 months	Daily home fortification of complementary foods in the diet using 12.5mg micronutrient powder (Sprinkles) The control group did not receive the micronutrient powder until after the study period* Each sachet of micronutrient powder	Hb (g/l)	Intervention group: mean Hb concentration increased by 7g/l from 101.0 g/l at baseline to 108.1 g/l at follow-up Control group: mean Hb concentration decreased by 2g/l from	NR	<0.001 (for difference in change from baseline*)	Not applicable	Mean baseline Hb in both intervention and control groups was approximately 100g/l; anaemia prevalence 72%* - Power calculation* - Attrition 14%; PP analysis* - Clustering effects adjusted for*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				contained 12.5mg elemental iron, 300mcg vitamin A, 5mg zinc, 30mg vitamin C, 160mcg folic acid		100.3g/l to 98.6g/l * p<0.001 for difference between intervention and control groups (mean Hb at follow-up as well as change in Hb concentration from baseline)* MD not reported				- Study setting*: impoverished communities where nutritional iron deficiency and other forms of micronutrient malnutrition are common among young children
Iron fortification of food and serum ferritin										
	Matsuyama et al (2017) AMSTAR 2 confidence rating: moderate									
Iron fortification and serum ferritin	RCT (Szymlek-Gay et al 2009) (125 healthy children	Mean 16.8 months	5 months	Daily consumption of - 1.5mg iron per 100ml in cows' milk group	Serum ferritin (controlled for C-reactive protein [CRP]*)	Increase in mean serum ferritin levels in the fortified milk group	NR	NR	Not applicable	- Power calculation* - ITT analysis* - Low risk of bias from

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	without anaemia)* New Zealand			- 2.6mg iron in red meat group (approximately 56g) - 0.01mg iron in control milk (whole cows' milk) Fortified milk also contained zinc, vitamins A, C and D, and B vitamins Control milk contained vitamin A and D		from baseline and decreased in the control group (p=0.06 for decrease)* (quantitative data not reported)				funding source - Groups receiving milk (intervention or control) had a significantly higher compliance rate (81.4% and 89.4%) compared with the meat group (3.4%)
Iron fortification and serum ferritin	RCT (Virtanen et al 2001) (36 healthy children without anaemia)* Sweden	12 months	6 months	Milk fortified with iron (and vitamin C) compared with non-fortified milk	Serum ferritin All children had normal CRP concentration at baseline and at the	No statistically significant difference in change from baseline serum ferritin	NR	0.06	Not applicable	-Power calculation but not for serum ferritin* -PP analysis* -Low risk of bias from

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
					end of the intervention*	between groups				funding source
Iron fortification and serum ferritin	RCT (Sazawal et al 2010) (570 children with anaemia)* India	Mean 22.4 months (intervention group) 23 months (control group)	12 months	Milk fortified with iron, zinc, vitamin A (and other micronutrients) compared with control milk (also fortified but with lower doses of iron, zinc and vitamin A) – part of a public health intervention	Serum ferritin (unclear whether adjusted for CRP)	Increase in serum ferritin levels among the fortified milk group compared with the control group after 1 year of intervention (quantitative data not reported)	NR	NR	Not applicable	-Power calculation (but not for serum ferritin)* - ITT analysis -Low risk of bias from funding source

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron fortification and serum ferritin	RCT (Villalpando et al 2006) (115) Mexico	Mean 20.4 months (intervention group) 22.5 months (control group)	6 months	Milk fortified with iron (5.8mg per 400ml daily portion), zinc vitamin A, folic acid compared with milk not fortified by iron, zinc and folic acid (but fortified with vitamin A) – part of a public health intervention programme	Serum ferritin (unadjusted for CRP*)	No statistically significant difference in change from baseline serum ferritin between groups (quantitative data not reported)	NR	NR	Not applicable	- 41% anaemia prevalence in intervention group; 30% in control group* - Power calculation (but not for serum ferritin)* - PP analysis* -Unclear risk of bias from funding source
	Pratt (2015) AMSTAR 2 confidence rating: critically low									
Iron fortification and serum ferritin	RCT (Szymlek-Gay et al 2009) (125) New Zealand	Mean 16.8 months	5 months	Daily consumption of - 1.5mg iron per 100ml in cows' milk group - 2.6mg iron in red meat group	Serum ferritin	Compared with the control group, serum ferritin (a) higher in the fortified	NR	(a) <0.001 (b) 0.033		Healthy, non-anaemic children Also reported in Matsuyama but more details provided

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(approximately 56g) - 0.01mg iron in control group (whole cows' milk) Milk also fortified with vitamin C, zinc and vitamin D		cows' milk group (b) higher in the red meat group Serum ferritin increased by 44% in cows' milk group (p=0.002) and did not change in the red meat group				
Iron fortification and serum ferritin	Randomised trial (Rosado et al 2010) (2666) Mexico	36 months	4 months	4 intervention groups: - 10mg iron in micronutrient-fortified porridge powder (also fortified with zinc, vitamin A, vitamin C and folic acid)* - 20mg iron in iron	Serum ferritin (adjusted for CRP*)	No change in serum ferritin after 4 months intervention in any of the treatment groups	NR	NR	NR	- 43 to 44% anaemia prevalence* - PP analysis* - Power calculation (but not for serum ferritin)*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				supplement group - 12.5mg in iron and folic supplement group -10mg in multiple micronutrient supplement group - 6.7mg iron in fortified water group						
Iron fortification of food and iron deficiency (ID)										
	Pratt (2015) AMSTAR 2 confidence rating: critically low									
Iron fortification and ID	Double-blinded, cluster*-randomised trial (Rivera et al 2010) (795) Mexico	12 to 30 months	12 months	Assessment of the effectiveness of a large-scale programme that distributed iron-fortified milk on anaemia and ID	Prevalence of ID (assessed as serum ferritin <12µg/l)	Intervention group: estimated prevalence of serum ferritin <12µg/l at baseline: 29.8% after 6 months: 18.6%	NR	0.006*	Findings adjusted for cluster effects, child's age, and SES	Baseline anaemia prevalence: 45% in intervention group 43% in control group -PP analysis* - Adjustment for cluster effects*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Daily portion of fortified milk contained 5.28mg iron (per 400ml) compared with control milk* Intervention and control milks also differed in their content of zinc, vitamin A and C (with the intervention milk containing higher doses of these)*		after 12 months 5.7% Control group: estimated prevalence of serum ferritin <12μg/l at baseline: 36.0% after 6 months: 41.8% after 12 months 17.1%				- Imbalance between intervention and control group numbers (n=144 compared with 43)*
Iron fortification of food and anaemia										
	Matsuyama et al (2017) AMSTAR 2 confidence rating: moderate									

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron fortification and odds of anaemia	MA of 9 RCTs (NR) 4 of 9 trials in HIC including 3 in UK (% weighting in MA NR)	Up to 5 years (5 of 9 trials in children aged 1 to 5 years; % weighting in MA NR)	NR	Fortification of milk or formula with iron (with or without other micronutrients, principally zinc or vitamin D) Control group: non-fortified milk or formula	Anaemia	OR 0.32	0.15 to 0.66	NR	Not applicable	I^2=75.2% - Random-effects model - Findings not stratified by baseline iron status - One review author partially funded by Danone Nutricia. - Funding source bias of the 9 RCTs was either unclear or low risk -Funnel plot for anaemia showed symmetry, suggesting minimal publication bias

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										-No information provided on type of analysis conducted by studies (ITT or PP)
Iron fortification and odds of anaemia	Subgroup MA of 6 RCTs (NR) Countries NR	Age >12 months at baseline	NR	Fortification of milk or formula with iron (with or without other micronutrients, principally zinc or vitamin D) Control group: non-fortified milk or formula	Anaemia	OR 0.46	0.19 to 1.12	NR	Not applicable	As above
	Pratt (2015) AMSTAR 2 confidence rating: critically low									

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron fortification and anaemia prevalence	Cluster-randomised trial (Lundeen et al 2010) (2283) Kyrgyz Republic	6 to 36 months	2 months	Daily home fortification of complementary foods in the diet using 12.5mg micronutrient powder (Sprinkles) The control group did not receive the micronutrient powder until after the study period* Each sachet of micronutrient powder contained 12.5mg elemental iron, 300mcg vitamin A, 5mg zinc, 30mg vitamin C, 160mcg folic acid	Anaemia prevalence (assessed by Hb <110g/l)	Intervention group: prevalence of anaemia decreased from 72% at baseline to 52% at follow-up Control group: Prevalence of anaemia increased from 72% to 75% at follow-up*	NR	<0.001 (for difference between groups at follow-up*)	Not applicable	Mean baseline Hb in both intervention and control groups was approximately 100g/l; anaemia prevalence 72%* Hb decreased from baseline to follow-up in the control group from 100.2 to 98.6g/l - Power calculation* - Attrition 14%; PP analysis* - Clustering effects adjusted for* - Study setting*:

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										impoverished communities where nutritional iron deficiency and other forms of micronutrient malnutrition are common among young children
Iron fortification and anaemia prevalence	Double-blinded, group-randomised effectiveness trial (Rivera et al 2010) (795) Mexico	12 to 30 months	12 months	Assessment of the effectiveness of a large-scale programme that distributed iron-fortified milk on anaemia and ID Daily portion of fortified milk contained	Anaemia prevalence (assessed by Hb <110g/l)	Intervention group: estimated prevalence of anaemia from baseline to 6 and 12 months decreased from 44.5% to 12.7% and 4.0%,	NR	0.02	Not applicable	Baseline anaemia prevalence 43% - PP analysis* - Adjustment for cluster effects*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				5.28mg iron (per 400ml) compared with control milk* Intervention and control milks also differed in their content of zinc, vitamin A and C (with the intervention milk containing higher doses of these)*		respectively Control group: estimated prevalence of anaemia from baseline to 6 and 12 months decreased from 42.6%, 19.7% and 9.4%, respectively				
Iron fortification and anaemia prevalence	RCT (Villalpando et al 2006) (115) Mexico	10 to 30 months	6 months	Milk fortified with iron (5.8mg per 400ml daily portion), zinc vitamin A, folic acid compared with milk not fortified by iron, zinc and	Anaemia prevalence (anaemia defined as <110g/l*)	Intervention group: prevalence of anaemia declined from 41.4% to 12.1%; p<0.001	NR	See measure of association or effect	Not applicable	41% anaemia prevalence in intervention group; 30% in control group* - Power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Intervention	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				folic acid (but fortified with vitamin A) – part of a public health intervention programme		Control group: no change – 30% to 24%; p=0.40 Treatment with fortified milk was inversely associated with the likelihood of being anaemic after the 6 month intervention (p<0.03); adjusted for age, sex and baseline anaemia*		column		(for anaemia prevalence)* - PP analysis* -Unclear risk of bias from funding source (Matsuyama)

Table A9.12 Iron supplementation and iron status

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and haemoglobin (Hb)										
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and Hb	MA of 9 trials (RCTs or quasi-randomised) (2154) Mainly low- and middle-income countries (LMIC)	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Hb	MD 6.97g/l	4.21 to 9.72	<0.00001	Not applicable	I^2=82% Random-effects model
Iron supplementation and Hb	Subgroup MA of 4 trials (without anaemia at baseline participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Hb	MD 3.91g/l	NR	0.03	Not applicable	I^2=62% Random-effects model Anaemia not defined

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and Hb	Subgroup MA of 4 trials (with anaemia at baseline, participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Hb	MD 11.77g/l	NR	0.0001	Not applicable	I^2=82% Random-effects model Anaemia not defined
Iron supplementation and Hb	Subgroup MA of 2 trials (iron replete at baseline participant number NR)	2 to 5 years	NR	Daily iron supplementation(10 to 82.5mg) compared with control	Hb	MD 2.28g/l	NR	0.07	Not applicable	I^2=0% Random-effects model Iron deficiency not defined
Iron supplementation and Hb	Subgroup MA of 3 trials (baseline iron deficiency participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Hb	MD 9.06g/l	NR	0.0006	Not applicable	I^2=0% Random-effects model Iron deficiency not defined
	De-Regil et al (2011) AMSTAR 2 confidence rating: high									

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and Hb	MA of 9 trials (1254) LMIC	0 to 59 months	4 trials had a duration of ≤3 month and 5 trials had a duration of >3 months.	Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Hb	MD 6.45g/l	2.36 to 10.55	NR	Not applicable	I^2 NR Random-effects model
Iron supplementation and Hb	Subgroup MA of 1 trial (307 participants with anaemia at baseline)	0 to 59 months	NR	Intermittent iron supplementation compared with control	Hb	MD 8.0g/l	5.0 to 11.0	NR	Not applicable	Random-effects model Anaemia status of children: Hb <110g/L for children aged 6 to 59 months No evidence identified in non-anaemic children
Iron supplementation and Hb	Subgroup MA of 8 trials (947 participants	0 to 59 months	NR	Intermittent iron supplementati	Hb	MD 6.25g/l	1.60 to 10.90	NR	Not applicable	I^2 NR Random-effects model

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	with mixed or unknown baseline status)			on compared with control (most trials provided weekly doses between 25-75mg of elemental iron)						No evidence identified in non-anaemic children
Iron supplementation and serum ferritin										
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and serum ferritin	MA of 5 trials (RCTs or quasi-randomised) (1407) Mainly low- and middle-income countries (LMIC)	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Ferritin	MD 11.64μg/l	6.02 to 17.25	<0.00001	Not applicable	I^2=48% Random-effects model Included studies did not specify whether they used arithmetic or geometric means so SR authors also calculated SMD (SMD 0.4; 95% CI 0.22 to 0.59;

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										p<0.0001; I^2=39%) Studies did not specifically discuss or account for the effect of inflammation or infection on ferritin.
Iron supplementation and serum ferritin	Subgroup MA of 2 trials (without anaemia at baseline participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Ferritin	MD 13.6 µg/l	NR	0.13	Not applicable	I^2=76% Random-effects model Anaemia not defined
Iron supplementation and serum ferritin	Subgroup MA of 3 trials (with anaemia at baseline, participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Ferritin	MD 11.39 µg/l	NR	0.03	Not applicable	I^2=81% Random-effects model Anaemia not defined

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and serum ferritin	Subgroup MA of 2 trials (iron replete at baseline participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Ferritin	MD 14.34 µg/l	NR	0.16	Not applicable	I^2=78% Random-effects model Iron deficiency not defined
Iron supplementation and serum ferritin	Subgroup MA of 3 trials (baseline iron deficiency participant number NR)	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Ferritin	MD 13.01 µg/l	NR	0.02	Not applicable	I^2=82% Random-effects model Iron deficiency not defined
	De-Regil et al (2011) AMSTAR 2 confidence rating: high									
Iron supplementation and serum ferritin	MA of 4 trials (310) LMIC	0 to 59 months	1 trial had a duration of ≤3 month and 3 trials had a duration of >3 months.	Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Ferritin	MD 13.15 µg/l	-2.28 to 28.59	NR	Not applicable	I^2 NR

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and serum ferritin	Subgroup MA of 1 trial (74 participants non-anaemic at baseline)	0 to 59 months	NR	Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Ferritin	MD 2.46 µg/l	-14.37 to 19.29	NR	Not applicable	No evidence identified in anaemic children (Hb <110g/L)
Iron supplementation and serum ferritin	Subgroup MA of 3 trials (236 participants with mixed or unknown baseline status)	0 to 59 months	NR	Intermittent iron supplementation versus control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Ferritin	MD 16.12 µg/l	-1.81 to 34.05	NR	Not applicable	I^2 NR
Iron supplementation and iron deficiency (ID)										

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	De-Regil et al (2011) AMSTAR 2 confidence rating: high									
Iron supplementation and ID	MA of 3 trials (431) LMIC	0 to 59 months	NR	Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	ID	RR 0.24	0.06 to 0.91	NR	Not applicable	I^2 NR Not enough studies (<4) to carry out subgroup analysis by anaemia status at baseline
Iron supplementation and anaemia										
	De-Regil et al (2011) AMSTAR 2 confidence rating: high									
Iron supplementation and anaemia	MA of 4 trials (658) LMIC	0 to 59 months		Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Anaemia	RR 0.43	0.23 to 0.80	NR	Not applicable	I^2 NR
Iron supplementation	Subgroup MA of 1 trial (307	0 to 59 months	NR	Intermittent iron supplementati	Anaemia	RR 0.61	0.49 to 0.74	NR	Not applicable	Anaemia status of children: Hb

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
and anaemia	children with anaemia at baseline)			on compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)						<110g/L for children aged 6 to 59 months No evidence identified in non-anaemic children
Iron supplementation and anaemia	Subgroup MA of 3 RCTs (351 children mixed or unknown status at baseline)	0 to 59 months	NR	Intermittent iron supplementation compared with control (most trials provided weekly doses between 25 to 75mg of elemental iron)	Anaemia	RR 0.26	0.07 to 1.03	NR	Not applicable	I^2 NR

Table A9.13 Iron supplementation and growth outcomes

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and body weight										
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and body weight (endpoint)	MA of 3 trials (RCTs or quasi-randomised) (participants NR) Mainly low- and middle-income countries (LMIC)	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Body weight (endpoint)	MD 0.15kg	-0.22 to 0.51	0.44	Not applicable	I^2=38% Stratification by baseline status either not performed or not reported
Iron supplementation and change in body weight	MA of 4 trials (RCTs or quasi-randomised) (participants NR) Mainly LMIC	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Change from baseline in body weight	MD -0.06kg	-0.14 to 0.02	0.15	Not applicable	I^2=0% Random-effects model Stratification by baseline status either not performed or not reported

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and change in weight z-score	MA of 3 trials (RCTs or quasi-randomised) (participants NR) Mainly LMIC	2 to 5 years	NR	Daily iron supplementation (10 to 82.5mg) compared with control	Change from baseline in weight z-score	MD -0.04	-0.12 to 0.05	0.43	Not applicable	I^2=0% Random-effects model Stratification by baseline status either not performed or not reported
Iron supplementation and length or height										
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and height (endpoint)	MA of 3 trials (RCTs or quasi-randomised) (participants NR) Mainly LMIC	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Height (endpoint)	MD 0.19cm	-1.33 to 0.94	0.74	Not applicable	I^2=0% Stratification by baseline status either not performed or not reported

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and change in height	MA of 3 trials (RCTs or quasi-randomised) (participants NR) Mainly LMIC	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Change from baseline in height	MD 0.26cm	-0.49 to 1.01	0.50	Not applicable	I^2=95% Random-effects model Stratification by baseline status either not performed or not reported
Iron supplementation and change in height z-score	MA of 3 trials (RCTs or quasi-randomised) (participants NR) Mainly LMIC	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Change from baseline in height z-score	MD -0.01	-0.14 to 0.12	0.86	Not applicable	I^2=83% Random-effects model Stratification by baseline status either not performed or NR

Table A9.14 Iron supplementation and neurological development

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and cognitive development										
	Pasricha et al (2013) AMSTAR 2 confidence rating: high									
Iron supplementation and cognitive development	MA of 6 RCTs (1093) Mainly MIC	4 to 23 months 61% weighting from studies with children aged 12 to 60 months	3 to 6 months	Daily iron supplementation (10 to15mg) compared with control	Bayley's mental development index	MD 1.65	-0.63 to 3.94	0.16	Not applicable	I^2=66% Random-effects model
Iron supplementation and cognitive development	Sensitivity analysis including only studies at low risk of bias (2 RCTs; participants NR)	No information on % weighting from studies in children aged 12 to	NR	Daily iron supplementation (10 to 15mg) compared with control	Bayley's mental development index	MD 2.05	-1.46 to 5.55	0.25	Not applicable	NR

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		60 months								
Iron supplementation and cognitive development	Subgroup MA of 3 RCTs (113 children with anaemia at baseline – anaemia defined by individual studies but not reported by review authors)	No information on % weighting from studies in children aged 12 to 60 months	NR	Daily iron supplementation (10 to 15mg) compared with control	Bayley's mental development index	MD 4.46	-9.32 to 18.24	0.53	Not applicable	I^2=80% Random-effects model
Iron supplementation and cognitive development	Subgroup MA of 5 RCTs (325 children without anaemia at baseline)	No information on % weighting from studies in children aged 12 to		Daily iron supplementation (10 to 15mg) compared with control	Bayley's mental development index	MD 1.49	-1.08 to 4.07	0.25	Not applicable	I^2=28% Random-effects model

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		60 months								
Iron supplementation and cognitive development	Subgroup MA of 3 RCTs (281 children with baseline iron deficiency)	9.4% weighting of MA from studies with children aged 12 to 60 months	NR	Daily iron supplementation (10 to 15mg) compared with control	Bayley's mental development index	MD 5.90	1.81 to 10.00	0.005	Not applicable	I^2=34% Random-effects model
Iron supplementation and cognitive development	Subgroup MA of 3 RCTs (90 children – iron replete at baseline)	8% weighting from studies with children aged 12 to 60 months	NR	Daily iron supplementation (10 to 15mg) compared with control	Bayley's mental development index	MD 0.65	-1.59 to 2.88	0.57	Not applicable	I^2=0% Random-effects model

Table A9.15 Iron supplementation and immune function

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and vomiting										
	Pasricha et al (2013) AMSTAR 2 confidence rating: high									
Iron supplementation and vomiting	MA of 3 RCTs (1020) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation (10 to 15mg) compared with control	Vomiting	RR 1.38	1.10 to 1.73	0.006	Not applicable	I^2=1% Random-effects model Not stratified by baseline nutritional status
Iron supplementation and diarrhoea										
	Pasricha et al (2013) AMSTAR 2 confidence rating: high									
Iron supplementation and diarrhoea (prevalence)	MA of 6 RCTs (1697) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation (10 to 15mg) compared with control	Diarrhoea prevalence	RR 1.03	0.86 to 1.23	0.78	Not applicable	I^2=0 Random-effects model Not stratified by baseline nutritional status

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and diarrhoea (prevalence)	Subgroup MA of 2 RCTs (442 children with anaemia at baseline)	4 to 23 months	NR	Daily iron supplementation (10-15mg) compared with control	Diarrhoea prevalence	RR 0.68	0.37 to 1.27	0.23	Not applicable	I^2=0 Random-effects model
Iron supplementation and diarrhoea (prevalence)	Subgroup MA of 1 RCT (179 children iron replete or without anaemia at baseline)	4 to 23 months	NR	Daily iron supplementation (10-15mg) compared with control	Diarrhoea prevalence	RR 0.66	0.17 to 2.57	0.55	Not applicable	I^2=0 Random-effects model
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and diarrhoea	MA of 2 trials (RCTs or quasi-randomised) (294) Mainly LMIC	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Episodes of diarrhoeal illnesses per child per year	MD: 0.3	NR	0.13	Not applicable	I^2=0 Baseline status: mixed or unknown

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and diarrhoea	Trial (Angeles et al 1993) (80) Indonesia	2 to 5 years	2 months	Daily iron (30mg) + vitamin C (10mg) compared with control (vitamin C, 20mg)	Diarrhoeal episodes	Diarrhoeal episodes in iron-supplemented group compared with control: 5.1 compared with 16.2	NR	NR	Not applicable	Baseline status: Anaemic (Hb 80-110g/l) Iron deficient (not defined)
Iron supplementation and diarrhoea	Trial (Adish et al, 1997) (407) Ethiopia	24 to 60 months	3 months	Daily iron (30mg) compared with placebo OR iron (30mg) and vitamin A (200000 IU) compared with vitamin A (200000 IU) alone	Diarrhoeal episodes	Diarrhoeal episodes (per person per month) in iron-supplemented group compared with control: 2.1 compared with 1.9	NR	NR	Not applicable	Baseline status: mixed or unknown

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and respiratory illnesses										
	Pasricha et al (2013) AMSTAR 2 confidence rating: high									
Iron supplementation and acute respiratory infection	MA of 2 RCTs (944) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation (10 to 15mg) compared with control	Acute respiratory infection	RR 1.04	0.92 to 1.19	0.51	Not applicable	I^2=0 Random-effects model Not stratified by baseline nutritional status
Iron supplementation and lower respiratory tract infection (incidence)	MA of 3 RCTs (NR) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation (10 to 15mg) compared with control	Lower respiratory tract infection	Rate ratio 1.00	0.89 to 1.12	0.96	Not applicable	I^2=0 Random-effects model Not stratified by baseline nutritional status
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and respiratory illness	MA of 2 trials (RCTs or quasi-randomised) (294) Mainly LMIC	2 to 5 years	1 to 12 months	Daily iron supplementation (10 to 82.5mg) compared with control	Respiratory illnesses per child per year	MD: -0.06	NR	0.81	Not applicable	I^2=0 Baseline status: mixed or unknown

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and respiratory illness	Trial (Angeles et al 1993) (80) Indonesia	2 to 5 years	2 months	Daily iron (30mg) and vitamin C (10mg) compared with control (vitamin C, 20mg)	Respiratory episodes	Respiratory episodes in iron-supplemented group compared with control: 10.3 compared with 27.0	NR	NR	Not applicable	Baseline status: Anaemic (Hb 80 to 110g/l) Iron deficient (not defined)
Iron supplementation and fever										
	Pasricha et al (2013) AMSTAR 2 confidence rating: high									
Iron supplementation and fever (prevalence)	MA of 4 RCTs (1318) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation(10-15mg) compared with control	Fever prevalence	RR 1.16	1.02 to 1.31	0.02	Not applicable	I^2=0 Random-effects model Not stratified by baseline nutritional status

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and fever (rate)	MA of 2 RCTs (NR) Mainly MIC	4 to 23 months	3 to 6 months	Daily iron supplementation(10-15mg) compared with control	Fever rate	Rate ratio 1.08	0.79 to 1.47	0.63	Not applicable	I^2=0 Random-effects model Not stratified by baseline nutritional status
	Thompson et al (2013) AMSTAR 2 confidence rating: moderate									
Iron supplementation and fever	Trial (Angeles et al 1993) (80) Indonesia	2 to 5 years	2 months	Daily iron (30mg) and vitamin C (10mg) compared with control (vitamin C, 20mg)	Fever episodes	Fever episodes occurred 1.7 times more frequently in controls than in the treatment group (13.5	NR	NR	Not applicable	Baseline status: Anaemic (Hb 80 to 110g/l) Iron deficient (not defined)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
						compared with 7.7)				
Iron supplementation and fever	Trial (Rosado et al, 1997) (419) Mexico	12 months	12 months	Daily iron (20mg) compared with placebo OR iron (20mg) and zinc (20mg) compared with zinc alone (20mg)	Fever episodes	No significant difference in number of episodes of fever Iron compared with placebo: 60 compared with 48 episodes Iron and zinc compared with zinc alone: 43 compared with 53 episodes	NR	NR	Not applicable	Baseline status: mixed or unknown

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association to effect	95% CI	p-value	Variables adjusted for	Comments
Iron supplementation and fever (rate)	Trial (Smith et al, 1989) (1382) Gambia	6m to 5 years	3 months	3 to 6mg per kg iron compared with placebo	Fever	Iron compared with control: 35 compared with 32 febrile episodes per health worker	NR	NR	Not applicable	Baseline status: anaemic or iron deficient

Micronutrients – zinc

Table A9.16 Zinc supplementation and zinc status

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Zinc supplementation and serum zinc levels										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and serum zinc levels	Subgroup analysis - age 1 to <5 years 22 estimates from 19 RCTs (4911)	1 to <5 years 2 of 19 studies in HIC	NR	Zinc supplementation compared with no zinc	Serum zinc levels	SMD -0.75 [negative SMD favours intervention]	-0.81 to -0.69	NR	Not applicable	I^2=93% Fixed-effects model
Zinc supplementation and serum zinc levels	Between-subgroup analysis Co-intervention with iron (Fe) compared with no Fe	Mainly children <5 years old % weighting in MA from studies in	NR	Zinc plus iron supplementation compared with zinc only	Serum zinc levels	Co-intervention with FE: SMD -0.47 (-0.54 to -0.39) No FE: SMD -0.70 (-0.75 to -0.65)	NR	<0.0001	Not applicable	NR

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		children aged 1 to 5 years NR								
Zinc supplementation and risk of zinc deficiency										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and risk of zinc deficiency	Subgroup analysis - age 1 to <5 years 12 estimates from 10 RCTs (3761)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Risk of zinc deficiency	RR 0.41	0.37 to 0.47	NR	Not applicable	I^2=90.6% Fixed-effects model
Zinc supplementation and risk of zinc deficiency	Between-subgroup analysis: zinc plus iron compared with no zinc only	Mainly children <5 years old % weighting in MA from	NR	Zinc plus iron supplementation compared with zinc only	Risk of zinc deficiency	Greater benefit in the subgroup not given iron (RR 0.37; 95% CI 0.33 to 0.42) compared	NR	<0.00001	Not applicable	NR

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		studies in children aged 1 to 5 years NR				with group given iron (RR 0.62; 95% CI 0.55 to 0.69)				
Zinc supplementation and haemoglobin levels										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and haemoglobin levels	Subgroup analysis - age 1 to <5 years 14 estimates from 12 RCTs (2332)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Haemoglobin levels	SMD -0.04	-0.12 to 0.04	0.36	Not applicable	I^2=62% Fixed effects
Zinc supplementation and serum or plasma ferritin concentration										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and serum or plasma ferritin	Subgroup analysis – age 1 to <5 years 11 estimates from 8 RCTs	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Serum or plasma ferritin	SMD 0.16	0.08 to 0.24	P=0	Not applicable	I^2=98% Fixed-effects model

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
concentration	(2716)									
Zinc supplementation and prevalence of anaemia										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and prevalence of anaemia	Subgroup analysis – age 1 to <5 years 8 estimates from 6 RCTs (2161)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Prevalence of anaemia	RR 0.99	0.88 to 1.12	0.88	Not applicable	I^2=50% Asymmetrical funnel plot Fixed-effects model
Zinc supplementation and prevalence of iron deficiency (ID)										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and ID	Subgroup analysis - age 1 to <5 years 11 estimates from 7 RCTs (1992)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	ID	RR 1.16	0.94 to 1.44	0.16	Not applicable	I^2=12.98% Fixed-effects model

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Zinc supplementation and ID	Between-subgroup analysis: zinc plus iron compared with no zinc only	Mainly children <5 years old % weighting in MA from studies in children aged 1 to 5 years NR	NR	Zinc plus iron supplementation compared with zinc only	ID	No difference in effect between subgroups	Not applicable	0.48	Not applicable	I^2 NR
Zinc supplementation and growth – height										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and height	Subgroup analysis - Age 1 to <5 years 27 estimates from 24 RCTs (6155)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Height	SMD -0.09 [negative SMD favours intervention]	-0.14 to -0.04	P=0	Not applicable	Fixed effects I^2=42%

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Zinc supplementation and height	Subgroup analysis - HIC 6 RCTs (284)	Mainly children <5 years old 56% weighting in subgroup MA from studies in children aged 1 to 5 years at baseline	NR	Zinc supplementation compared with no zinc	Height	SMD -0.17	-0.40 to 0.06	0.14	Not applicable	I^2=45%
Zinc supplementation and height	Between-subgroup analysis: zinc plus iron compared with no zinc only	Mainly children <5 years old % weighting in MA	NR	Zinc plus iron supplementation compared with zinc only	Height	Greater benefit in subgroup not given iron (SMD -0.12; 95% CI -0.16 to -0.08) compared	See previous column	0.01	Not applicable	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		from studies in children aged 1 to 5 years NR				with no difference in the group given iron (SMD -0.01; 95% CI -0.08 to 0.07)				
Zinc supplementation and growth – weight										
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and weight	Subgroup analysis - Age 1 to <5 years 23 estimates from 20 RCTs (5565)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Weight	SMD -0.06 [negative SMD favours intervention]	-0.11 to -0.01	0.03	Not applicable	I^2=43%; Fixed-effects
Zinc supplementation and weight	Subgroup analysis - HIC 5 RCT (271)	Mainly children <5 years old %60 weighting of subgro	NR	Zinc supplementation compared with no zinc	Weight	SMD -0.16 [negative SMD favours intervention]	-0.40 to 0.07	0.18	Not applicable	I^2=44.5%; Fixed-effects

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		up MA from studies in children aged 1 to 5 years at baseline								
Zinc supplementation and weight	Between-subgroup analysis: zinc plus iron compared with no zinc only	Mainly children <5 years old % weighting in MA from studies in children aged 1 to 5 years NR	NR	Zinc plus iron supplementation compared with zinc only	Weight	No difference in effect between subgroups	NR	0.22	Not applicable	None
Zinc supplementation and growth – weight for height										

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Mayo-Wilson et al (2014) AMSTAR 2 confidence rating: moderate									
Zinc supplementation and growth – weight-to-height ratio	Subgroup analyses: - Age 1 to <5 years 14 estimates from 12 RCTs (4302)	Age 1 to <5 years	NR	Zinc supplementation compared with no zinc	Weight-to-height	SMD -0.02	-0.08 to 0.05	0.62	Not applicable	I^2=6.8%; fixed effects Graded
Zinc supplementation and growth – weight-to-height ratio	Between-subgroup analysis - Fe compared with no Fe	Mainly children <5 years old % weighting in MA from studies in children aged 1 to 5 years NR	NR	Zinc plus iron supplementation compared with zinc only	Weight-to-height	No difference in effect between subgroups	NR	0.06	Not applicable	None

Micronutrients – vitamin A

Table A9.17 Vitamin A supplementation and vitamin A status

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin A supplementation and serum vitamin A										
	Imdad et al (2017) AMSTAR 2 confidence rating: high									
Vitamin A supplements and serum retinol level	MA of 15 RCTs (11,788) LIC, LMIC, UMIC	6 to 60 months	Longest follow-up (NR)	Vitamin A-supplements	Serum retinol levels	SMD 0.26	0.22 to 0.30	<0.001	Not applicable	I^2=95%; Fixed- effects
Vitamin A supplements and serum retinol level sensitivity analysis (test for small study bias)	MA of 14 RCTs LIC, LMIC, UMIC	6 to 60 months	Longest follow-up (NR)	Vitamin A-supplements	Serum retinol levels	SMD 0.50	0.30 to 0.70	NR	Not applicable	I^2=95%; Random-effects; The overall estimate was considerably larger than the fixed-effect estimate, suggesting

										small studies report larger effects Asymmetrical funnel plot
Vitamin A supplementation and vitamin A deficiency										
	Imdad et al (2017) AMSTAR 2 confidence rating: high									
Vitamin A supplements and vitamin A deficiency	MA of 4 RCTs (2262) LIC, LMIC, UMIC	6 to 60 months	24 months (At longest follow-up)	Vitamin A supplements	Vitamin A deficiency	RR 0.71	0.65 to 0.78	<0.0001	Not applicable	I^2=78%; Fixed- effects

Table A9.18 Vitamin A fortification and vitamin A status

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin A fortification and serum retinol										
	Eichler et al (2012) AMSTAR 2 confidence rating: low									
Vitamin A fortification and serum retinol	MA of 4 RCTs (NR)	6 months to 3 years (% weighting in children aged 1 to 5 years not reported)	NR	Vitamin A fortification (with other micronutrients)	Serum retinol concentration	MD: 3.7µg/dl	1.3 to 6.1µg/dl	NR	Not applicable	I^2=37%
	Das et al (2013) AMSTAR 2 confidence rating: critically low									

Vitamin A fortification and serum retinol	MA of 5 estimates from 3 RCTs (2362) UMIC and LMIC	48 to 72 months	More than 6 months	Vitamin A fortification Food vehicle: biscuits, monosodium glutamate, sugar, flour and seasoning.	Serum retinol concentration	SMD: 0.61	0.39 to 0.83	<0.0001	Not applicable	I^2=84%; random effects; 3 estimates from 1 study were in children aged 3 to 6 years (55.5% weighting of MA)
Vitamin A fortification and vitamin A deficiency										
	Das et al (2013) AMSTAR 2 confidence rating: critically low									
Vitamin A fortification and vitamin A deficiency	MA of 4 estimates from 2 RCTs (1465) UMIC and LMIC	48 to 72 months	More than 6 months	Vitamin A fortification Food vehicle: biscuits, monosodium glutamate, sugar, flour and seasoning.	Vitamin A deficiency	RR 0.39	0.09 to 1.74	0.22	Not applicable	Plasma (serum) retinol concentration of less than 20 µg/dl – adapted from WHO (Global prevalence of vitamin A deficiency in populations at risk 1995-2005); I^2=88%; random effects; 4 effect estimates from 2 RCTs of which 3 estimates from 1 study were in children aged 3 to 6 years (70.9% weighting of MA)

Table A9.19 Vitamin A supplementation and ophthalmological outcomes

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin A supplementation and Bitot's spots										
	Imdad et al (2017) AMSTAR 2 confidence rating: high									
Vitamin A supplements and Bitot's spots	1 RCT (NR) LIC	9 to 72 months	Every 6 months for 18 months	Vitamin A supplements	Incidence of Bitot's sports	No effect: RR 0.93	0.76 to 1.14	NR	Not applicable	Fixed-effects
Vitamin A supplements and Bitot's spots	MA of 5 RCTs (1,063,278) LIC, LMIC, UMIC	6 to 60 months	At longest follow-up (<1 year since randomisation)	Vitamin A supplements	Prevalence of Bitot's sports	RR 0.42	0.33 to 0.53	<0.0001	Not applicable	I^2=49%; Fixed-effects
Vitamin A supplementation and night blindness										
	Imdad et al (2017) AMSTAR 2 confidence rating: high									
Vitamin A supplements and night blindness	1 RCT (NR) LIC	9 to 72 months	Every 6 months for 18 months	Vitamin A supplements	Incidence of night blindness	RR 0.53	0.28 to 0.99	NR	Not applicable	Fixed effects

Vitamin A supplements and night blindness	MA of 2 RCTs (22,972) UMIC	0 to 5 years	16 months (At longest follow-up)	Vitamin A supplements	Prevalence of night blindness	RR 0.32	0.21 to 0.50	NR	Not applicable	I^2=0%; Fixed effects
Vitamin A supplementation and xerophthalmia										
	Imdad et al (2017) AMSTAR 2 confidence rating: high									
Vitamin A supplements and xerophthalmia incidence	MA of 3 RCTs (NR) LIC, LMIC, UMIC	0 to 72 months	18 months (At longest follow-up)	Vitamin A supplements	Incidence of Xerophthalmia	No effect: RR 0.85	0.70 to 1.03	0.11	Not applicable	I^2=63%; fixed effects
Vitamin A supplements and xerophthalmia prevalence	MA of 2 RCTs (22,972) UMIC and LMIC	6 to 60 months	16 months (At longest follow-up)	Vitamin A supplements	Prevalence of Xerophthalmia	RR 0.31	0.22 to 0.45	<0.0001	Not applicable	I^2=0%; fixed effects

Table A9.20 Vitamin A fortification and haemoglobin concentration

Exposure and outcome	Study type (n participants) country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin A fortification and haemoglobin (Hb)										
	Das et al (2013) AMSTAR 2 confidence rating: critically low									
Vitamin A fortification and Hb	MA of 4 estimates from 2 RCTs (1538) UMIC and LMIC	48 to 72 months	More than 6 months	Vitamin A fortification Food vehicle: biscuits, monosodium glutamate, sugar, flour and seasoning.	Hb levels	SMD: 0.48	0.07 to 0.89	0.02	Not applicable	I^2=93%; random effects; 4 effect estimates from 2 RCTs of which 3 estimates from 1 study were in children aged 3-6 years (73.5% weighting of MA)

Table A9.21 Vitamin A supplementation and growth

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin A supplementation and growth										
	Ramakrishnan et al (2009) AMSTAR 2 confidence rating: critically low									
Vitamin A supplements and change in height	MA of 17 estimates from 14 RCTs (69,320)	Mostly 1 to 5 years	NR	Vitamin A supplements	Change in height	Cohen's effect size: 0.08	-0.18 to 0.34	NR	Not applicable	Heterogeneity p<0.05; random -effects 11 of 17 data sets had positive effect sizes for change in height in favour of vit A; the overall weighted mean effect size was small and was not statistically significant; stratified analyses did not find any

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										differences by age, duration, or baseline nutritional status
Vitamin A supplements and change in weight	MA. Number of estimates, RCTs or participant NR	1 to 5 years	NR	Vitamin A supplements	Change in weight	Cohen's effect size: -0.03	-0.23 to 0.18	NR	Not applicable	Heterogeneity p<0.01; random-effects stratified analyses did not find any differences by age, duration of follow-up
Vitamin A supplements and change in weight-for-height z-score (WHZ)	MA of 5 RCTs (NR)	1 to 5 years	NR	Vitamin A supplements	Change in WHZ	Cohen's effect size: 0.01	-0.06 to 0.09	NR	Not applicable	Heterogeneity NR; random effects

Micronutrients – vitamin D

Table A9.22 Vitamin D fortification and vitamin D status

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin D fortification and serum vitamin D										
	Hojsak et al (2018) AMSTAR 2 confidence rating: critically low									
Vitamin D fortification and vitamin D status	1 RCT (Akkermans et al 2017) (318) Germany, the Netherlands, UK	1 to 3 years	20 weeks	Formula milk fortified with 1.7μg per 100ml of vitamin D (and 1.2mg per 100ml iron) versus unfortified cows' milk	Serum vitamin D	Fortified milk increased serum vitamin D and decreased the risk of vitamin D deficiency (serum 25(OH)D <50nmol/l) compared with unfortified milk (quantitative details not reported)	NR	NR	Not applicable	Study was funded by Danone Nutricia Research Baseline status mean (SD)* Intervention group: 69.4nmol/l (27.0) Control group: 70.2nmol/l (26.7) Intention-to-treat analyses

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin D fortification and vitamin D status	1 RCT (Houghton et al 2011) (225) New Zealand	12 to 20 months	20 weeks	Vitamin D-fortified cows' milk compared with vitamin D-fortified formula compared with red meat	Serum vitamin D	Vitamin D-fortified cows' milk or formula significantly reduced the proportion of children with vitamin D deficiency (25(OH)D< 50nmol/l) compared with intake of red meat (quantitative data not reported)	NR	NR	Not applicable	Baseline status (mean, 95% CI)* All children: 52.3nmol/l (48.9 to 55.9nmol/l) Intervention group: 52.8nmol/l (48.1 to 57.4) Type of analysis not reported

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Vitamin D fortification and vitamin D status	1 RCT (Hower et al 2013) (92) Germany	2 to 6 years	Approximately 6 months (during winter months)*	Daily consumption of vitamin D-fortified formula (2.85µg per 100ml) compared with non-fortified semi-skimmed cows' milk	Serum vitamin D	Daily consumption of fortified formula contributed to the prevention of an otherwise frequently observed decrease in serum vitamin D concentration during winter (quantitative data not reported)	NR	NR	Not applicable	Study funded by HiPP GmbH and Co. Baseline status before winter (median, range)* Intervention group: median 21.5 ng/ml (10.1 to 43.0 ng/ml) Control group: median 18.4 ng/ml (11.0 to 44.9 ng/ml) Per protocol analysis

Foods, dietary components, and dietary patterns – foods

Table A9.23 Vegetables and fruit consumption

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	SR Ledoux et al (2011) AMSTAR 2 confidence rating: critically low									
Vegetables and fruit and body weight	PCS (Newby et al, 2003) (1379) USA	2 to 5 years	6 to 12 months	Number of vegetables and fruit servings (classification of vegetables and fruit not reported)	Weight change (kg) (at baseline, 18% of girls and 23% of boys were overweight or obese)	0.09kg per year per each additional serving of vegetables	0.05 to 0.13	0.02	Age, sex, SES and ethnicity did not adjust for baseline weight.	None
Vegetables and fruit and BMI z-score	PCS (Faith et al, 2006) (971) USA (low income)	1 to 5 years	up to 2 years	Vegetables and fruit consumption (did not include juice, carrots, potatoes and salads)	Adiposity assessed by BMI z-score	No association (estimate NR)	NR	NR	SES and ethnicity	None

Table A9.24 Dairy consumption (excluding formula milk)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total dairy consumption										
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Total dairy consumption and body fat (%)	PCS (Carruth and Skinner, 2001) (53) USA	2 years	6 years	Total dairy product consumption (*servings per day) (*higher consumption versus lower consumption of dairy products)	% body fat	Higher average dairy product consumption over the years was associated with lower % body fat (Beta coefficient -3.54)	SE 1.04	0.001	Sex, BMI, calcium, protein, carbohydrates and fat intakes	None
Total dairy consumption and body fat (g)	PCS (Carruth and Skinner, 2001) (53) USA	2 years	6 years	Total dairy product consumption (*servings per day) (*higher consumption versus lower consumption of dairy products)	Body fat (g)	Higher average dairy product consumption over the years was associated with lower body fat (g) (Beta coefficient -907.06)	SE 284.06	0.003	Sex, BMI, calcium, protein, carbohydrates and fat intakes	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total dairy consumption and body fat (mm)	PCS (Moore et al, 2006) (92) USA	3 to 6 years	8 years	Total dairy product consumption (low (<1.75 servings per day) compared with high consumption)	Subcutaneous fat (mm)	Greater subcutaneous fat (25mm)	NR	0.005	Age, physical activity, maternal education, baseline anthropometry, saturated fat intake, energy intake	Date of the reference for the primary study (Moore et al 2006) in SR evidence tables is different than the in the references of the SR (Moore et al 2008). The characteristics of the primary study and the results are different from the detail extracted by the SR
Total dairy consumption and BMI	PCS (Moore et al, 2006) (92) USA	3 to 6 years	8 years	Total dairy product consumption (low (<1.75 servings per day)	BMI	Higher BMI (2 units)	NR	0.046	Age, physical activity, maternal education, baseline anthropometry,	Date of the reference for the primary study (Moore et al 2006) in SR evidence

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				compared with high consumption)					saturated fat intake, energy intake	tables is different than the in the references of the SR (Moore et al 2008). The characteristics of the primary study and the results are different from the detail extracted by the SR
Total dairy consumption and BMI	PCS (Garden et al, 2011) (362) Australia	18 months	Age 8 years	Consumption of dairy products measured as % total energy (compared with protein, meat and fruit consumption)	BMI	High consumption of dairy products was associated with lower BMI (β -0.21)	−0.41 to 0.01	0.04	Sex, birth weight, breastfeeding for 6 months, parental obesity status, ethnicity, smoking in pregnancy, paternal education and asthma study	The PCS used a dataset from The Childhood Asthma Prevention Study (CASP)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									intervention group	
Total dairy consumption and BMI	PCS (Rangan et al, 2012) (335) Australia	18 months	Age 8 years	Quartiles of energy adjusted dairy product consumption (high compared with low quartiles)	BMI	NR (no association)	NR	0.09	Unadjusted (adjusted analysis NR)	The PCS used a dataset from the CASP cohort
	Dror and Allen (2014) AMSTAR 2 confidence rating: critically low									
Total dairy consumption and linear growth	PCS (Rangan et al, 2012) (335) Australia	1.5 years	Age 8 years	Quintiles of dairy consumption (energy adjusted)	Change in height (cm)	No association (estimate NR)	NR	NR	The analysis was adjusted for child's age, sex, Socio-Economic Index for Areas score and baseline weight status (weight-for-length z-score at 18 months), maternal and paternal education level, maternal and paternal countries of	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									birth, maternal age at birth, maternal smoking status during pregnancy, gestational diabetes, breastfeeding, CAPS randomisation group (diet, active or control, and dust mites, active or control), total energy intake, fruit consumption and vegetable consumption.*	
Consumption of individual dairy products										
	de Beer (2012) AMSTAR 2 confidence rating: critically low									
Yoghurt consumption and linear growth	RCT (He at al, 2005) (402) China	Mean age 3.3 years	9 months	Intervention: 125g of yoghurt 5 days a week	Change in height (cm)	Mean difference +0.19cm 5.43cm (SD 0.69)	0.0481 to 0.3319	<0.05	Not applicable	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Control: no intervention		compared with 5.24cm (SD 0.76)				
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Cheese and cream or crème fraiche consumption and overweight or obesity	PCS (Huus et al, 2009) (14,224) Sweden	2.5 years	2.5 years	Consumption of cheese, cream or crème fraiche	Overweight or obesity	Higher cheese consumption and lower cream or crème fraiche consumption was associated with overweight or obesity	NR	NR	Mother's education and BMI, father's education and BMI, heredity of diabetes, consumption of vegetables, potatoes, fried potatoes, eggs, sausage, chocolate, candies, porridge	None
Total dairy consumption and bone health										
	Dror and Allen (2014) AMSTAR 2 confidence rating: critically low									
Total dairy consumption and bone mineral content (g) and bone	PCS (Moore et al, 2008) (106) USA	3 to 5 years	Age 15 to 17 years	Dairy consumption	(a) Total body bone mineral content (g) (b) Bone area (cm)	Two or more servings of dairy per day associated with higher total body bone mineral content (g) and bone	NR	(a) 0.009 (b) 0.02	Sex, physical activity, age, height, BMI, activity, and percent body fat (from DXA) at the time of bone scan	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
area (cm)						area compared to less than 2 servings of dairy per day				
Blood pressure (BP)										
Total dairy consumption and systolic BP and diastolic BP	PCS (Rangan et al, 2012) (335) Australia	1.5 years	Age 8 years	Quintiles of energy adjusted dairy consumption	Systolic BP Diastolic BP	Children in the higher quintile at age 1.5 years had lower systolic and diastolic BP at age 8 years	NR	<0.05 (for both outcomes)	Age, sex, SES, baseline weight status, maternal smoking status during pregnancy, maternal and paternal countries of birth and education level, gestational diabetes, breastfeeding, energy intake, vegetables and fruit consumption	None
Total dairy consumption and	PCS (Moore et al, 2005) (95) USA	3 to 6 years	Age 13 years	Servings per day of dairy	(a) Systolic BP	(a) Children consuming >2 servings per day of	NR	NR	Child's baseline blood pressure, mean activity counts per	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
systolic BP and diastolic BP				>2 servings per day compared with <2 servings per day	(annual gains) (b) Diastolic blood pressure (annual gains)	dairy at ages 3 to 6 years had smaller annual gains in systolic BP from ages 3 to 13 years Beta coefficient 2.90 (SE 0.18) compared with Beta coefficient 2.21 (SE 0.24) (b) No difference between groups (estimate NR)			hour, intake of magnesium and sodium per day at age 3 to 6 years, vegetables and fruit consumption and change in child's BMI from 3 to 12 years	
Total dairy consumption and cognitive ability										
	Tandon et al (2016) AMSTAR 2 confidence rating: critically low									
Total dairy consump	PCS (Nyaradi et al, 20013)	1 to 3 years	age 10 years	Dairy consumption	Verbal cognitive outcomes	Dairy consumption at ages 2	NR	NR	Sex, maternal age, maternal education,	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
tion and verbal Cognitive outcomes	(1346)					and 3 was associated with better verbal cognitive outcomes at age 10 years			family income, father living with family, reading to the child, maternal Bradburn Negative Affect score (maternal mental health distress) and breastfeeding.	

Dietary patterns

Table A9.25 Diet quality

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Costa et al (2018) AMSTAR 2 confidence rating: moderate									
'Unhealthy' dietary pattern and body fat (kg)	PCS (Wosje et al, 2010) (292) USA	3.8 to 4.8 years	Measurements at age ranges: >4.8–5.8, >5.8–6.8 and >6.8–7.8 years; follow-up every 4 months	A dietary pattern consisting of higher consumption of non-wholegrains, cheese, processed meats, eggs, fried potatoes, discretionary fats and artificially-sweetened beverages	Body fat (kg measured by DXA)	Participants in the highest quartile for processed food consumption had higher fat mass than quartiles 1 and 2and3 across all age ranges	NR	NR	Child's score for 'healthy' dietary pattern, sex, height, exact age, total energy intake, calcium intake, accelerometer counts per minute, TV viewing time, outdoor playtime, other dietary pattern scores	Dietary pattern 'that contained mostly ultraprocessed foods' identified by reduced rank regression

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
‘Unhealthy’ dietary pattern and body fat (%)	PCS (Alexy et al 2011) (585) Germany	3 years	Until age 18 years	Convenience food consumption (*% total food consumption) Convenience foods included pre-baked frozen products, canned or instantaneous products such as salads or soups, or ready-to-eat meals like pizza	Body fat % (triceps and subscapular skinfolds)	Girls: no association (Beta coefficient 0.012) Boys: higher convenience food consumption at baseline significantly predicted change in body fat % (Beta coefficient 0.104)	Girls: NR Boys: NR	Girls: 0.6953 Boys: 0.0098	Age, residual energy, maternal BMI, maternal education and physical activity	Study sample included 296 boys and 290 girls but only 196 boys and 170 girls were included in the longitudinal analysis * Did not include convenience food consumed in communal feeding environments (for example, day-care centres and schools), as the authors intended to focus on the special eating situation within the family,

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										which is mainly responsible for the development of dietary habits
‘Unhealthy’ dietary pattern and body fat (kg)	PCS (Leary et al, 2015) (4,750) UK	38 months	Until age 15 years	‘Junk food’ dietary pattern (including fizzy drinks, sweets and confectionary, fried foods, sausages, burgers, crisps)	Body fat (kg measured by DXA)	A higher junk food dietary pattern score at 38 months was associated with an increase in body fat at age 15 years (Beta coefficient 0.06)	0.02 to 0.10	0.002	Sex and age at the time of body composition measurement, total energy intake at 38 months for the four dietary patterns, parental factors (maternal and paternal height and BMI, maternal age and	Dietary pattern identified through Principal Component Analysis

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									parity), social factors (social class, maternal education), birth weight, gestational age, pubertal status, stratified by sex	
	Tandon et al (2016) AMSTAR 2 confidence rating: critically low									
Diet quality and receptive vocabulary	PCS (Nyaradi et al, 2013) (1346) Australia	Exposure assessed at age 1, 2 and 3 years	Outcome assessed at 10 years of age	Eating Assessment in Toddlers (EAT) diet scores	Receptive vocabulary measured by Peabody Picture Vocabulary test (PPVT III)	A higher EAT score at age 1 year was associated with higher PPVT III	NR	NR	Gender, maternal age, maternal education, family income, father living with family, reading to the child, maternal	EAT diet scores based on Dietary Guidelines for Children and Adolescents in Australia. A higher score represented more eating occasions of foods from the

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									Bradburn Negative Affect score (maternal mental health distress) and breastfeeding	categories of wholegrain, vegetables, fruits, meat ratio and dairy.
Diet quality and non-verbal cognitive ability	PCS (Nyaradi et al, 2013) (1346) Australia	Exposure assessed at age 1, 2 and 3 years	Outcome assessed at 10 years of age	Eating Assessment in Toddlers (EAT) diet scores	Nonverbal cognitive ability	A higher EAT score at age 1 year was associated with non-verbal cognitive ability	NR	NR	Gender, maternal age, maternal education, family income, father living with family, reading to the child, maternal Bradburn Negative Affect score (maternal mental health	EAT diet scores based on Dietary Guidelines for Children and Adolescents in Australia. A higher score represented more eating occasions of foods from the categories of wholegrain, vegetables, fruits, meat ratio and dairy.

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									distress) and breastfeeding	
'Unhealthy' dietary pattern and Key Stage 2 (KS2)	PCS (Feinstein et al, 2008) (5741) England	Exposure assessed at 38, 54 and 81 months	Outcome assessed between age 10 and 11 years	'Junk food' dietary pattern *characterised by high-fat processed foods (sausages, burgers and poultry products), snack foods high in fat or sugar (crisps, sweets, chocolate, ice lollies and ice creams) fizzy	Key Stage 2 (KS2)	At age 38 months was associated with lower results on Key Stage 2 (estimate NR)	NR	NR	Gender, ethnicity, birth order, various socioeconomic measures and mother's behaviours, breastfeeding, watching children's programmes, HOME score (indicator of cognitive stimulation and emotional warmth in the home	Multiple measures of SES and mother's behaviours which is a possible source of multicollinearity as all the variables are highly correlated to each other and were included in the same regression model. This can result in an unstable estimate (large standard error) – they did not investigate for

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				drinks and the number of takeaway meals eaten per month					environment)	multicollinearity in the model]
'Healthy' dietary pattern and KS2	PCS (Feinstein et al, 2008) (5741) England	Exposure assessed at 38, 54 and 81 months	Outcome assessed between age 10 and 11 years	'Health conscious' dietary pattern *characterised as vegetarian foods, nuts, salad, rice, pasta, fruit, cheese, fish, cereal, water and fruit juice	KS2	At age 38 months was not associated with KS2 results	NR	NR	Gender, ethnicity, birth order, various socioeconomic measures and mother's behaviours, breastfeeding, watching children's programmes, HOME score (indicator of cognitive stimulation and	Multiple measures of SES and mother's behaviours which is a possible source of multicollinearity as all the variables are highly correlated to each other and were included in the same regression model. This can result in an unstable estimate (large

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									emotional warmth in the home environment)	standard error) – they did not investigate for multicollinearity in the model]
‘Healthy’ dietary pattern and Intelligence quotient (IQ)	PCS (Smithers et al, 2013) (7652) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 and 15 years of age	‘Healthy’ dietary pattern (characterised by breastfeeding at 6 months, raw vegetables and fruit, cheese and herbs	IQ	Was weakly associated with higher IQ at age 8 years (but not 15 years)	NR	NR	Maternal age, maternal education, social class, marital status, maternal tobacco smoking during pregnancy, parity, family income, ethnicity, the number of children (<16 years old) living in the family home, stimulation	This PCS used a dataset from the Avon Longitudinal Study of Parents and Children (ALSPAC).

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									in the home environment, duration of breastfeeding and other dietary trajectories	
‘Unhealthy’ dietary pattern and IQ	PCS (Smithers et al, 2013) (7652) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 and 15 years of age	Discretionary’ (characterised by foods such as biscuits, sweets and crisps)	IQ	Associated with lower IQ at age 15 years (but not 8 years)	NR	NR	Maternal age, maternal education, social class, marital status, maternal tobacco smoking during pregnancy, parity, family income, ethnicity, the number of children (<16 years	This PCS used a dataset from the Avon Longitudinal Study of Parents and Children (ALSPAC).

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									old) living in the family home, stimulation in the home environment, duration of breastfeeding and other dietary trajectories	
'Healthy' dietary pattern and IQ	PCS (Smithers et al 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Nutrient-dense' dietary patterns (*Not specified in the SR and in the primary study none of the patterns are	Full Scale Intelligence Quotient (FSIQ)	In early life (age not specified) associated with increase in FSIQ	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years	This PCS used a dataset from ALSPAC.

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				described as 'nutrient dense')					old) living in the family home and dietary pattern scores at younger ages.	
'Healthy' dietary pattern and Verbal IQ	PCS (Smithers et al 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Nutrient-dense' dietary patterns (*Not specified in the SR and in the primary study none of the patterns are described as 'nutrient dense')	Verbal Intelligence Quotient (VIQ)	In early life (age not specified) associated with increased VIQ	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern	This PCS used a dataset from ALSPAC.

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									scores at younger ages.	
‘Unhealthy’ dietary pattern and IQ	PCS (Smithers et al 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	‘Discretionary’ dietary patterns (characterised by foods such as biscuits, sweets and crisps)	Full Scale Intelligence Quotient (FSIQ)	In early life (age not specified) associated with decreases in FSIQ	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	This PCS used a dataset from ALSPAC.

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
‘Unhealthy’ dietary pattern and Verbal IQ	PCS (Smithers et al 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	‘Discretionary’ dietary patterns (characterised by foods such as biscuits, sweets and crisps)	Verbal Intelligence Quotient (VIQ)	In early life (age not specified) associated with decreases in VIQ	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	This PCS used a dataset from ALSPAC.
‘Unhealthy’ dietary pattern and IQ	PCS (Northstone et al, 2012) (3966) England	Exposure assessed at 3	Outcome assessed at age 8.5	‘Processed food’ dietary pattern (foods with	IQ assessed using Wechsler Intelligence Scale for	At age 3 was associated with a decrease	NR	NR	Age at WISC testing and WISC administrato	*Dietary patterns obtained via principal

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
		and 4 years,		high fat and sugars content and by processed and convenience foods)	Children (WISC) Version III	in IQ at age 8.5 years			r, dietary pattern scores at that time point, breastfeeding duration, energy intake, maternal education, maternal social class, maternal age, housing tenure, life events, HOME score and all other dietary pattern scores	component analysis (PCA)

Table A9.26 Other dietary patterns

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
‘Ready-to-eat’ or ‘freshly cooked’ dietary patterns										
	Tandon et al (2016) AMSTAR 2 confidence rating: critically low									
‘Ready-to-eat’ dietary pattern and IQ	PCS (Smithers et al, 2013) (7652) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 and 15 years of age	‘Ready-to-eat’ pattern (*characterised by commercially manufactured foods for infants at 6 and 15 months and biscuits, bread and breakfast cereals at 24 months)	IQ	No association at either age	NR	NR	Maternal age, maternal education, social class, marital status, maternal tobacco smoking during pregnancy, parity, family income, ethnicity, the number of children (<16 years old) living in the family home, stimulation in the home environment, duration of	Dataset from ALPAC cohort

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									breastfeeding and other dietary trajectories	
'Ready-to-eat' dietary pattern and IQ	PCS (Smithers et al, 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Ready-to-eat' dietary pattern (at 24 months) (characterised by *biscuits, bread or toast, breakfast cereal, yoghurt, milk pudding, cola at age 24 months)	FSIQ	At age 24 months was associated with increase in FSIQ at age 8 years	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	Dataset from ALPAC cohort

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
'Ready-to-eat' dietary pattern and verbal IQ	PCS (Smithers et al, 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Ready-to-eat' dietary pattern (at 24 months) (characterised by *biscuits, bread or toast, breakfast cereal, yoghurt, milk pudding, cola at age 24 months)	VIQ	At age 24 months was associated with increase in VIQ at age 8 years	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	Dataset from ALPAC cohort
'Ready-prepared baby foods' pattern and IQ	PCS (Smithers et al, 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Ready-prepared baby foods' pattern (at 6 and 15 months)	FSIQ	At age 6 and 15 months associated with decrease in FSIQ at	NR	NR	Maternal age, education, social class, marital status, tobacco,	Dataset from ALPAC cohort

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(*characterised by rice cereal, other baby cereal, rusks, baby meat, baby vegetables, baby milk pudding, baby fruit pudding at age 6 and 15 months)		age 8 years			smoking, family income, parity, ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	
'Ready-prepared baby foods' pattern and verbal IQ	PCS (Smithers et al, 2012) (1366) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 years of age	'Ready-prepared baby foods' pattern (at 6 and 15 months) (*characterised by rice cereal,	VIQ	At age 6 and 15 months associated with decrease in VIQ in age 8 years	NR	NR	Maternal age, education, social class, marital status, tobacco, smoking, family income, parity,	Dataset from ALPAC cohort

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				other baby cereal, rusks, baby meat, baby vegetables, baby milk pudding, baby fruit pudding at age 6 and 15 months)					ethnicity, number of children (<16 years old) living in the family home and dietary pattern scores at younger ages.	
'Freshly-cooked' pattern and vocabulary	PCS (von Stumm et al, 2012) (5217) Scotland	Exposure and outcome assessed at 3 and 5 years	Exposure and outcome assessed at 3 and 5 years	Slow' (sit down restaurant, or meal with fresh ingredients) Compared with consuming more 'fast' meals	Vocabulary	Consuming more slow meals at age 3 was associated with increase in vocabulary at age 3 and 5 years	NR	NR	Socioeconomic status and cognitive ability from earlier assessments	Consuming more slow versus fast food meals (frozen or ready prepared, take away) per week partially mediated the effect of socioeconomic status on

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
'Freshly-cooked' pattern and cognitive performance				(frozen or ready prepared, take away)	Cognitive performance (measured by picture test to assess non-verbal reasoning)	Associated with higher cognitive performance at age 5 years	NR	NR		cognitive performance at age 3 and 5 years
	Tandon et al (2016) AMSTAR 2 confidence rating: critically low									
'Traditional' dietary pattern and IQ	PCS (Smithers et al, 2013) (7652) England	Exposure assessed at 6, 15 and 24 months	Outcome assessed at 8 and 15 years of age	'Traditional' patterns (characterised by meat, cooked vegetables, and puddings)	IQ	Were associated with lower IQ at age 15 years (but not 8 years)	NR	NR	Maternal age, maternal education, social class, marital status, maternal tobacco smoking during pregnancy, parity, family income, ethnicity, the number of children (<16 years old) living in the family home,	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									stimulation in the home environment, duration of breastfeeding and other dietary trajectories	
Snacking and IQ	PCS (Northstone et al, 2012) (3,966) England	Exposure assessed at 3 and 4 years,	Outcome assessed at age 8.5	'Snack' pattern (finger foods such as fruit, biscuits, bread and cakes)	IQ IQ assessed using Wechsler Intelligence Scale for Children (WISC) Version III	At age 3 was associated with an increase in IQ at age 8.5 years	NR	NR	Age at WISC testing and WISC administrator, dietary pattern scores at that time point, breastfeeding duration, energy intake, maternal education, maternal social class, maternal age, housing tenure, life events, HOME score	*Dietary patterns obtained via principal component analysis (PCA)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									and all other dietary pattern scores	

Dietary (non-nutrient) components

Table A9.27 Probiotics

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Probiotics										
	Onubi et al (2015) AMSTAR 2 confidence rating: low									
Probiotics and weight	RCT (Firmansyah et al, 2009) (393) Indonesia	12 months	12 months duration outcome measured between 12 months and 16 months (not clear if age or time)	Twice-daily dose of Bifidobacterium longum and Lactobacillus rhamnosus with 200ml milk + prebiotics + LC-PUFA (+ normal diet) compared with a twice-daily consumption of 200ml milk + normal diet	Weight gain (per day)	MD 0.93g per day	0.12 to 1.95	0.025	Not applicable	- For weight and weight-for-age this was significantly higher than the growth standards recommended by the WHO for the age group - not clear effect on change in weight was due to the probiotics, prebiotics or LC-PUFA.

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Probiotics and weight-for-age	RCT (Firmansyah et al, 2009) (393) Indonesia	12 months	12 months duration outcome measured between 12 months and 16 months (not clear if age or time)	Twice-daily dose of Bifidobacterium longum and Lactobacillus rhamnosus with 200ml milk + prebiotics + LC-PUFA (+ normal diet) compared with a twice-daily consumption of 200ml milk + normal diet	Change in weight-for-age	MD 0.09	0.01 to 0.18	0.036	Not applicable	- For weight and weight-for-age this was significantly higher than the growth standards recommended by the WHO for the age group - not clear effect on change in weight was due to the probiotics, prebiotics or LC-PUFA.
Probiotics and change in length	RCT (Firmansyah et al, 2009) (393) Indonesia	12 months	12 months duration outcome measured between 12 months	Twice-daily dose of Bifidobacterium longum and Lactobacillus rhamnosus with 200ml milk + prebiotics + LC-PUFA (+ normal diet)	Change in length (linear growth)	There was no significant difference in change in length between groups	NR	NR	Not applicable	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
			and 16 months (not clear if age or time)	compared with a twice-daily consumption of 200ml milk + normal diet						
Probiotics and weight-for-age z-score (WAZ) and weight-for-length z-score (WLZ)	RCT (Saavedra et al, 2004) (131) USA	Age 3 to 24 months	210 ± 127 day duration	A high dose probiotic (1×107 Bifidobacterium lactis Bb12 and Streptococcus thermophilus Colony Forming Units (CFU) per gram of standard milk-based formula), a low dose probiotic (1×106 of the above) and a control (standard milk-based formula with no probiotics)	Monthly change in WAZ and WLZ	No difference in effect for either outcome	NR	NR	Not applicable	Consumption in each group had to be ≥240 ml per day for more than 14 days.
Probiotics and height-	RCT (Saavedra et al, 2004)	Age 3 to 24 months	210 ± 127 day duration	A high dose probiotic (1×107	Monthly change height-	No difference	NR	NR	Not applicable	Consumption in each group had to be ≥240

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
for-age z-score	(131) USA			Bifidobacterium lactis Bb12 and Streptococcus thermophilus Colony Forming Units (CFU) per gram of standard milk-based formula), a low dose probiotic (1×106 of the above) and a control (standard milk-based formula with no probiotics)	for-age z-score					ml per day for more than 14 days.

Table A9.28 ‘Non-nutritive sweeteners’ or ‘Non-sugar sweeteners’

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	World Health Organization et al (2022) AMSTAR 2 confidence rating: low									
‘Non-sugar sweeteners’ (NSS) and body weight	MA of 2 PCS (1633)	2-6 years	8 months to 1.5 years	Per daily serving of NSS (from drinks)	Change in body weight (kg)	MD 0.03	-0.14 to 0.21	0.72	Total energy intake, socioeconomic status, physical activity (but not baseline weight)	GRADE assessment: low certainty.
	Karalexi et al (2015) AMSTAR 2 confidence rating: critically low									
‘Non-nutritive sweeteners’ and Type 1 diabetes	PCS (Lamb et al, 2015) (2547)	Mean age 2 years	10.2 years	Non-nutritive sweeteners	(a) Islet autoimmunity (b) Progression to type 1 diabetes	(a) No association (OR 1.07) (b) No association (OR 1.02)	(a) 0.96 to 1.20 (b) 0.69 to 1.49	NR	The analysis adjusted for adjusted for the HLA-DR, DQ genotype, type 1 diabetes family history, ethnicity (non-Hispanic white compared with other), diet survey type (FFQ or Young Adolescent Questionnaire (YAQ)) and total energy.	Children at increased risk of developing type 1 diabetes

Drinks

Table A9.29 Breastfeeding beyond first year of life

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Growth										
	Delgado and Matijasevich (2013) AMSTAR 2 confidence rating: critically low									
Breastfeeding and weight	PCS (Fawzi et al, 1998) (28,753) Sudan	Children age <36 months (*mean baseline age NR)	Age 24 to 35.9 months	Breastfeeding ≥2 years	Weight (g)	Poor households: MD: -205g Affluent households: MD: -38g Low maternal education: MD: -133g Higher level of maternal education: MD: -88g	Poor households: -279g to -131g Affluent households: -106g to 30g Low maternal education: -193g to -74g Higher level of maternal education: -179g to 4g	NR	Child age, sex, dietary vitamin A intake, morbidity, household wealth, availability of water in the house, maternal literacy. The relationship between continued breastfeeding and nutritional status was mediated by SES	The analyses included children of healthy and low nutritional status (wasting or stunting).

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									(household wealth) and maternal education.	
Breastfeeding and linear growth	PCS (Simondon et al, 2001) (443) Senegal	13 months	Age 39 months (follow up every 6 months)	Breastfeeding for ≥2 years	Height or length (cm)	Children (aged 21 to 25.9 months) who were breastfed for ≥2 years had higher growth over the following 6 months than children who had stopped breastfeeding at the beginning of the 6-	SD 0.3	<0.05	Season (wet or dry), quality of housing, initial age and weight.	Housing quality was a key modifier. Children from poor housing breastfed ≥2 years grew more than children from poor housing who were no longer breastfed while the opposite was true for children from good housing.

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						month interval MD: 0.7cm				
Cognitive development										
	Delgado and Matijasevich (2013) AMSTAR 2 confidence rating: critically low									
Breastfeeding and cognitive development	PCS (Daniels and Adair, 2005) (1979) Philippines	From birth	Ages 8.5 years and 11.5 years	Breastfeeding for ≥2 years compared with breastfeeding for 0<6 months	Cognitive ability score at (a) age 8.5 years (b) age 11.5 years	(a) No association between breastfeeding duration and cognitive ability score at age 8.5 years Breastfeeding for ≥2 years (49.4; SD 13.4) versus	NR	(b) Not performed or reported (b) 0.446	Parental education, paternal presence in home, maternal age, parity, alcohol use during pregnancy, preterm status of child, maternal literacy, child's gender, number of baths taken	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						breastfeeding for 0 to <6 months (53.7; SD 13.4) (b) No association between breastfeeding duration and cognitive ability score at age 11.5 years (NR)			per week, dietary variety at age 2 years, household income, non-income-producing assets, electricity in the home, and environmental hygiene score	
Breastfeeding and psychosocial development	PCS (Duazo et al, 2010) (2752) Philippines	NR	Up to age 5 to 6 years	Breastfeeding for ≥2 years compared with breastfeeding for 0<6 months	Psychosocial development score at age 5 and 6	No association n breastfeeding for ≥2 years 1.54 (psychological	Breastfeeding for ≥2 years 20.49 to 3.57 breastfeeding for <6 months 20.75 to 3.99	>0.1	Sex, day-care attendance, maternal education, father's presence in the home, hygiene and non-	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						development score) breastfeeding for <6 months 1.62 (psychological development score)			income-producing assets	

Table A9.30 Milk consumption

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Total milk consumption										
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Total milk consumption and body fat (%)	PCS (Hasnain et al, 2014) (103) USA	3 to 5 years	12 years	Milk consumption (tertiles) highest tertile (411ml per day) compared with the lowest tertile (115ml per day)	% body fat	Mean difference -7.3%	NR	0.0095	Age, baseline anthropometry, *% energy intake from fat, television viewing, beverage consumption, maternal BMI and education	None
Total milk consumption and BMI z-score	PCS (Faith et al, 2006) (971) Australia	1 to 5 years	4 years	Milk consumption	BMI z-score	Beta coefficient -0.002 no association	SE 0.002	0.39	Baseline child's weight-for-height z-score, sex, ethnicity, children's food and beverage consumption (not clear if baseline), parental feeding styles and attitude variables	None
Total milk consumption and	PCS (Newby et al, 2004) (1345) USA	2 to 5 years	8 months	Milk consumption	Annual change BMI z-score	Beta coefficient 0.00	SE 0.01	0.84	Age, sex, birth weight, energy intake (not clear if baseline), sociodemographi	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
BMI z-score									c variables, height change	
Total milk consumption and BMI z-score	PCS (De Boer et al, 2014) (8950) NR	4 years	1 year	Milk consumption	BMI z-score	NR (no association)	NR	0.79	Sex, ethnicity, socioeconomic status and milk type	None
Total milk consumption and BMI z-score	PCS (Huh et al, 2010) (656) USA	2 years	1 year	Total milk consumption (servings per day)	BMI z-score	NR (no association)	NR	>0.05	Age, sex, ethnicity, baseline BMI z-score, baseline energy intake and non-dairy beverage consumption, television viewing, maternal BMI and education, paternal BMI	This analysis excludes children with overweight (defined as BMI >85th centile) at age 2 years*
Total milk consumption and incident overweight	PCS (Huh et al, 2010) (852) USA	2 years	1 year	Total milk consumption (servings per day)	Incident overweight (*defined as BMI for age and sex ≥ 85th %ile)	NR (no association)	NR	>0.05	Age, sex, ethnicity, baseline BMI z-score, baseline energy intake and non-dairy beverage consumption, television viewing, maternal BMI and	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									education, paternal BMI	
Whole or reduced fat milk consumption										
	Dougkas et al (2019) AMSTAR 2 confidence rating: low									
Full-fat milk consumption and BMI z-score	PCS (Huh et al, 2010) (852) USA	2 years	1 year	Whole milk consumption (servings per day)	BMI z-score	Beta coefficient -0.09 full-fat milk consumption at 2 years was associated with a decrease in BMI z-score at age 3 years. No association when analysis excludes children (n=852) with BMI >85th centile*	0.16 to -0.01	0.02	Age, sex, ethnicity, baseline BMI z-score, baseline energy intake and non-dairy beverage consumption, television viewing, maternal BMI and education, paternal BMI	This analysis includes all children (n=852)*
Reduced-fat milk consump	PCS (Huh et al, 2010) (852)	2 years	1 year	Reduced fat milk consumption	BMI z-score	NR (no association)	NR	NR	Age, sex, ethnicity, baseline BMI z-score,	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
tion and BMI z-score	USA			(2% and 1% or skimmed), servings per day*					baseline energy intake and non-dairy beverage consumption, television viewing, maternal BMI and education, paternal BMI	
Full-fat compared with reduced-fat milk consumption and BMI z-score	PCS (Scharf et al, 2013) (8300) USA	2 years and 4 years	2 years	Full-fat compared with reduced-fat milk consumption	Change in BMI z-score	No difference in change in BMI z-scores from ages 2 to 4 years between groups*	NR	0.6	Sex, ethnicity and SES	None
Skimmed or 1% milk consumption and BMI z-score	PCS (Scharf et al, 2013) (8300) USA	2 years and 4 years	2 years	Skimmed or 1% milk consumption (comparison NR)	Change in BMI z-score	OR 1.57 of becoming overweight or obese between ages 2 and 4 years	1.03 to 2.42	p<0.05	Sex, ethnicity, SES, child's BMI, fruit juice and SSB consumption, maternal BMI, daily glasses of milk at age 4*	Children with 'normal' weight at baseline
	Vanderhout et al (2020) AMSTAR 2 confidence rating: low									
Whole compared with	PCS (Wosje et al 2001) (51)	1 to 2 years	1 year	Whole milk compared with reduced fat	Change in body weight	No difference at	NR	NR	NR	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
reduced fat milk consumption and body weight	USA			milk consumption		12, 18 or 24 months				
Whole compared with reduced fat milk consumption and body fat	PCS (Wosje et al 2001) (51) USA	1 to 2 years	1 year	Whole milk compared with reduced fat milk consumption	Change in body fat	No difference at 12, 18 or 24 months	NR	NR	NR	None

Table A9.31 100% fruit juice consumption

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
100% fruit juice consumption										
	Frantsve-Hawley et al (2017) AMSTAR 2 confidence rating: moderate									
Fruit juice consumption and change in BMI	PCS (Faith et al 2006) (825) USA	1 to 4 years	Measured every 6 months, up to 48 months (4 years)	100% fruit juice (servings per day)*	BMI, BMI z-score	Each additional serving per day associated with BMI z-score increase of 0.005 (SE 0.002)	NR	<0.01	Baseline BMI-z-score, sex, ethnicity, consumption of potatoes, vegetables, fruits, milk, parental feeding behaviours	Children from low income families
Fruit juice consumption and change in BMI	PCS (Guerrero, 2016) (15,418) USA	48 months (4 years)	2 years	Any compared with no 100% fruit juice consumption	BMI	Change in BMI from age 4 to 6 years with any compared with no SSB consumption: -0.101 (SE 0.053)	NR	>0.05	Age, sex, ethnicity, birthweight, number of parents in household, poverty status, maternal education, breastfeeding, consumption of fast food, fruits and vegetables	None

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Fruit juice consumption and change in BMI	PCS (Newby, 2004) (1345) USA	2 to 5 years	6 months	100% fruit juice (ounce per day)	BMI	Each additional ounce per day of fruit juice associated with 0.01 (SE 0.00) change in BMI	NR	0.20	Total energy consumption, baseline BMI, age, sex, SES, maternal education, birth weight	None
Fruit juice and change in BMI z-score	PCS (Shefferley et al 2016) (8950) USA	2, 4, 5 years	2 and 3 years	100% fruit juice (≥1 serving per day compared with <1 serving per day)	BMI z-score	0.030 (SE 0.037) change in BMIz (between age 2 and 4*) with <1 serving per day (at age 2*) compared with 0.282 (SE 0.028) change in BMIz with ≥1 serving per day	NR	0.0003	Sex, ethnicity, SES, maternal BMI, baseline BMI z-score	None

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Fruit juice and BMI z-score	PCS (Skinner et al, 1999) (105) USA	24, 28 and 32m	4 months	≥12 oz 100% fruit juice compared with <12 oz 100% fruit juice	BMI	BMI of children who consumed <12 oz juice: BMI 16.3kg/m^2 BMI of children ≥12 oz juice: BMI 16.4kg/m^2	NR	0.42	Age, sex, maternal height and BMI	Same cohort as Skinner et al 2001 – these results have not been reported in the main report
Fruit juice and change in BMI z-score	PCS (Skinner et al, 2001) (72) USA	24, 28, 32, 36m	4 years	100% fruit juice (oz per day)	BMI	For each additional oz per day of fruit juice, BMI decreased by 0.057	NR	0.99	Baseline BMI and height, sex, total energy consumption, parental height or BMI	Same cohort as Skinner et al 1999
Fruit juice consumption and change in BMI	PCS (Sonneville et al, 2015) (1163) USA	1 year	6 years	100% fruit juice consumption (oz per day) compared with non-consumers	BMI	When compared with no juice consumption:	See previous column	(1) 0.01 (2) 0.05	Age, sex, ethnicity, baseline WHZ, water intake, maternal age, education, pre-pregnancy BMI,	Evidence of dose-response association

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(1) mean change in BMI (beta coefficient; 95% CI) not adjusted for total energy 0.08 (-0.05 to 0.20) for 1 to 7 oz per day 0.23 (0.07 to 0.39) for 8 to 15 oz per day 0.36 (0.08 to 0.64) for ≥16 oz per day (2) mean change in BMI (Beta coefficient; 95% CI) after adjusting			household income	

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						for total energy 0.07 (-0.06 to 0.21) for 1 to 7 oz per day 0.23 (0.05 to 0.40) for 8 to 15 oz per day 0.27 (-0.05 to 0.59) for ≥16 oz per day				
Fruit juice consumption and odds of incident obesity	PCS (Welsh et al, 2005) (10,904) USA	2 to 3 years	1 year	100% fruit juice >1 servings per day compared with <1 serving per day	BMI	When compared with <1 serving per day OR of incident obesity (95% CI) among children with normal	See previous column	NS (p-value NR)	Baseline BMI, age, sex, ethnicity, birthweight, total energy intake, consumption of HFSS foods	None

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						weight at baseline OR 1.1 (0.8 to 1.5) for 1 to <2 servings per day OR 1.0 (0.7 to 1.4) for 2 to <3 servings per day OR 1.2 (0.8 to 1.7) for ≥3 servings per day				

Table A9.32 Sugar-sweetened beverage consumption

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Sugar-sweetened beverages (SSBs) and BMI or body weight										
	Te Morenga et al (2012) AMSTAR 2 confidence rating: moderate									
Sugar-sweetened beverages and odds of overweight	MA of 7 estimates from 5 PCS (7255)	Mostly under age 5 years. Findings in children aged 1 to 5, 85% weighting in MA	1 to 8 years later	SSB consumption (servings per day or per week)	BMI	OR 1.55	1.32 to 1.82	<0.001	Total energy intake (4 of 5 studies or 6 of 7 comparisons) adjusted for baseline BMI Other confounders adjusted for by most studies: age, sex, dietary intake,	Random-effects model I^2=0

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									physical activity	
	Frantsve-Hawley et al (2017) AMSTAR 2 confidence rating: moderate									
SSBs and odds of overweight	PCS (De Coen, 2014) (568) Belgium	3 to 6 years	18 and 30 months	SSB consumption (ml per day) Validated semi-quantitative FFQ*	BMI z-score Measurements performed by research team*	Odds of overweight (after 30 months*) for children who consumed >65ml per day* SSB OR 1.36 To note that 65ml per day was the mean intake level in	0.77 to 2.40	NR	Baseline BMI, child consumption of water, milk products, vegetables and fruit, sweet and savoury snacks, physical activity, screen time, parental educatio	None

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						the study sample*			n and professional status, parental weight status, number of children in household	
SSBs and risk of overweight	PCS (Wheaton, 2015) (4169) Australia	4 to 5 years	6 years	SSB consumption compared with no consumption	BMI z-score	RR for normal weight becoming overweight with SSB consumption compared with no consumption =	NR	0.57	Baseline BMI, age, sex, ethnicity, SES, parental BMI, intakes of vegetables and fruit, and high-fat foods, sedentar	Data from cohort re-analysed by Millar et al (2014)

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						0.97 (SE 0.05)			y behaviours (TV and computer use)	
	Frantsve-Hawley et al (2017) AMSTAR 2 confidence rating: moderate									
SSB and change in BMI z-score	PCS (De Boer, 2013) (9600) USA	2 years	Age 4 years	1 SSB per day compared with <1 per day* Data collected by trained assessor during interview*	BMI z-score Measurements performed by trained assessors*	Greater increase in BMI z-score (from age 2 to 4 years*) in children consuming 1 SCB per day compared with <1 SCB per day at age 2 (data NR)	NR	<0.05	Sex, ethnicity, SES	ECLS-B cohort

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
SSBs and change in BMI	PCS (Guerrero, 2016) (15,418) USA	48 months (4 years)	2 years	Consumption of any versus no SSBs Data collected via parent interviews*	BMI Measurements followed standard protocols for the ECLS-B cohort*	Change in BMI from age 4 to 6 years with any compared with no SSB intake: 0.138 (SE 0.037)	NR	<0.01	Age, sex, ethnicity, birthweight, number of parents in household, poverty status, maternal education, breastfeeding, consumption of fast food, fruits and vegetables	ECLS-B cohort*
SSB and BMI z-score	PCS (Kuhl, 2014) (36) USA	2 to 5 years	6 months	SSB consumption	BMI z-score	Unit increase in SSB consumption	-0.011 to 0.040	NR	Total energy intake, intake of fruits and	None

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						associated with increase in BMI z-score (beta coefficient 0.191)			vegetables, sweet and salty drinks, physical activity and screen time	
SSBs and change in BMI	PCS (Millar, 2014) (4169) Australia	4 to 5 years	6 years	SSB consumption per day	BMI z-score	Each additional intake of SSB per day associated with increase in BMI z-score (beta coefficient 0.015)	0.004 to 0.025	<0.01	Sex, dietary fat intake, household income, maternal BMI	Data from cohort re-analysed by Wheaton et al (2015)
SSBs and change in BMI	PCS (Newby, 2004) (1345) USA	2 to 5 years	6 months	SSB consumption (ounce per day)	BMI Measurements performed by trained staff	Each additional ounce per day of SSB	NR	0.34	Baseline BMI, age, sex, SES, maternal	Adjusting for energy intake did not substantially change the

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				FFQ for the previous month		associated with beta coefficient -0.02 (SE 0.02) change in BMI			education, birth weight	results (−0.01; SE=0.02; p=0.50)
	Luger et al (2017) AMSTAR 2 confidence rating: low									
SSBs X BMI	PCS (Cantoral et al, 2015) (227) Mexico	1 year	13 years	SSB consumption (units NR)	BMI (odds of obesity*)	Association between SSB consumption and BMI (data NR)	NR	NR	Sex, age, breastfeeding duration, non-SSB energy intake, maternal obesity at 12m post-partum, physical activity, TV	None

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									watching*	
SSBs and change in weight-for-height z-score (WHZ)	PCS (Chaidez et al, 2014) (67) USA	2.3 years	6 months	SSB consumption (units NR)	Change in WHZ*	Association between SSB consumption and WHZ (data NR)	NR	NR	Sex, birth weight, baseline WHZ, intake of foods high in dietary fat and sugar, parenting styles, maternal education and income*	Sample in Hispanic children
SSBs and body fat										
	Perez-Morales et al (2013) AMSTAR 2 confidence rating: critically low									

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
SSBs and body fat	PCS (Kral et al, 2008) (135) USA	3 to 5 years	3 years	Sweetened milk, fruit drinks, caloric and non-caloric soda, soft drinks (units NR)	Waist circumference (cm)	A greater increase in soda consumption over time was associated with greater child WC (beta coefficient 0.04)	NR	0.0001	Change in BMIz from age 3 to 5 years, total energy intake at 3 years*	Sample in white children
	Tandon et al (2016) AMSTAR 2 confidence rating: critically low									
SSBs and cognitive development	PCS (Nyaradi et al 2013) (1455) Australia	1, 2, 3 years	Age 10 years	SSB consumption (as part of a diet score)	(1) Verbal ability (Peabody Picture Vocabulary Test III) (2) Non-verbal reasoning (Raven's Coloured Progressive Matrices)	(1) NR (2) Higher intake of SSB at age 1 associated with lower non-verbal reasoning ability at age 10	NR	NR	Sex, breastfeeding duration, maternal characteristics (age, education, mental health distress), family income, father living with family, reading to the child	No information on ethnicity

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments

Eating and feeding behaviours

Table A9.33 Children's eating behaviours

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Food fussiness (picky eating)										
	Brown et al (2016) AMSTAR 2 confidence rating: moderate									
Picky eating and BMI z-score	PCS (Gregory et al 2010) (156) Australia	Age 2 to 4 and 3 to 5 years	12 months	Food responsiveness, food fussiness and interest in food Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score	No association between child eating behaviours at ages 2 to 4 years (mean age 3.3 years) and BMI z-score at ages 3 to 5 years (mean age 4.3 years) (R^2_{Change}=0.01; p=0.707)	NR	NR	Child baseline BMI z-score, age and gender, maternal age, maternal BMI and education*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Picky eating and change in standardised weight status	PCS (Hittner et al 2011) (486) USA	Mean age 12.22 months *	Mean age 36.12 months *	Changes in 3 feeding behaviours assessed (reactivity to food, predictable appetite, distractibility at mealtime) + 5 temperaments from ages 1 to 3 years 4 clusters of emergent eating patterns were identified, one of which was “emerging high-reactive and fussy eaters”*	Weight-for-length z-score (WLZ) at age 1 year BMI z-score at age 3 years Change in standardised weight status from year 1 to year 3 was operationalised as the change in child WLZ from year 1 to year 3.	Fussy eaters had the lowest weight-to-length z-score of the 4 clusters at year 1 (-1.02, SD 1.26) No association [between eating clusters] with change in standardised weight from year 1 to year 3 (mean 0.48; SD 1.25)	NR	0.4	Analyses investigated differences in eating factors between genders (no difference)*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Picky eating and change in BMI	PCS (Jacobi et al 2003) (135) USA	Age 3.5 years	Age 5.5 years	Parental perceptions of child's picky eating measured by the Stanford Feeding Questionnaire (SFQ)	BMI	No association overall between picky eating at 4 and 5 years and change in BMI at ages 4 and 5, but girls with PE had increase in BMI over 1 year (15.3 to 15.7) compared with non-picky girls (16.4 to 16.3) (no association in boys)	NR	NR	Analyses conducted separately for boys and girls	Quantitative data not reported by SR Children with PE were lighter at baseline than children without PE*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Picky eating and odds of underweight	PCS (Dubois et al 2007) (1498) Canada	Age 2.5, 3.5 and 4.5 years	Age 4.5 years	Picky eating Eating Behaviour Questionnaire adapted from ALSPAC*	BMI	OR 2.4 Increased odds of being underweight at age 4.5 years if picky at all 3 ages compared with children who were never picky No association with weight status if picky at 1 or 2 of the ages measured compared with never picky (data not reported)	1.4 to 4.2	NR	Child characteristics (sex, birthweight, day care attendance, food insecurity status) maternal characteristics (age, immigrant status, education, smoking status during pregnancy), family characteristics (type, household income, number of obese parents)* Study did not adjust	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									for child baseline weight	
	Kininmonth et al (2021) AMSTAR 2 confidence rating: critically low									
Food fussiness and BMI z-score	PCS (Bergmeier et al 2014) (201) Australia	Aged 2 to 5 years (mean 2.92 years)	12 months	Food fussiness Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (Center for Disease Control)	No association	NR	NR	Baseline BMI z-score; maternal education, family income, mother's BMI, child temperament, maternal parenting styles and practices, child eating behaviours at baseline*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Food fussiness and BMI z-score	PCS (Mallan et al 2016) (340) Australia	14 months	Age 3.7 years	Food fussiness Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association *	NR	NR	Baseline z-score, control compared with intervention group, maternal age at delivered, parental university education, maternal BMI, breastfeeding duration, age solids introduced, number of fruits tried at baseline, number of vegetables tried at baseline, number of noncore foods tried	No sample size calculation. Data were taken from both the intervention and control groups of NOURISH. The intervention group received education sessions aimed to improve parental feeding practices and influence infants' food intake and eating habits. It is therefore important to note that the results

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									at age 14 months	presented could be influenced by the effect of intervention. Food fussiness was entered into the regression models as a covariate rather than as an independent variable.
Change in food fussiness and change in BMI z-score	PCS (McPhie et al 2012) (117) Australia	2 to 4 years	12 months	Change in food fussiness between baseline and follow-up Food fussiness measured by Child Eating Behaviour Questionnaire (CEBQ)	Change in BMI z-score (Center for Disease Control)	No association	NR	NR	Baseline weight status	Sample size calculation was explored but actual sample size fell short of calculation.

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Satiety responsiveness										
	Kininmonth et al (2021) AMSTAR 2 confidence rating: critically low									
Satiety responsiveness and BMI z-score	PCS (Mallan et al 2014)	2 years	Median age 4.4 years	Satiety responsiveness Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	Inverse association	NR	NR	Age, sex, birth weight z-score*	Data were taken from both the intervention and control groups of NOURISH. The intervention group received education sessions aimed to improve parental feeding practices and influence infants' food intake and eating habits. It is therefore important to note that the results

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										presented could be influenced by the effect of intervention.
Satiety responsiveness and BMI z-score	PCS (Quah et al 2015) (208 at baseline, 179 at last follow up) Malaysia	12 months, 15 months, 18 months	At 24 months	Satiety responsiveness Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association	NR	NR	Birth BMI z-score, maternal ethnicity, maternal education, infant feeding pattern up to 6 months, mother age, birth order, smoking during pregnancy, gestational age, pregnancy BMI at 26 weeks*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Slowness in eating										
	Kininmonth et al (2021) AMSTAR 2 confidence rating: critically low									
Slowness in eating and BMI z-score	PCS (Mallan et al 2014)	2 years	Median age 4.4 years	Slowness in eating Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association	NR	NR	Age, sex, birth weight z-score*	Data were taken from both the intervention and control groups of NOURISH. The intervention group received education sessions aimed to improve parental feeding practices and influence infants' food intake and eating habits. It is therefore important to note that the results

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										presented could be influenced by the effect of intervention.
Slowness in eating and BMI z-score	PCS (Quah et al 2015) (208 at baseline, 179 at last follow up) Malaysia	12 months, 15 months, 18 months	At 24 months	Slowness in eating Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association	NR	NR	Birth BMI z-score, maternal ethnicity, maternal education, infant feeding pattern up to 6 months, mother age, birth order, smoking during pregnancy, gestational age, pregnancy BMI at 26 weeks*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Food responsiveness										
	Kininmonth et al (2021) AMSTAR 2 confidence rating: critically low									
Food responsiveness and BMI z-score	PCS (Mallan et al 2014)	2 years	Median age 4.4 years	Food responsiveness Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association	NR	NR	Age, sex, birth weight z-score*	Data were taken from both the intervention and control groups of NOURISH. The intervention group received education sessions aimed to improve parental feeding practices and influence infants' food intake and eating habits. It is therefore important to note that the results

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										presented could be influenced by the effect of intervention.
Enjoyment of food										
	Kininmonth et al (2021) AMSTAR 2 confidence rating: critically low									
Enjoyment of food and BMI z-score	PCS (Mallan et al 2014)	2 years	Median age 4.4 years	Enjoyment of food Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (WHO)	No association	NR	NR	Age, sex, birth weight z-score*	Data were taken from both the intervention and control groups of NOURISH. The intervention group received education sessions aimed to improve parental feeding practices and influence

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										infants' food intake and eating habits. It is therefore important to note that the results presented could be influenced by the effect of intervention.
Enjoyment of food and BMI z-score	PCS (Bergmeier et al 2014) (201) Australia	Aged 2 to 5 years (mean 2.92 years)	12 months	Enjoyment of food Child Eating Behaviour Questionnaire (CEBQ)	BMI z-score (Center for Disease Control)	No association	NR	NR	Baseline BMI z-score; maternal education, family income, mother's BMI, child temperament, maternal parenting styles and practices, child eating behaviours at baseline*	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Inability to delay gratification										
	Caleza et al (2016) AMSTAR 2 confidence rating: critically low									
Inability to delay gratification and risk of overweight	PCS (Seeyave et al 2009) (805) USA	Age 4 years	Age 11 years	Children given an Ability to Delay Gratification (ATDG) task using food (known to be the child's preferred food)* Delay duration: 7 minutes	BMI at age 11 years	RR 1.29 Children that failed the ATDG task were more likely to be overweight at age 11 years (compared with children who passed the task)	1.06 to 1.58	NR	BMI z-score at age 4 years (baseline), sex, ethnicity, income-to-needs ratio, maternal marital status*	Review authors state that this study used an adequate prospective calculation of the sample size
Inability to delay gratification and change in BMI z-score	PCS (Francis and Susman, 2009) (1061)	3 years	Age 12 years	Children's self-regulatory capacity measured in 2 video-recorded behavioural procedures (1 involving food, one not	BMI at all data collection points (ages 3, 5, 7, 9, 11 and 12 years)* Dependent variable of	Children low in self-regulation (who scored low in both tasks) had the most rapid gains	NR	NR	Identical mixed models were run separately for boys and girls* Analyses adjusted for	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				involving food) designed to assess the extent to which children exhibit self-regulatory skills at ages 3 and 5 years* At age 3, the target was a non-edible toy; at age 5, the target was snack food* Delay duration: 150 seconds (for toy)* 210 seconds (for food)	the analysis was change in BMI z-scores from age 3 to 12 years	in BMI z-score from age 3 to 12 compared with children with high self-regulation Change in BMI z-score in children with low self-regulation (0.57± 0.05)			maternal education and family income*	
Eating or skipping breakfast										
	Blondin et al (2016) AMSTAR 2 confidence rating: critically low									
Breakfast consumption and child odds of	PCS (Kupers et al 2014) (1366) Netherlands	Mean age 2.1 years	3 years	Parent-reported questionnaire included a question on breakfast	BMI	OR 0.72 Odds of overweight at age 5 years in children	0.15 to 3.49	NR	Birth weight, origin (Dutch or non-Dutch), maternal	Null findings attributed to the infrequency of breakfast skipping at

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
overweight				frequency: 'How often does your child eat breakfast weekly?' at age 2 and 5 years		who skip breakfast at age 2 and 5 years compared with not skipping breakfast at age 2 and 5 years			educational level, maternal and paternal BMI at 2 or 5 years, and family type (single-parent family or not).	both baseline and follow-up in this sample (3.0% to 5.3%) Risk of being overweight at age 5 years was based on BMI z-score (Dutch reference growth charts (1997) and Cole's BMI category cut-off for overweight status)

Table A9.34 Feeding practices to increase fruit or vegetable consumption or acceptance

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Feeding practices (collectively) and vegetable consumption										
	Hodder et al (2020) AMSTAR 2 confidence rating: high									
Feeding practices and vegetable consumption	MA of 19 trials (2140) Mostly high-income countries (HIC)	≤5 years	Immediate to 6 months Mean duration of follow-up was 8.3 weeks.	Interventions designed to increase fruit or vegetable consumption. Repeated exposure (6 studies), pairing with positive stimuli (3 studies) and infant feeding practices (4 studies) compared with no treatment	Vegetable consumption	SMD 0.58 Equivalent to an increase of 5.30 grams of as-desired vegetable consumption		0.0014	NR	I^2=77% Random-effects model 76% weighting of MA from trials in children aged 1 to 5 years.
Feeding practices and vegetable consumption	Sensitivity analysis excluding trials at high risk of bias (8 trials, 701)	≤5 years	NR	NR	Vegetable consumption	SMD 0.54	0.18 to 0.90	0.004	NR	Random-effects model

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Feeding practices and vegetable consumption	Sensitivity analysis of trials with low attrition or high attrition with ITT analysis (11 trials, 971)	≤5 years	NR	NR	Vegetable consumption	SMD 0.49	0.22 to 0.77	0.0004	NR	Random-effects model
Feeding practices and vegetable consumption	Subgroup analysis in children aged >12 months (all trials in children aged 1 to 5 years) (15 trials, participant NR)	>12 months to ≤5 years	NR	NR	Vegetable consumption	SMD 0.58	0.34 to 0.83	P<0.00001	NR	Random-effects model I^2=72%
Feeding practices and vegetable consumption in children from low	RCT (Cooke et al, 2011) (216) UK	Age 4 to 5 years	3 weeks, 12 exposure sessions	1) repeated exposure (RE) 2) RE + non-food reward (sticker) 3) RE + social reward (praise)	Target vegetable consumption (g)	RE coupled with reward significantly increased the consumption of a	NR	NR	NR	Sample size calculation performed

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
SES backgrounds				4) no intervention		target vegetable				
Feeding practices and vegetable consumption in children from low SES backgrounds	RCT (Smith et al, 2017) (240) USA	Age 3 to 5 years	8 weeks	1) weekly take home of fruits and vegetables 2) weekly take home of vegetable and fruit + nutrition education, which included tastings	Consumption of vegetable and fruit consumption measured by carotenoid levels in the skin	Both interventions increased vegetable and fruit consumption compared with no intervention	NR	NR	NR	Sample size calculation performed
	Nekitsing et al (2018) AMSTAR 2 confidence rating: low									
Feeding practices and vegetable consumption	MA of 30 intervention studies (4017) Mostly high-income countries (HIC)	Mean age 3.8 years (based on 19 studies that reported age)	2 single sessions to 8 months	Interventions were educational interventions, repeated exposure, pairing or stealth, food services,	Vegetable consumption	SMD: 0.40	0.31 to 0.50	<0.001	NR	I^2=73.4% Random-effects model Subgroup analyses found that effect size varied significantly (p<0.05) by study

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				reward, modelling, choice, variety, visual presentation versus no treatment or baseline consumption; usual care or received treatment after the intervention phase						design, outcome measures, intervention recipient (child or parent or teacher), intervention strategy and type of vegetable used Funnel plot asymmetry and results of Egger's test suggest presence of publication bias Duval and Tweedie's trim and fill method indicate that under the random-effects model, 8 studies are missing. If these were added, then the imputed combined effect would be g=0.31

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
										(95% CI 0.21 to 0.41)
Feeding practices and vegetable consumption	MA of 44 intervention arms across 30 studies (4017) Mostly high-income countries (HIC)	Mean age 3.8 years (based on 19 studies that reported age)	2 single sessions to 8 months	Interventions were educational interventions, repeated exposure, pairing or stealth, food services, reward, modelling, choice, variety, visual presentation versus no treatment or baseline consumption; usual care or received treatment after	Vegetable consumption	SMD: 0.42	0.33 to 0.51	<0.001	NR	I^2=69.07%

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				the intervention phase						
Repeated taste exposure and vegetable consumption										
	Nekitsing et al (2018) AMSTAR 2 confidence rating: low									
Repeated exposure and vegetable consumption	Subgroup MA of 10 intervention studies (participants NR) Mostly high-income countries (HIC)	Unclear Mean age of children 3.8 years across in 19 studies included in SR with data on age	Unclear – but likely <8 months	Repeated taste exposure (alone or coupled with other strategies such as reward, modelling) versus no treatment or baseline consumption; usual care or received treatment after the intervention phase	Vegetable consumption	(a) SMD: 0.57 (b) Meta-regression analysis of the 10 studies involving taste exposure found that the number of taste exposures was directly associated with effect size:	(a) 0.43 to 0.70 (b) 0.00 to 0.06	(a) NR (b) 0.01	NR	(a) I^2=52% Random-effects model

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Beta coefficient 0.035 Children require 8-10 exposures for a significant improvement in consumption (a moderate effect size or SMD 0.5)				
Repeated exposure and vegetable consumption	Subgroup MA of 5 intervention arms (number of studies NR) (134) Mostly high-income	Unclear Mean age of children 3.8 years across in 19 studies include	Unclear – but likely <8 months	Repeated taste exposure only versus no treatment or baseline consumption; usual care or received treatment after	Vegetable consumption	SMD: 0.79	0.53 to 1.05	NR	NR	I^2 NR Random-effects model

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	countries (HIC)	d in SR with data on age		the intervention phase						
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									
Repeated taste exposure with pairing on consumption of vegetables	Intervention study (Caton et al, 2014) (332) UK, Denmark, France	4 to 38 months	Unclear	Children were randomly assigned to 1 of 3 conditions Repeated exposure (x10) to artichoke puree that was (a) basic or unflavoured (b) sweet (flavour-flavour learning, FFL) (c) added energy (flavour-nutrient learning, FNL)	Vegetable consumption (artichoke) Pre- and post-intervention measures of artichoke puree were measured	5 to 10 exposures to the taste of the unfamiliar vegetables was needed to increase consumption of that vegetable 2 weeks after the intervention.	NR	NR	NR	None
Repeated taste exposure and pairing on vegetable consumption										
	Nekitsing et al (2018) AMSTAR 2 confidence rating: low									

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Repeated taste exposure with pairing on consumption of vegetables	Subgroup MA of 8 intervention arms (number of studies NR) (358) Mostly HIC	Unclear Mean age of children 3.8 years across in 19 studies included in SR with data on age	Unclear – but likely <8 months	Repeated taste exposure to vegetables plus pairing (with liked foods, flavours, additional nutrients)	Vegetable consumption	SMD: 0.43	0.26 to 0.61	NR	NR	I^2 NR Conclusion of review authors: taste exposure to the vegetable on its own (plain form) produced a larger impact on consumption than pairing with other flavours, dips or energy
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									
Repeated taste exposure with pairing on consumption of vegetables	Intervention study (Caton et al, 2014) (332) UK, Denmark, France	4 to 38 months	Unclear	Children were randomly assigned to 1 of 3 conditions Repeated exposure (x10) to artichoke puree that was (1) basic or unflavoured (2) sweet (flavour-flavour learning, FFL)	Vegetable consumption (artichoke) Pre- and post-intervention measures of artichoke puree were measured	Children in the added energy condition (FNL) showed the smallest change in consumption over time, compared with those in the basic or	NR	NR	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(3) added energy: 144kcal per 100g from sunflower oil* (flavour-nutrient learning, FNL)		sweetened artichoke condition (FFL). Contrary to expectation the FNL was less effective than RE.				
Repeated taste exposure and acceptance of textures (fruit or vegetable)										
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									
Repeated taste exposure to textures and acceptance of new complex textures	Intervention study (Lundy et al 1998) (12) USA	13 to 22m	20 days	3 intervention groups: (1) 10 days of exposure to pureed texture (apple sauce) followed by 10 days of exposure to a lumpy texture (2) 20 days exposure to lumpy texture	Acceptance of complex textures (measured by head and body movements and eagerness)	Increased acceptance of complex textures	NR	NR	NR	Quantitative data not reported by SR

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(3) 20 days exposure to a pureed texture						
Repeated taste exposure to textures and vegetable consumption	Intervention study (Blossfeld et al 2007) (70) USA	12m	2 test sessions*	Children exposed to cooked carrots with 2 different textures: pureed and chopped	Consumption of carrots (pureed and chopped)	Children consumed more pureed carrots than chopped carrots at age 12 months but children with more teeth were more accepting of chopped carrots. However, children's consumption of chopped carrots was	NR	NR	NR	Quantitative data not reported by SR

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						predicted by previous experiences of carrots in a variety of forms (tastes and textures)				
Repeated visual exposure and preference or acceptance (fruit or vegetable)										
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									
Repeated visual exposure and taste preference (fruit)	Intervention study (Birch et al, 1987) (43) USA	23 to 69 months	Unclear	Children received either 'look' or 'taste' exposures to 7 unfamiliar fruits. Foods were exposed 5, 10, or 15 times and one fruit remained unfamiliar. After exposure, children were assigned to make 2 judgements of	Visual and taste preferences of previously exposed foods	Visual exposure enhanced visual preferences of foods while taste exposure enhanced taste preferences of foods. However, visual exposure to foods did not	NR	NR	NR	Quantitative data not reported by SR

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				the 21 food pairs based: one based on looking and one based on tasting the foods, and choosing the one they liked best		correlate with taste preferences of the same foods				
Repeated visual exposure and willingness to taste (fruit)	Intervention study (Houston-Price et al, 2009) (20) UK	21 to 24 months	2 weeks	Repeated visual exposure to pictures of fruits and vegetables every day for 2 weeks; half the fruits and vegetables were familiar to the child, half were not familiar	Child's willingness to taste unfamiliar fruits (taste test)	Prior visual exposure to an unfamiliar fruit increased willingness to taste the fruit compared with a non-exposed unfamiliar fruit	NR	NR	NR	Quantitative data not reported by SR

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Repeated visual exposure and willingness to taste (vegetable)	Intervention study (Houston-Price et al, 2009) (20) UK	21 to 24 months	2 weeks	Repeated visual exposure to pictures of fruits and vegetables every day for 2 weeks; half the fruits and vegetables were familiar to the child, half were not familiar	Child's willingness to taste unfamiliar vegetables (taste test)	Prior visual exposure to a familiar vegetable decreased willingness to taste the vegetable compared with a non-exposed familiar vegetable	NR	NR	NR	Quantitative data not reported by SR
Repeated visual exposure and willingness to taste (vegetable)	Intervention study (Heath et al 2014) (68) UK	20 to 24 months	2 weeks	Repeated visual exposure to pictures of liked, disliked and unfamiliar vegetables every day for 2 weeks	Child's willingness to taste initially liked, disliked or unfamiliar vegetables after visual exposure compared with control vegetable of same initial status (preference	Children were more easily persuaded to eat the target food than a matched control vegetable, and consumed more of the target food. The	NR	NR	NR	Quantitative data not reported by SR

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
					and familiarity) Amount of each food eaten was also measured*	strongest exposure effect was seen for initially unfamiliar vegetables				
Multicomponent interventions										
	Hodder et al (2018) AMSTAR 2 confidence rating: high									
Multicomponent interventions and vegetables and fruit consumption	Cluster-RCT (De Bock et al, 2012) (348) Germany	3-6 years	6 months	Intervention activities consisted of familiarizing with different food types and preparation methods as well as cooking and eating meals together in groups of children, teachers and parents. Availability of fruit, vegetables	Children: Height, weight, waist circumference, total body fat using skinfold measurement. Parents: Questionnaire assessing multiple domains of behaviour including Children's' eating behaviour	Children's vegetables and fruit consumption increased significantly. No significant changes in the consumption of water and sugared drinks were found. No anthropom	NR	NR	Not applicable	High drop-out rate

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				and water was increased.	and physical activity. Food frequency questionnaire Socio-demographic information	etric measurements changes were found.				

Table A9.35 Feeding practices on children's preferences for sweet taste

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Appleton et al (2018) AMSTAR 2 confidence rating: moderate									
Taste exposure and food preference (sweet taste)	Controlled trial (Sullivan and Birch, 1990) (39) USA	Age 44 to 71 months (mean age: 55 months)	9 weeks	Pre-intervention*: preferences were measured for 6 unfamiliar foods (including 3 versions of tofu and ricotta cheese) Intervention: 2 times per week for 9 weeks (total of 15 exposures) to either sweet tofu (14g sucrose per 100g), salted tofu (2g salt per 100g), or plain tofu	(a) preference for 3 varieties of tofu and ricotta cheese (plain, salted, sweetened) (b) In subset of participants: preference for plain, salted, sweetened tofu compared with same 3 versions of jicama (completely unfamiliar food)* Rank order of foods from	Preference for exposed variety of tofu increased regardless of whether it was sweet, salty or plain; but increased preference for the exposed flavour did not have an effect on preference for the other unexposed varieties* 1 and 2: children preferred	NR	NR	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
					"most liked" to "least liked" Outcome measured: (a) pre-exposure, after 8th and 15th exposures (b) after 15th exposure	sweet ricotta cheese and sweet jicama to the other varieties, but exposure to sweet variety of tofu did not increase preference for sweet ricotta or jicama compared with exposure to salty or plain tofu Preference increased for the exposed version only*				

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Interpretation by SR: exposure impacts on preferences for same food, but has no impact on preferences for other sweet foods				
Taste exposure and food preference (sweet taste)	Controlled trial (Ogden et al, 2012) (53) UK	Age 1 to 7 (mean age 3)	2 days	Restriction group: 75g chocolate coins given to children to eat over ~2 days following restrictive rules (parental restriction on how much and when child could eat the chocolate coins)	At start and end of trial, parents asked to rate child's preoccupation with food in terms of 4 constructs: (a) Demanding chocolate coins (b) Eating chocolate coins	Reduced demanding and eating chocolate in both groups, and greater in non-restricted group. Increased demands for other sweet foods in non-	NR	NR	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Non-restriction group: 75g chocolate coins given to children following non-restrictive rules (children were allowed to eat the coins as and when they wanted over ~2 days)	(c) Demanding other sweet foods (d) Eating other sweet foods	restricted group compared with restricted group. No effects in eating other sweet foods. Interpretation by SR: exposure (lower restriction) reduces demand for same sweet food, but increases demand for other sweet foods				

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Taste exposure and food preference (sweet taste)	PCS (Sonneville et al, 2015) (1163) USA	1 year	Median age 3.1 years and 7.7 years	Fruit juice consumption per day 1) small: 1 to 7oz 2) medium: 8 to 15 oz 3) large: 16 oz Parent-completed questionnaire for past month Also measured water consumption	Consumption of fruit juice, SSBs (soda, fruit drinks) (servings per day)	Juice consumption compared with no juice consumption at age 1 year was associated with higher SSB (medium and large consumption) and juice consumption (all consumption) at ages 3 and 7 years (SSB and juice, all consumption levels). Interpretation by SR: higher consumption of juice in	NR	NR	Models adjusted for confounders: maternal age, education, pre-pregnancy BMI, household income, child age, sex, ethnicity, weight-for-length z-score at 1 year	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						early childhood is associated with higher consumption of juice and SSB in later years No association with water consumption at age 1 year				
Taste exposure and food preference (sweet taste)	PCS (Okubo et al, 2016) (493) Japan	16 to 24 months	~2 years (aged 41 to 49 months)	Exposure to SSBs (non-100% fruit juice, other sweetened juice) at ages 16 to 24 months: 1) <1 per week 2) 1 to 3 per week 2) 4 to 6 per week 3) ≥1 per day	Consumption of fruit, confectionary, 100% fruit and vegetable juice, SSBs (fermented milk drinks, sugar-sweetened drinks, cocoa)	Higher early SSB consumption (>1 week*) are associated with later higher consumption of SSBs and some other sweet foods and lower consumptio	NR	NR	Demographic differences between groups Models adjusted for confounders*: Child factors (birth	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Parent-completed questionnaire assessing preceding month	Units: g per 1000 kcal per day	n or no associations with other sweet foods			order, birth weight, breastfeeding duration, age at introduction to solid foods, body weight at age 42 months); maternal factors (BMI, education, employment, income, smoking,	

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									maternal SSB consumption during pregnancy and at 42 months postpartum)	

Table A9.36 Feeding practices on food acceptance or consumption

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Parental restriction on food acceptance or consumption										
	Osei-Assibey et al (2012) AMSTAR 2 confidence rating: low									
Parental restriction and total energy intake	Nested non-randomised controlled trial (Sud et al, 2010) (70) USA	4 to 6 years	4 dinner visits, of 1 day each	At each visit children were offered an ab libitum laboratory dinner* Parental restriction (including access to palatable foods) assessed by Child Feeding Questionnaire (CFQ)*	Total energy intake	Restrictive feeding practices were not associated with total energy intake	NR	0.5	NR	Quantitative data not reported by SR
	Mura Paroche (2017) AMSTAR 2 confidence rating: critically low									
Effect of restriction or monitoring and children's eating	PCS (Gregory et al, 2010) (156) Australia	2 to 4 years (mean 3.3 years)	Mean age 4.3 years	Maternal (a) pressure to eat (b) restriction (c) monitoring (all measured by the Child	(1) Children's eating behaviours (using items from the food responsiveness and food	(a) Pressure to eat at baseline inversely predicted child	NR	NR	Eating behaviour at baseline, child age, gender,	'Interest in food' not defined

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
behaviours or interest in food				Feeding Questionnarie)* plus (d) modelling of healthy eating (answers to 3 items on modelling healthy eating measured using a 5-point Likert scale)	fussiness subscales of the Child Eating Behaviour Questionnaire (CEBQ)* Items measured: -food fussiness -food responsiveness -interest in food (2) child BMI z-scores	interest in food at follow up (b) and (c) Restriction and monitoring did not predict changes in child eating behaviour (changes in food fussiness or responsiveness or interest in food (d) modelling of healthy eating at baseline inversely predicted child food			maternal age, BMI, education	

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						fussiness at follow up Maternal feeding practices did not prospectively predict child food responsiveness or BMI				
Effect of modelling on food acceptance or consumption										
	Ward et al (2015) AMSTAR 2 confidence rating: moderate									
Effect of adult modelling and food acceptance (familiar and unfamiliar)	Series of quasi-experimental studies (Hendy and Raudenbush, 2000) (97) USA	Preschool children (age not specified)	Unclear	Study 1 (n=34): Familiar lunch foods presented under either silent teacher modelling compared with simple exposure Study 2 (n=23):	Study 1: Acceptance of four familiar foods (unspecified) across 3 school lunches (measured in number of bites) Study 2: Acceptance	Silent modelling compared with simple exposure Familiar foods sampled: MD -0.305 ($p \geq 0.05$) Unfamiliar foods sampled:	NR	See 'Measure of association or effect'	NR	Different children recruited for each study

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Unfamiliar foods presented under silent teacher modelling compared with simple exposure Study 3 (n=26): Unfamiliar foods presented under either enthusiastic teacher modelling compared with simple exposure Study 4 (n=14) Unfamiliar foods presented under either enthusiastic teacher modelling	of 4 unfamiliar foods (chickpeas, prunes, water chestnuts, matzo crackers*) across 3 school lunches (measured in number of bites) Study 3: Acceptance of 2 unfamiliar foods (fresh mango and dried cranberries*) across 5 school lunches (measured in number of bites)	MD 0.024 (p≥ 0.05) Enthusiastic modelling compared with simple exposure Bites of new food: MD 5.08 (p<0.03) After adjusting for peer modelling, the association between enthusiastic modelling and acceptance of new food was no longer significant (p=0.35).				

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				compared with enthusiastic peer modelling compared with simple exposure	Study 4: Acceptance of 3 unfamiliar foods (fresh mango, fresh kiwi, dried apples*) across 5 school lunches (measured in number of bites)					
Effect of adult modelling and acceptance of vegetables and fruit (unfamiliar)	Quasi-experimental studies (Hendy et al, 1999) (64) USA	Preschool children (age not specified)	3 consecutive days	Four unfamiliar foods (kiwi fruit, chickpeas, coconut and sweet red pepper*) presented to the children during preschool lunch for 3 consecutive days	(a) Number of foods sampled with at least 1 bites (b) Number of meals during which at least one of the new foods was sampled (c) Total number of bites of new	Silent modelling was not more effective compared with simple exposure (a) MD 0.8 ($p \geq 0.05$) (b) MD 0.55 ($p \geq 0.05$) (c) MD 2.75 ($p \geq 0.05$)	NR	See ‘Measure of association or effect’	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				Teachers were randomly assigned to 5 actions to encourage children's food acceptance: (1) Simple exposure (control) (n=12) (2) Silent modelling (n=14) The teachers also said "I like to try new foods" twice during each of the 3 meals (3) Reward (food) (n=14) (4) Ask to try one bite (n=14) (5) Choice offering (n=10)	foods across all 3 meals					
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Effect of adult modelling and food consumption (unfamiliar food)	Intervention study (Addessi et al, 2005) (27) USA	2 to 5 years	Unclear	Children were assigned to one of 3 intervention groups: (a) Presence (a model was present but not eating the food), (b) Different food (model and child ate different foods) (c) Same food (model and child ate the same foods)	Child acceptance of unfamiliar food (semolina)*	Children in the 'same food' condition ate more of the unfamiliar food than those in the 'presence' and 'different food' conditions. Children's ages (below or above the median age of 45 months), early feeding practices and classroom membership did not	NR	NR	NR	Quantitative data not reported by SR School setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						affect food acceptance				
Effect of adult modelling and fruit or vegetable consumption (familiar and unfamiliar food)	Intervention study (Edelson et al 2016) (60 families with children aged 12 to 36 months)	12 to 36 months	Unclear	Parents video recorded all regular eating occasions over one day, plus an additional meal in which parents introduced a unfamiliar fruit or vegetable to the child.* Parents also completed a feeding style questionnaire* Prompts used by parents included pressure to eat, use of another food	Child food consumption (Parents completed 3 x 24 hour dietary recalls 3 months after the video recordings)	The most immediately successful prompt for regular meals across food types was modelling (compared to a neutral prompt as a reference*). A prompt was considered 'successful' if the child took a bite of the target food	NR	NR	NR	Quantitative data not reported by SR Home setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				or a non-food item as a reward, reasoning with the child, and modelling.		within 20s of the prompt without making a refusal in between* For the unfamiliar food condition, no prompting technique was significantly better than a neutral prompt (for example, “eat your peas” spoken in a neutral or positive tone of voice) *				

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Effect of adult modelling and children's eating behaviours or interest in food	PCS (Gregory et al, 2010) (156) Australia	2 to 4 years (mean 3.3 years)	Mean age 4.3 years	Maternal (a) pressure to eat (b) restriction (c) monitoring (all measured by the Child Feeding Questionnarie)* plus (d) modelling of healthy eating (parental answers to 3 items on modelling healthy eating measured using a 5-point Likert scale)	(1) Children's eating behaviours (using items from the food responsiveness and food fussiness subscales of the Child Eating Behaviour Questionnaire (CEBQ)* Items measured: -food fussiness -food responsiveness -interest in food (2) child BMI z-scores	(a) Pressure to eat at baseline inversely predicted child interest in food at follow up (b) and (c) Restriction and monitoring did not predict changes in child eating behaviour (d) modelling of healthy eating at baseline inversely predicted child food fussiness at follow up	NR	NR	Eating behaviour at baseline, child age, gender, maternal age, BMI, education	'Interest in food' not defined

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Maternal feeding practices did not prospectively predict child food responsiveness or BMI				
Effect of adult modelling and food acceptance (unfamiliar food)	Intervention study (Harper and Sanders, 1975) (80) USA	14 to 48 months	Unclear	Children were assigned to 3 intervention groups: (a) “offer-only condition,” (b) “adult-also-eats condition,” (c) “male or female visitor offer-only condition.” Children were offered 2 new foods at home	Child acceptance of unfamiliar foods (unspecified)	Children accepted the food item offered more often when adults were also eating, especially girls. Foods were more often accepted when presented by the mother	NR	NR	NR	Quantitative data not reported by SR Home setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						than by a visitor, especially by children at the younger end of the age range				
	Mikkelsen et al (2014) AMSTAR 2 confidence rating: low									
Effect of peer modelling and food acceptance (unfamiliar foods)	Quasi-experimental study (Hendy, 2002) (38) USA	3 to 6 years	Unclear	Presentation of 3 unfamiliar foods (all dried fruits) during 5 preschool meals (3 baseline meals + 2 modelled), approximately once a week* Aim of experiment was to test the effectiveness of trained child peer models to increase child unfamiliar food acceptance	Number of bites taken of the unfamiliar foods (all dried fruits) Food preference also measured	The study found that girl models were more effective at increasing food acceptance than boy models. However, the effect disappeared after 1-month follow-up.	NR	NR	NR	Quantitative data not reported by SR Convenience sampling School setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Mura Paroche et al (2017) AMSTAR 2 confidence rating: critically low									
Effect of peer modelling and vegetable preference	Intervention study (Birch et al 1980) (39) USA	2 to 4 years (mean age 3.1 years)	4 days	A (target) child who preferred vegetable A to B was seated with 3 or 4 peers with opposite preference patterns. Children were served their preferred and non-preferred vegetable pairs at lunch and asked to choose one. On day 1 the target child chose first, while on days 2, 3, and 4 peers chose first	Food choice	70% of the children showed a shift from choosing their preferred food on day 1 to choosing their non-preferred food by day 4. Consumption data corroborated these results. In the post-intervention test, fewer than half of the peers changed their preferred foods.	NR	NR	NR	School setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Younger children were more affected by peer modelling than older children				
Effect of peer modelling and food consumption (snack food)	Intervention study (Lumeng and Hillman et al 2007) (54) USA	2.5 to 6.5 years	2 sessions*	Children took part in two conditions; eating in a small group (n=3) and large groups (n=9).	Consumption of snack food (plain crackers, in grams*) and duration of snack session were recorded	Children consumed approx. 30% more food when eating in a large group compared with a small group if the snack duration was longer than 11.4 min. No group differences in consumption were observed	NR	NR	NR	School setting

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						when snack duration was shorter than this				
Effect of using rewards on food acceptance or consumption										
	Ward et al (2015) AMSTAR 2 confidence rating: moderate									
Effect of rewards (food) and food acceptance and consumption (unfamiliar vegetables and fruit)	Quasi-experimental studies (Hendy et al, 1999) (64) USA	Preschool children (age not specified)	3 consecutive days	Four unfamiliar foods (kiwi fruit, chickpeas, coconut and sweet red pepper*) presented to the children during preschool lunch for 3 consecutive days Teachers were randomly assigned to 5 actions to encourage	(a) Number of foods sampled with at least 1 bite (b) Number of meals during which at least one of the new foods was sampled (c) Total number of bites of new foods across all 3 meals	Use of food reward (dessert or sweets)* was more effective compared with simple exposure (a) MD 2.45 ($p < 0.001$) (b) MD 1.5 ($p < 0.001$) (c) MD 11.55 ($p < 0.02$)	NR	See ‘Measure of association or effect’	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				children's food acceptance: (1) Simple exposure (control)(n=12) (2) Silent modelling (n=14) the teachers also said "I like to try new foods" twice during each of the 3 meals (3) Reward (food) (n=14) (4) Ask to try one bite (n=14) (5) Choice offering (n=10)						
Effect of rewards (non-food) and food consumption (vegetable)	Pre-post study (Ireton and Guthrie, 1972) (19) USA	Preschool age (unspecified)	3-week experimental period	Various preparation methods of vegetables and use of immediate positive reinforcement	Child consumption of cooked vegetables	Compared with no positive reinforcement, positive reinforcement, mean consumptio	NR	See 'Measure of association or effect'	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				(verbal praise and use of a non-food reward (stickers) compared with no positive reinforcement		n of all vegetables (in grams) were higher when educators gave immediate positive reinforcement Asparagus: MD 14.06g ($p<0.001$) Broccoli: MD 21.88g ($p<0.01$) Cauliflower: MD 15.63g ($p<0.02$) Spinach: MD 10.47g ($p<0.001$)				

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						Squash: MD 20.78g (p<0.01)				
Verbal encouragement to eat on food acceptance or consumption										
	Ward et al (2015) AMSTAR 2 confidence rating: moderate									
Effect of encouraging children to eat and food acceptance and consumption (unfamiliar vegetables and fruit)	Quasi-experimental studies (Hendy et al, 1999) (64) USA	Preschool children (age not specified)	3 consecutive days	Four unfamiliar foods (kiwi fruit, chickpeas, coconut and sweet red pepper*) presented to the children during preschool lunch for 3 consecutive days Teachers were randomly assigned to 5 actions to encourage	(a) Number of foods sampled with at least 1 bite (b) Number of meals during which at least one of the new foods was sampled (c) Total number of bites of new foods across all 3 meals	Asking children to 'try one bite' was more effective compared with simple exposure (a) MD 1.85 (p<0.007) (b) MD 1.45 (p<0.001) (c) MD 5.55 (p<0.02)	NR	See 'Measure of association or effect'	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				children's food acceptance: (1) Simple exposure (control) (n=12) (2) Silent modelling (n=14) The teachers also said "I like to try new foods" twice during each of the 3 meals (3) Reward (food) (n=14) (4) Ask to try one bite (n=14) (5) Choice offering (n=10)						
Offering choice on child food acceptance or consumption										
	Ward et al (2015) AMSTAR 2 confidence rating: moderate									

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Effect of choice offering and food acceptance and consumption (unfamiliar food)	Quasi-experimental studies (Hendy et al, 1999) (64) USA	Preschool children (age not specified)	3 consecutive days	Four unfamiliar foods (kiwi fruit, chickpeas, coconut and sweet red pepper*) presented to the children during preschool lunch for 3 consecutive days Teachers were randomly assigned to 5 actions to encourage children's food acceptance: (1) Simple exposure (control) (n=12) (2) Silent modelling (n=14)	(a) Number of foods sampled with at least 1 bites (b) Number of meals during which at least one of the new foods was sampled (c) Total number of bites of new foods across all 3 meals	Choice offering was more effective compared with simple exposure (a) MD 1.7 (p<0.007) (b) MD 1.0 (p<0.02) (c) MD 21.75 (p<0.007)	NR	See 'Measure of association or effect'	NR	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				The teachers also said "I like to try new foods" twice during each of the 3 meals (3) Reward (food) (n=14) (4) Ask to try one bite (n=14) (5) Choice offering (n=10)						
Pressure to eat on children's eating behaviours or interest in food										
	Mura Paroche (2017) AMSTAR 2 confidence rating: critically low									
Effect of pressure to eat and children's eating behaviours or interest in food	PCS (Gregory et al, 2010) (156) Australia	2 to 4 years (mean 3.3 years)	Mean age 4.3 years	Maternal (a) pressure to eat (b) restriction (c) monitoring (all measured by the Child Feeding Questionnarie) * plus (d) modelling of healthy	(1) Children's eating behaviours (using items from the food responsiveness and food fussiness subscales of the Child Eating Behaviour	(a) Pressure to eat at baseline inversely predicted child interest in food at follow up (b) and (c) Restriction	NR	NR	Eating behaviour at baseline, child age, gender, maternal age, BMI, education	'Interest in food' not defined

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				eating (answers to 3 items on modelling healthy eating measured using a 5-point Likert scale)	Questionnaire (CEBQ)* Items measured: -food fussiness -food responsiveness -interest in food (2) child BMI z-scores	and monitoring did not predict changes in child eating behaviour (d) modelling of healthy eating at baseline inversely predicted child food fussiness at follow up Maternal feeding practices did not prospectively predict child food responsiveness or BMI				

Table A9.37 Feeding practices or styles

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Feeding practices										
	Russell et al (2016) AMSTAR 2 confidence rating: moderate									
Feeding practices and child standardised weight	PCS (Faith et al, 2006) (1797) USA	Age 1 to 5 years	Every 6 months	Questions on parental feeding practices included in self-administered survey*: "How often do you limit how much this child eats?" "Do you agree with the statement 'Children need to finish dinner before dessert'? "Have you tried offering this child more fruit or vegetables to eat?"	Weight and height measured at each interview Main outcome: Change in age- and gender-standardised BMI per month*	No differences in feeding practices and child weight (change in BMI z-scores)	NR	NR	Child sex, ethnicity, baseline weight-for-height z-score, food consumption (servings per day)*	Quantitative data not reported by SR

	Hurley et al (2011) AMSTAR 2 confidence rating: critically low									
Feeding practices and child standardised weight	PCS (Farrow and Blissett, 2008) (62 mother-child dyads) UK	Recruited at birth	Age 2	Monitoring Restriction Pressure to eat (measured by the Child Feeding Questionnaire)	Weight SDS	Pressure and restriction at age 1 year significantly predicted lower child weight SDS at 2 years Results for monitoring NR	NR	NR	Child weight at 1 year	Mixed SES Ethnicity not reported (in primary study) Quantitative data not reported by SR
	Bergmeier et al (2015) AMSTAR 2 confidence rating: critically low									
Feeding practices or styles and weight status	PCS (Lumeng et al, 2012) (1218) USA	15, 24, 36 months	Age 36 months	(a) Assertive prompting (pressuring to eat) (verbal or physical encouragements) (b) Intrusiveness defined as maternal behaviour that was adult centred rather than child-centred and imposed the mother's agenda on the child	Height and weight by objective measures during laboratory visits Age 15 months: weight-to-length z-score (WLZ)* Ages 24 and 36 months: BMI z-score (BMIz)* WLZ and BMIz collectively referred to as	Assertive prompting and intrusive style had small but significant associations with greater child adiposity (across ages 15, 24 and 36 months*)	NR	NR	Child's ethnicity, sex, age family income-to-needs ratio, maternal education, weight status and depressive symptoms	Mostly white participants Quantitative data not reported by SR

				At each of the 3 ages, children and their mothers were filmed in a laboratory while the child ate a standardised snack; maternal feeding behaviours were observed and coded.	adiposity z-scores*					
	Mura Paroche (2017) AMSTAR 2 confidence rating: critically low									
Feeding practices and weight status	PCS (Gregory et al, 2010) (156) Australia	2 to 4 years (mean 3.3 years)	Mean age 4.3 years	Maternal a) pressure to eat b) restriction c) monitoring (all measured by the Child Feeding Questionnarie)* plus d) modelling of healthy eating (answers to 3 items on modelling healthy eating measured using a 5-point Likert scale)	(1) Children's eating behaviours (using items from the food responsiveness and food fussiness subscales of the Child Eating Behaviour Questionnaire (CEBQ)* Items measured: -food fussiness	(a) Pressure to eat at baseline inversely predicted child interest in food at follow up (b) and (c) Restriction and monitoring did not predict changes in child eating behaviour	NR	NR	Eating behaviour at baseline, child age, gender, maternal age, BMI, education	None

					-food responsiveness -interest in food (2) child BMI z-scores	(d) modelling of healthy eating at baseline inversely predicted child food fussiness at follow up Maternal feeding practices did not prospectively predict child food responsiveness or BMI				
Feeding styles										
	Bergmeier et al (2015) AMSTAR 2 confidence rating: critically low									
Feeding practices or styles and child weight	PCS (Lumeng et al, 2012) (1218) USA	15, 24, 36 months	Age 36 months	(a) Assertive prompting (verbal or physical encouragements) (b) Intrusiveness defined as maternal behaviour that was adult centred rather	Height and weight by objective measures during laboratory visits Age 15 months: weight-to-length z-score (WLZ)*	Assertive prompting and intrusive style had small but significant associations with greater child adiposity.	NR	NR	Child's ethnicity, sex, age family income-to-needs ratio, maternal education,	Mostly white participants Quantitative data not reported by SR

				than child-centred and imposed the mother's agenda on the child At each of the 3 ages, children and their mothers were filmed in a laboratory while the child ate a standardised snack; maternal feeding behaviours were observed and coded.	Ages 24 and 36 months: BMI z-score (BMIz)* WLZ and BMIz collectively referred to as adiposity z-scores*				weight status and depressive symptoms	

Excess weight and obesity

Table A9.38 Obesity and childhood growth trajectory outcomes

Exposure and Outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Rapid early weight gain or growth										
	Brisbois et al (2012) AMSTAR 2 confidence rating: critically low									
Rapid early growth and adult BMI	PCS (McCarthy et al 2007) (679) UK	2 to 5 years	Age 18 to 50 years*	Growth velocity (weight gain) measured as the deviance from the average predicted growth rate (kg per year) converted into z-scores*	Adult BMI	Association between higher growth velocity and adult BMI (size of association NR)	NR	<0.001	All models adjusted for adult age, child sex and gestational age. Model 2 additionally adjusted for parental height and weight. Model 3 additionally adjusted for SES. Model 4 additionally adjusted for maternal smoking in	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									pregnancy. Model 5 additionally adjusted for current adult smoking status.	
Rapid early growth and adult BMI	PCS (Terry et al 2007) (261) USA	1 to 7 years	Age 20 to 40 years	Rapid growth (defined as an increase in percentile rank across 2 major reference growth percentiles as defined by the Centers of Disease Control and Prevention growth charts)*	Adult BMI	Rapid growth age 1 to 7 predicted higher adult BMI at 20 and 40 years (no effect size)	NR	Not provided	Maternal BMI, maternal weight gain during pregnancy, birth weight, postnatal growth rate (percentile change) at birth-age 4m, and age 4m-1y	None
Age at adiposity rebound (AR)										
	Brisbois et al (2012) AMSTAR 2 confidence rating: critically low									

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Early AR and adult BMI	PCS (Freedman et al 2001) (626) USA	<5 years	Unclear	Early adiposity rebound	Unclear	Positive association (size of association NR)	NR	<0.001	Unclear	None
Early AR and adult BMI	PCS (Prokopec et al 1993) (158) Czech Republic	<5 years	18 years*	Early adiposity rebound	Adult BMI*	Positive association (size of association NR)	NR	<0.05	Unadjusted	None
Early AR and adult BMI	PCS (Rolland-Cachera) (164) France	<5 years	21 years*	Early adiposity rebound (under age 5 years) versus late adiposity rebound (older than 7 years)	Adult BMI*	Positive association (size of association NR)	NR	(females: p<0.01; males: p<0.01)	Unadjusted	None
Early adiposity rebound and adult obesity	PCS (Williams et a 2009) (458) New Zealand	<5.5 years	Age 26 years	Early adiposity rebound (age <5.5 years) compared with later adiposity rebound (age >5.5 to 7 years)	Risk of developing adult obesity	RR 5.91	3.03 to 11.55	NR	Adjusted for sex	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Child BMI or obesity										
	Brisbois et al (2012) AMSTAR 2 confidence rating: critically low									
Child obesity and adult obesity	PCS (Garn et al, 1985) (383) USA	1 to 5 years	NR	Childhood obesity (classified as being in the ≥85th percentile)*	Adult obesity	Childhood obesity associated with adult obesity (RR of 1.77)	NR	p<0.05	Unadjusted	None
Child BMI and adult obesity	PCS (Gasser et al, 1995) (232) France	Early childhood BMI (ages not stated)	NR	BMI	RR of becoming a heavy adult*	Increase in RR (details not NR)	NR	NR	Unadjusted	None
Child obesity and adult obesity	PCS (Guo et al, 2002) (347) USA	3 years	Age 35 years	BMI	Obesity	Females with obesity (BMI ≥ 30) at age 35 years had a higher BMI at age 3 (p<0.05) than females without obesity at age 35 years. BMI	NR	NR	Unadjusted	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						at age 3 did not differ between males with or without obesity at age 35 years.				
Child BMI and adult BMI	PCS (Kindblom et al 2009) (612) USA	1 to 4 years	Unclear	BMI	Unclear	Correlation in boys only (male only cohort)	NR	NR	Age*	None
Child BMI and adult BMI	PCS (Kubo et al, 2007) (244) Japan	3 months to 5 years	Unclear	BMI	Adult BMI*	Correlation in girls only (female only cohort)	NR	NR	Unadjusted	None
Child BMI and adult overweight	PCS (Magarey et al, 2003) (155) Australia	2 years	Age 20 years	BMI	Adult overweight (BMI ≥25kg/m^2)*	RR 2.72 Overweight at 20 years	NR	NR	Parental weight status*	None
Child BMI and adult BMI	PCS McCarthy et al, 2007) (679) UK	1.5 years	Unclear	BMI	BMI	No significant correlation	NR	Not significant	Adult age, sex, and gestational age (model 1; unclear which	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									results of 4 models was cited by Brisbois)*	
Child obesity and adult obesity	PCS (Prokopec et al, 1993) (158) Czech Republic)	1 year	Age 18 years	‘Lean’ children BMI <25th percentile versus ‘Fat’ children BMI >75thth percentile*	Adult BMI >75th percentile ‘defined as ‘fat’ in the primary study	Childhood ‘fatness’ associated with adult ‘fatness’ (RR 1.8)	NR	NR	Unadjusted	None
Child overweight or obesity and adult overweight or obesity	PCS (Rolland-Cachera et al, 1987) (102) France	1 year	Age 20 years	BMI >75th percentile ‘defined as ‘fat’ in the primary study	Adult BMI >75th percentile ‘defined as ‘fat’ in the primary study	Childhood ‘fatness’ associated with adult ‘fatness’ (RR 2.0)	NR	NR	Unadjusted	None
Child BMI and adult BMI	PCS (Siervogel et al, 1999) (459) USA	>2 years and >5 years	NR	BMI	Adult BMI	Significant log OR with high adult BMI	NR	NR	Unadjusted	None

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Child BMI and adult BMI	PCS (Williams et al, 2001) (925) New Zealand	3 years and 5 years	Age 21 years*	BMI	Adult BMI*	Correlation (size of correlation NR)	NR	<0.05	Unadjusted	None

Table A9.39 Child Body Mass Index (BMI) and other health outcomes in later life

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Type 2 diabetes										
	Llewellyn et al (2016) AMSTAR 2 confidence rating: low									
Child BMI and Type 2 diabetes	Subgroup MA (1 estimate from 1 PCS) (n and country not reported)	≤6 years	NR	BMI	Type 2 diabetes	OR 1.23	95% CI 1.10 to 1.37	NR	NR	None
Coronary heart disease										
	Llewellyn et al (2016) AMSTAR 2 confidence rating: low									
Child BMI and coronary heart disease	Subgroup MA (3 estimate from 3 PCS) (n and country not reported)	≤6 years	NR	BMI	Coronary heart disease	OR 0.97	95% CI 0.85 to 1.10	NR	NR	I^2=52%;

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Stroke										
	Llewellyn et al (2016) AMSTAR 2 confidence rating: low									
Childhood BMI and stroke	Subgroup MA (3 estimate from 3 PCS) (n and country not reported)	≤6 years	NR	BMI	Stroke	OR 0.94	95% CI 0.75 to 1.19	NR	NR	I^2=58%
Breast cancer										
	Llewellyn et al (2016) AMSTAR 2 confidence rating: low									
Childhood BMI and breast cancer	Subgroup MA (1 estimate from 1 PCS) (n and country not reported)	≤6 years	NR	BMI	Breast cancer	OR 0.88	95% CI 0.67 to 1.16	NR	NR	None

Oral health

Table A9.40 Free sugars intake and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Moores et al (2022) AMSTAR 2 confidence rating: high									
Free sugars intake and dental caries	PCS (Devenish et al 2020) (2181 recruited, 965 included in analyses) Australia	1 and 2 years	Ages 2-3 years	Free sugars intake 1 year: 24-hour recall and 2-day estimated food record 2 years: externally validated FFQ Data combined into a single variable: (1) Non-compliant (free sugars intake >10% of energy intake on	Early childhood caries (ECC) defined as dmfs ≥1, including non-cavitated lesions (based on NIDCR and ICDAS methods). Measured after child's second birthday by trained and dental practitioners.	Prevalence ratio (PR) 1.97 for children with free sugars intake >10% energy on both dietary assessments compared with those who complied with the WHO threshold of <5% energy	1.13 to 3.34	NR	Maternal education, SES, age at time of dental examination, and breastfeeding duration (model 1). All children from area with fluoridated water.	Power calculation performed

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				both occasions) (2) Partially non-compliant (free sugars intake >10% energy intake on one but not both occasions) (3) Semi-compliant (free sugars intake <10% energy intake on both occasions, but >5% on at least 1 occasion) (4) Compliant (free sugars intake <5% of energy intake on both occasions)		from free sugars on both dietary assessments				

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Free sugars intake and dental caries	PCS (Karjalainen et al 2015) (148 recruited, 142 at baseline with data) Finland	3 years	Age 16 years	Sucrose intake measured using 4-day food diaries Participants dichotomised by sucrose intake: ≥10% energy and <10% energy	Changes in D_3MFT/d_3mft (assessed using WHO caries criteria)	DMFT or dmft scores of the high sucrose group significantly higher than those of the low sucrose group (p=0.046) Hazard ratio (HR) for caries survival (% caries free at end of follow-up or discontinued the study caries free) in sucrose intake	See previous column	See 'measure of association or effect'	Sex and intervention group controlled for in analyses. No significant differences in toothbrushing or use of fluoride toothpaste between the sucrose groups at ages 3, 6, 9, 12, or 16 years	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						<10% energy compared with ≥10% energy: 1.22 (95% CI 0.77 to 1.93); p=0.396				
	Moynihan and Kelly (2014) AMSTAR 2 confidence rating: high									
Free sugars intake and dental caries	PCS (Battellino et al, 1997) (820) Argentina	4 years	1 year	Sucrose intake FFQ and 24 hour recall interview with the mother or teacher at beginning, middle and end of study and the average intake taken	Change in dmft and dmfs (measured using the WHO criteria)	Correlation coefficient 0.4	NR	NR	NR	No power calculation
Free sugars intake and dental caries	PCS (Rodrigues et al, 1999) (510) Brazil	3 years	1 year	Added sugars intake at school: 2 x 3-day weighed food records conducted by	Caries increment (assessed using WHO caries criteria)	OR 2.99 of having a high caries increment in children who	1.82 to 4.91	<0.001	Family income, baseline age, household size, tooth brushing, daily intake of	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
				an independent observer Sugars intake at home: 24h recall interview with the mother; 10% of interviews repeated to test reliability of 24h recall data		consumed >10% energy (32.6g) from added sugars per day compared with children consuming <10% energy from added sugars			sugars at home, use of fluoride gel and visiting the dentist	
Free sugars intake and dental caries	PCS (MacKeown et al 2000) (259) South Africa	1 year	4 years	Added sugars Semi-quantitative FFQ (authors state that it was validated)	Change in caries incidence and prevalence according to WHO criteria (dmfs)	Change in caries incidence and prevalence was not significantly associated with added	NR	NR	None	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						sugars intake Prevalence of dental caries increased from 1.5% at age 1 (when sugars intake equated to 17g per day or approximately 6% energy intake) to 62.2% at age 5 years (when sugars intake was 48g per day and >10% of energy				

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						intake – approximately 14.4% EI)				
Free sugars intake and dental caries	PCS (Karjalainen et al 2001) (148 recruited, 135 included in analysis) Finland	3 years	3 years	Sucrose 4-day food diary completed by the mother and day care staff	dmft (measured using WHO criteria) caries incidence	Sucrose intake of children who developed caries by age 6 years was 10.2 (SD 3.1) % EI compared with 8.9 (SD 3.6) % EI in children who remained caries free	NR	0.026	No differences between children who were caries free and those who developed caries in tooth brushing habits, use of fluoride tables, day care use or maternal educational level; all participants came from a low fluoride area	No power calculation
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Free sugars intake and dental caries	PCS (Meurman and Pienihakkinen, 2010)	18 months	42 months (3.5 years)	Added sugars (sometimes compared with never) – data obtained	Caries increment, dmft*	Sugars added at 18 months associated with caries	NR	NR	Frequency of consumption of drinks other than water, frequency of	Power calculation performed*

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	(366) Finland			from interview of caregivers using a 4-level Likert scale*		increment at 42 months			night-feeding, frequency of sweet snacks consumption, mutans streptococci colonisation of teeth, caretaker occupation, oral health of both parents*	

Table A9.41 Sugar-sweetened beverages and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Moynihan et al (2019) AMSTAR 2 confidence rating: moderate									
Consumption of drinks containing free sugars and ECC	PCS (Warren et al 2009) (212 recruited; 125 included in analysis) USA	6 months to 18 months	Age 18 months	Sugar-sweetened beverage (SSB) consumption SSBs included regular soda pop, sports drinks, powder concentrate beverages made with sugar and juice-based drinks with added sugar.	Caries prevalence. Number with frank decay (d2-3 or filled surfaces)	OR 3.04	1.07 to 8.64	0.04	Age	No power calculation
Consumption of drinks containing free sugars and ECC	PCS (Watanabe et al 2014) (33,655 recruited; 31,202	1.5 years	Age 3 years	Daily SSB consumption	Incidence of dental caries.	OR 1.56	1.46 to 1.65	P<0.001	Breastfeeding duration, bottle-feeding while falling asleep, family income, parental	No power calculation (although sample size was large)

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	included in analysis) Japan								education level, toothbrushing frequency and use of fluoride varnish	
Consumption of drinks containing free sugars and ECC	PCS (Wendt et al, 1996) (671 recruited; 289 included in analysis) Sweden	1 year	Age 2 and 3 years	Consumption of sugars-containing liquids (not defined) to quench thirst	Caries incidence (%)	Not drinking sugars-containing liquids to quench thirst at age 1 year was an independent predictor of being caries-free at age 3 years (OR 2.26; 95% CI 1.07 to 4.77).	See previous column	0.033	NR	No power calculation. Lack of data on the comparator (that is, the proportion of children who received milk or water at age 1 who had caries or were caries free at age 3 years

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Consumption of drinks containing free sugars and ECC	PCS (Wigen & Wang, 2014) (1607 recruited, 1366 included in analysis) Norway	1.5 years	Age 5 years	Consumption of sugars-containing liquids (not defined) at night	ECC experience (not defined)	Compared with no consumption: - OR 1.5 (0.8 to 2.8) for sometimes consuming sugars-containing drinks - OR 2.2 (1.1 to 4.5) for nightly consumption. Compared with consuming sugars-containing drinks < once per week: - OR 1.7 (1.1 to 2.08) for	See previous column	NR	Toothbrushing frequency, sugary drink consumption level, maternal health and lifestyle variables, family characteristics (including maternal education).	No power calculation.

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						consuming sugars-containing drinks at least once per week.				

Table A9.42 Breastfeeding duration and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
Breastfeeding ≥12 months compared with <12 months										
	Moynihan et al (2019) AMSTAR 2 confidence rating: moderate									
Breastfeeding ≥12 months compared with <12 months and ECC risk	PCS (Peres et al 2017) (1303 recruited; 870 included in analysis) Brazil	3, 12 and 24 months	Age 5 years	Breastfeeding (BF) duration 0 to 12 months; 13 to 23 months; ≥24 months	(1) ECC measured by the average number of dmfs according to the WHO criteria (2) Severe early childhood caries (S-ECC) defined as dmfs ≥6	BF duration 13 to 23 months compared with 0 to 12 months: (1) mean ratio of dmfs 0.9 (2) RR 1.0	(1) 0.6 to 1.3 (2) 0.6 to 1.6	NR	Family income, maternal schooling, maternal age, sugar consumption and bottle feeding at age 5 years. Study conducted in a fluoridated area.	Power calculation
	Tham et al (2019) AMSTAR 2 confidence rating: low									
Breastfeeding ≥12 months compared with <12 months	PCS (Chaffee et al 2014) (715 pregnant women; 537 children	<6 months 6 to 11 months	Age 38 months	Breastfeeding duration	Severe-ECC (S-ECC) at 38 months S-ECC: ≥1 affected maxillary teeth or ≥4 dmfs	Prevalence ratio (PR) of S-ECC Marginal structural models (fully-adjusted)*:	See previous column	NR	Maternal age, education, parity, pre-pregnancy BMI; smoking status, social class, child age, sex, time-varying	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
and ECC risk	included in analysis) Brazil	12 to 23 months ≥24 months				<6m = 1 (ref) 6-11m = 1.77 (1.12 to 2.85)* 12-23m = 1.82 (0.85 to 3.20)* ≥24m = 2.10 (1.50 to 3.25) Regression models (fully-adjusted): <6m = 1 (ref) 6 to 11 months = 1.45 (0.83 to 2.53) 12 to 23 months = 1.39 (0.73 to 2.64) ≥24 months = 1.85			bottle use, added sugar in bottle at age 5 to 9 months and age 2 to 3 years, introduction to soft drinks and sweets before age 6 months, length-for-age z-scores Interactions: high frequency day time breastfeeding, and long duration high frequency. Study conducted in fluoridated area.	

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
						(1.11 to 3.08)				
Breastfeeding ≥12 months compared with <12 months and ECC risk	PCS (Tanaka et al 2013) (315) Japan	6 to 11 months, 12 to 17 months, ≥18 months versus <6 months	Age 41 to 50 months	Breastfeeding duration (defined as length of the period during which infants received breastmilk, regardless of exclusivity*)	ECC Defined as the presence of ≥ 1 dft (missing teeth excluded)	Adjusted OR of ECC <6 months = 1 (ref) 6 to 11 months = 0.67 (0.27 to 1.62) 12 to 17 months = 1.09 (0.45 to 2.71) ≥18 months = 2.47 (0.95 to 6.59)	0.76 to 2.16	NR	Bottle use for sweetened liquids other than milk, bottle-feeding while falling asleep, age of introduction of foods (in months), maternal age at baseline, maternal smoking during pregnancy, family income, paternal and maternal educational level, child's sex, birth weight, age at first tooth eruption, tooth-	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									brushing frequency, use of fluoride gel/toothpaste, dental check-up frequency, household smoking, age at oral examination*	
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Breastfeeding >12 months compared with <12 months and ECC risk	PCS (Cogulu et al, 2008) (56) Turkey	>12 months	2 years	Breastfeeding duration	ECC (definition not reported)	No association (data NR)	NR	NR	None	No power calculation
Breastfeeding ≥24 months compared with <24 months										
	Moynihan et al (2019) AMSTAR 2 confidence rating: moderate									
Breastfeeding ≥12 months compare	PCS (Chaffee et al 2014) (715 pregnant	<6 months 6 to 11 months	Age 38 months	Breastfeeding duration	Severe-ECC (S-ECC) at 38 months S-ECC: ≥1 affected	Breastfeeding ≥24 months compared with	0.85 to 1.78	NR	Maternal characteristics (age, education, smoking), social class, daily	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
d with <12 months and ECC risk	women; 537 children included in analysis) Brazil	12 to 23 months ≥24 months			maxillary teeth or ≥4 dmfs	breastfeeding 12 to 23 months, prevalence ratio for S-ECC: 1.17			frequency of bottle use at ages 5 to 9 months, added sugar in bottle at ages 5 to 9 months, frequency of consumption of vegetables, fruit, beans and meat at ages 11 to 15 months.	
Breastfeeding ≥12 months compared with <12 months and ECC risk	PCS (Peres et al 2017) (1303 recruited; 1128 included in analysis) Brazil	3, 12 and 24 months	Age 5 years	Breastfeeding duration	(1) dmfs according to the WHO criteria (2) Severe early childhood caries (S-ECC)	(1) mean ratio of dmfs 1.9 (2) RR 2.4	(1) 1.5 to 2.4 (2) 1.7 to 3.3	NR	Family income, maternal schooling, maternal age, sugar consumption and bottle feeding at age 5 years. Study conducted in a fluoridated area.	None

Table A9.43 Use of infant feeding bottles for milk feeds and development of dental caries

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Bottle milk feeds and dental caries	PCS (Yonezu et al 2006) (592) Japan	≥18 months *	2 years*	Bottle-feeding (contents not specified) at ≥18m*	Caries incidence*	No association (data NR)	NR	NR	None	None

Table A9.44 Night time feeding (milk) from an infant feeding bottle and development of dental caries

Exposure and Outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Night time bottle feeding (milk) and dental caries	PCS (Gao et al 2010) (1576) Singapore	3 to 6 years	12 months*	Putting child to sleep with a bottle of milk	dmft (WHO diagnostic criteria) One year's caries increment (change in dmft >0)*	Associated with increased caries development (data NR)	NR	NR	Age and gender, frequency of between-meal sweet foods or drink consumption, sweet consumption at bedtime, toothbrushing frequency and duration per toothbrushing session*	None
Night time bottle feeding (milk) and dental caries	PCS (Ohsuka et al 2009) (188) Japan	Mean age 1.6 years	3 years*	Putting child to sleep with a bottle of milk	Caries incidence, dmft*	Associated with increased caries development (data NR)	NR	NR	Sex, living with grandparents, birth order, toothbrushing by parents, use of milk bottles, snack-eating time and frequency, average daily milk consumption, daytime caring person*	None

Table A9.45 Use of infant feeding bottles to consume liquids containing free sugars and development of dental caries

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Consumption of liquids containing free sugars from an infant feeding bottle and ECC	PCS (Cogulu et al 2008) (56)* Turkey	>12 months*	24 months*	Use of bottles for feeding (containing sweetened milk*)	Caries incidence*	No association (data NR)	NR	NR	None	None
	Moynihan et al (2019) AMSTAR 2 confidence rating: moderate									
Consumption of liquids containing free sugars from an infant feeding bottle and ECC	PCS (Feldens et al 2010) (500 recruited; 334 included in analysis) Brazil	12 months	4 years	Use of bottles for consuming fruit juices or soft drinks	S-ECC Defined as ≥1 cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or decayed (d_{1+}), missing, filled	RR 1.41	1.08 to 1.86	0.025	Maternal schooling, daily breastfeeding frequency at age 12 months, daily meals and snacks at age 12 months, high density of sugar at 12 months, teeth at 12 months.	None

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
					surfaces (dmfs) ≥ 5				Fluoride level of the water supply in area was 0.7 ppm.	
Consumption of liquids containing free sugars from an infant feeding bottle and ECC	PCS (Tanaka et al 2013) (1002 recruited; 315 included in analysis) Japan	29 to 39 months	41 to 50 months	Consumption of sweetened liquids (other than milk) from a bottle	ECC Defined as presence of one or more carious teeth (decayed or filled)*	OR 2.47	1.23 to 5.05	NR	Bottle use for sweetened liquids other than milk, bottle-feeding while falling asleep, age of introduction of foods (in months), maternal age at baseline, maternal smoking during pregnancy, family income, paternal and maternal educational level, child's sex, birth weight, age at first tooth eruption, tooth-	No power calculation

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									brushing frequency, use of fluoride gel/toothpaste, dental check-up frequency, household smoking, age at oral examination*	
Consumption of liquids containing free sugars from an infant feeding bottle and ECC	PCS (Wendt et al, 1996) (671 recruited; 289 included in analysis) Sweden	1 year	Age 2 and 3 years	Consumption of sugars-containing liquids in a feeding bottle	Caries incidence (%)	Among children who received sugars-containing liquids in a feeding bottle at age 1 year and were caries free (n=51), 44% had caries at age 3 while 32% were still caries free	NR	<0.05	NR	Lack of data on the comparator group (that is, the proportion of children who received milk or water at age 1 who had caries or were caries free at age 3 years

Table A9.46 Milk or dairy consumption and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Dror and Allen (2014) AMSTAR 2 confidence rating: critically low									
Milk and dental carries	PCS (Marshall et al, 2003) (642) USA	1 to 3 years	Age 4 to 7 years	Median milk consumption	Surface and tooth level dental carries	Median milk consumption at age 2 to 3 years was lower in children with surface and tooth level dental caries	NR	<0.05	Unclear	None
Non-milk dairy and dental carries	PCS (Marshall et al, 2003) (642) USA	1 to 3 years	Age 4 to 7 years	Low or high cumulative (below or above median) non-milk dairy	Surface and tooth level dental carries	Low cumulative non-milk dairy associated with fewer surface caries compared with higher cumulative median) non-milk dairy consumption	NR	<0.01	*Age at dental exam, sex, fluoride exposure, and sugar-sweetened beverage consumption	None

Table A9.47 Foods containing free sugars and development of dental caries

Exposure and outcome	Study type (n participants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Baghlaf et al (2018) AMSTAR 2 confidence rating: high									
Free sugars intake and dental caries	PCS (Gao et al 2010) (1576) Singapore	3 to 6 years	1 year	Bedtime sweet intake every night compared with no bedtime sweet intake Parent-administered survey*	dmft (WHO diagnostic criteria) One year's caries increment (change in dmft >0)*	OR 1.33	1.01 to 1.68	NR	Frequency of between-meal sweets, plaque index, toothbrushing and fluoride use (toothpaste or other agents).	No power calculation
	Moynihan et al (2019) AMSTAR 2 confidence rating: moderate									
Consumption of foods containing free sugars and ECC	PCS (Feldens et al 2010) (500 recruited; 334 included in analysis) Brazil	12 months	4 years	Consumption of foods (not described) with a high density of added sugars (defined as >50% simple carbohydrate per 100g food) compared with no consumption of these foods.	S-ECC Defined as ≥1 cavitated, missing or filled smooth surfaces in primary maxillary anterior teeth or decayed (d_{1+}), missing, filled surfaces (dmfs) ≥ 5	RR 1.43	1.08 to 1.89	0.003	Maternal schooling, daily breastfeeding frequency at age 12 months, daily meals and snacks at age 12 months, bottle use for fruit juices/soft drinks at 12 months, high density of sugar at 12 months, teeth at 12 months. Fluoride level of	Power calculation performed

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
									the water supply in area was 0.7 ppm.	
	Hooley et al (2012b) AMSTAR 2 confidence rating: critically low									
Sugars-containing foods and drinks intake and dental caries	PCS (Fontana et al 2011) (329) USA	18 to 36 months	12 months*	Dietary habits (including consumption of sugars-containing foods and drinks) collected by questionnaire (unspecified)*	Presence of at least one new lesion (ICDAS score of ≥3), one new filling or progression of a lesion from a score of 3 or 4 to ≥5*	Association between snacking on non-fresh fruits and popcorn and ECC (data NR)	NR	NR	Multiple variables, including measures of SES and toothbrushing*	Power calculation implied
Sugars-containing foods and drinks intake and dental caries	PCS (Ohsuka et al 2009) (188) Japan	Mean age 1.6 years	3 years	Snack-eating frequency – data obtained from questionnaires filled out by mothers*	Caries prevalence or incidence, dmft*	Association between frequent consumption of sweet foods and ECC (data NR)	NR	NR	Sex, living with grandparents, birth order, toothbrushing by parents, use of milk bottles, snack-eating time and frequency, average daily milk consumption, daytime caring person*	No power calculation

Table A9.48 'Ultra-processed foods' and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Cascaes et al (2022) AMSTAR 2 confidence rating: low									
Ultra-processed foods (UPF) consumption and dental caries	Subgroup meta-analysis of 5 PCS (2401 participants)	4/5 studies under age 5 years. In 1 study children were aged 6 years	4/5 studies 3-6 years follow up. In 1 study follow up was 1 year	Highest compared with lowest category of UPF consumption (frequency) UPF defined using NOVA classification. UPFs examined in all 5 studies were sugars-containing foods (including sugary cereals, chocolate, sweet confectionary, ice cream), savoury foods (crisps, crispy fried noodles) and carbonated beverages or soft drinks	Dental caries assessed through the decayed, filled and missing surfaces or teeth (dfms/dmft or DMFS/DMFT) indices based on the WHO criteria.	RR 2.00	1.27 to 3.15	NR	All 5 studies adjusted for at least 2 of the following potential confounding factors: socioeconomic status measures, toothbrushing, fluoride exposure, night time feeding	None

Table A9.49 Breastfeeding or use of bottles for feeding and malocclusion risk

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Thomaz et al (2018) AMSTAR 2 confidence rating: moderate									
Breastfeeding ≥12 months and malocclusion risk	Subgroup MA (3 estimates from 3 PCS) (419) Brazil, Argentina and USA	Breastfeeding ≥12 months	Age 3 to 5 years (2 studies); data unavailable for the 3rd study*	Breastfeeding duration ≥12 months compared with breastfeeding <12 months	Malocclusion	OR 0.38	0.24 to 0.60	<0.0001	1 out of 3 estimates was adjusted for confounding (non-nutritive sucking habits the only one specified by the SR as a key confounder)	Random-effects I^2=0%
Breastfeeding ≥12 months and malocclusion risk (overjet)	Subgroup MA (2 estimates from 2 PCS) (272) Brazil and USA	Breastfeeding ≥12m	Age 3 to 5 years	Breastfeeding duration ≥12 months compared with breastfeeding <12 months	Malocclusion (overjet)	OR 0.30	0.16 to 0.57	0.0003	1 out of 2 estimates was adjusted for confounding (non-nutritive sucking habits the only one specified by the SR as a key confounder)	Random-effects I^2=0%

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Hermont et al (2015) AMSTAR 2 confidence rating: moderate									
Use of bottles for feeding ≥12 months and malocclusion risk	PCS (Moimaz et al 2014) (80) Brazil	12 and 30 months	Age 30 months	Bottle feeding at (a) 12 months (b) 30 months	Malocclusion (posterior crossbite)	NR	NR	(a) 0.02 (b) 0.04	None	33% of cohort lost to follow-up

Table A9.50 Body weight and development of dental caries

Exposure and outcome	Study type (n partici-pants) Country	Baseline age	Follow up	Exposure	Outcome	Measure of association or effect	95% CI	p-value	Variables adjusted for	Comments
	Hooley et al (2012a) AMSTAR 2 confidence rating: low									
BMI and dental caries	PCS (Ismail et al, 2009) (788) USA (low-income African American households)	Mean age 2.6	2 years	Weight-for-age percentiles computed according to the 2000 US Centers for Disease Control and Prevention growth charts and grouped into quartiles*	Dental caries (dmft)	Higher caries (dmft: 1 to 6) associated with higher weight-for-age (that is, the children in the highest weight-for-age quartile had significantly greater risk of caries than children in the lowest quartile*)	NR	NR	Predictors included frequency of soda consumption, asthma diagnosis, gender, dental visits, toothbrushing, baseline caries, parental mental health, SES*	None