UNIVERSITY of OTAGO

Te Whare Wānanga o Otāgo

NEW ZEALAND

EDGAR

National Centre for Diabetes and Obesity Research

How early in life should obesity prevention begin?

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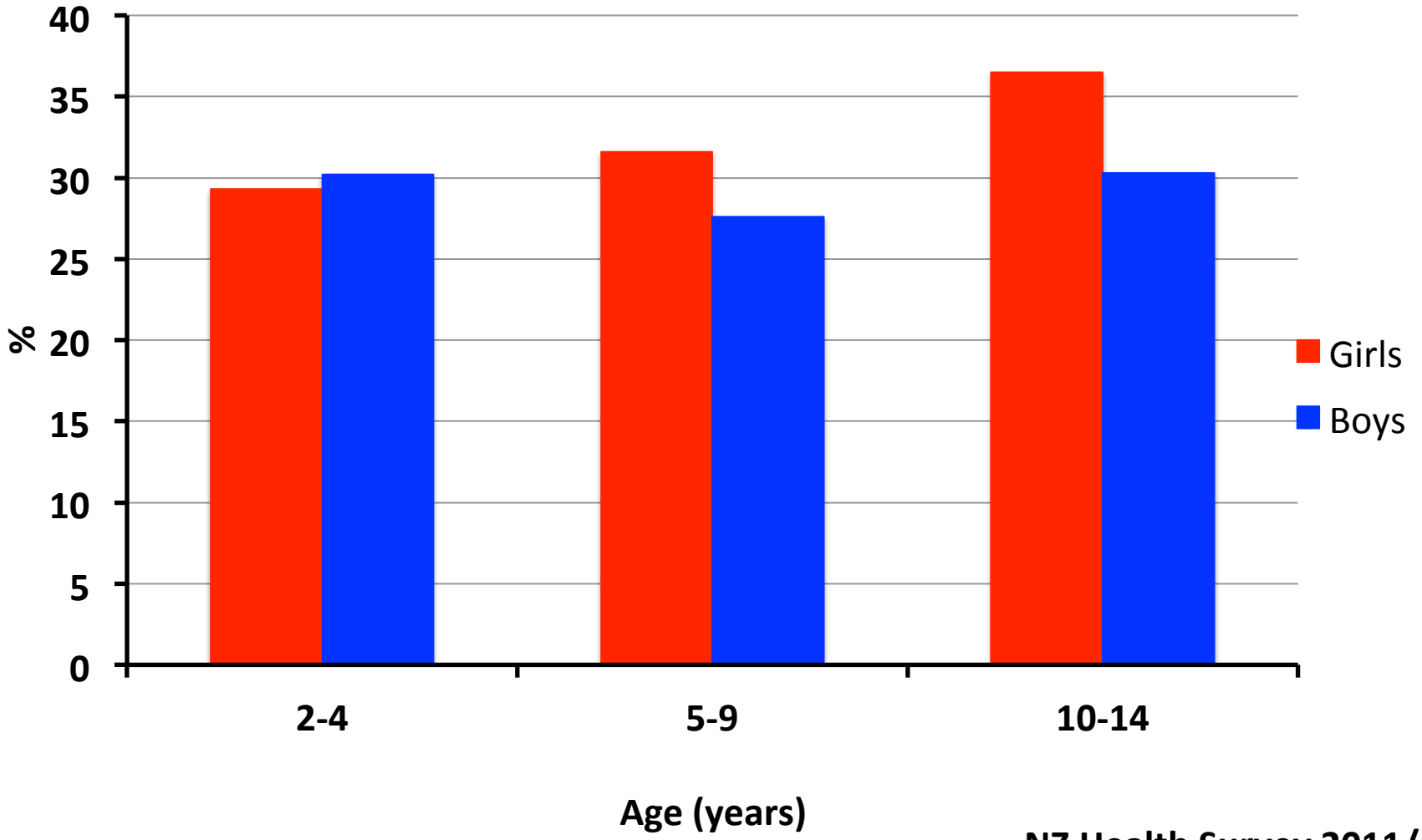
Obesity is a problem *throughout* childhood and adolescence



NZ Health Survey 2011/12

Birth weights have increased by a small amount

Group (birth years)	White (g)	Black (g)
Mothers (1956 – 1976)	3304	3089
Baby girls (1989-1991)	3378	3133
Difference	74*	44*
Fathers (1956-1976)	3461	3217
Baby boys (1989-1991)	3516	3248
Difference	55*	31*

Am J Epidemiol 1995;144:563

Risk of childhood obesity 2 times higher in high vs normal birth weight babies

Study or Subgroup	BW > 4000 g Events	Total	BW: 2500–4000 g Events	Total	Weight	Odds Ratio M-H, Random, 95% CI
Che 2010	16	142	104	1495	5.7%	1.70 [0.97, 2.96]
Gu 2003	16	163	68	1305	5.5%	1.98 [1.12, 3.50]
He (b) 2005	14	143	56	1226	4.9%	2.27 [1.23, 4.19]
Hirschler 2008	28	95	133	860	7.0%	2.28 [1.42, 3.69]
Li 2007	36	141	15	120	4.4%	2.40 [1.24, 4.64]
Liao 2007	53	79	149	325	6.3%	2.41 [1.44, 4.04]
Liu 2005	12	50	7	100	2.1%	4.20 [1.53, 11.47]
Lu 2008	8	52	47	725	3.1%	2.62 [1.17, 5.89]
Ma 2009	21	79	36	643	5.0%	6.10 [3.34, 11.14]
Monteiro 2003	13	81	66	927	4.5%	2.49 [1.31, 4.75]
Ruan 2009	82	260	474	2066	12.3%	1.55 [1.17, 2.05]
Rui 2008	8	13	42	137	1.6%	3.62 [1.12, 11.72]
Shen 2004	17	26	54	149	2.7%	3.32 [1.39, 7.97]
Wang 2009	179	1537	632	9255	16.3%	1.80 [1.51, 2.14]
Zhang 2009	456	1977	1626	13708	18.5%	2.23 [1.98, 2.50]
Total (95% CI)		**4838**		**33041**	**100.0%**	**2.23 [1.91, 2.61]**
Total events	959		3509			

Heterogeneity: Tau² = 0.03; Chi² = 26.03, df = 14 (*P* = 0.03); I² = 46%

Test for overall effect: Z = 10.12 (*P* < 0.00001)

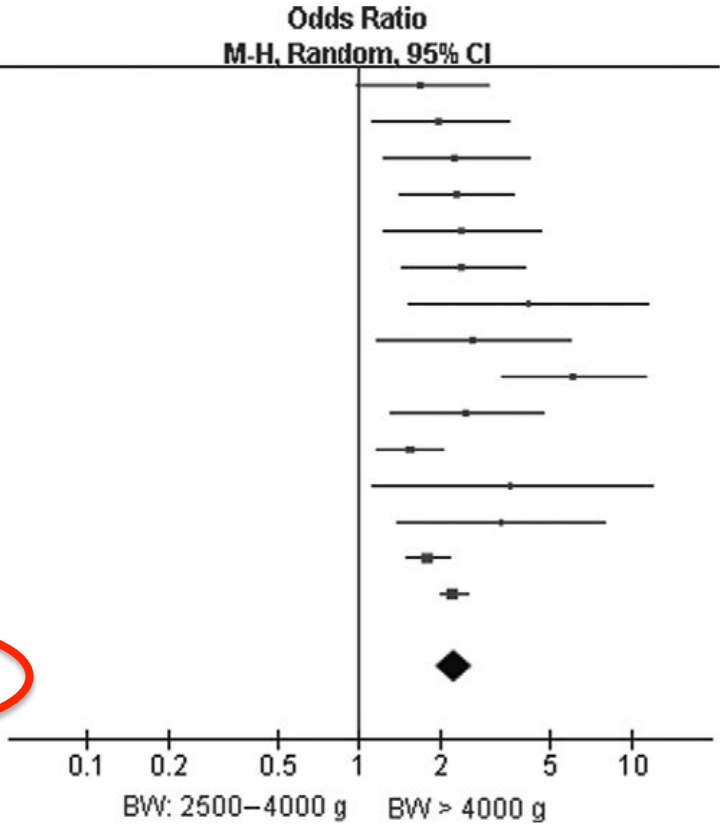
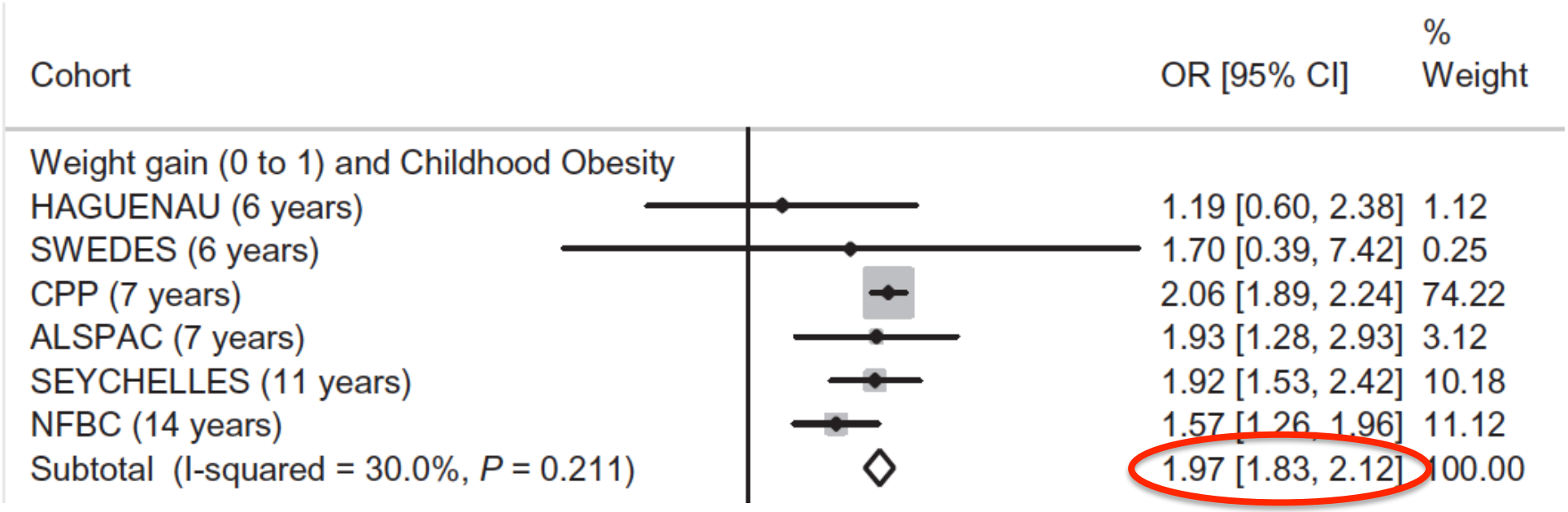


Figure 4 Forest plot of the BW/obesity association between BW >4000 g and BW = 2500–4000 g. BW, birth weight; CI, confidence interval.

Obes Rev 2011;12:525

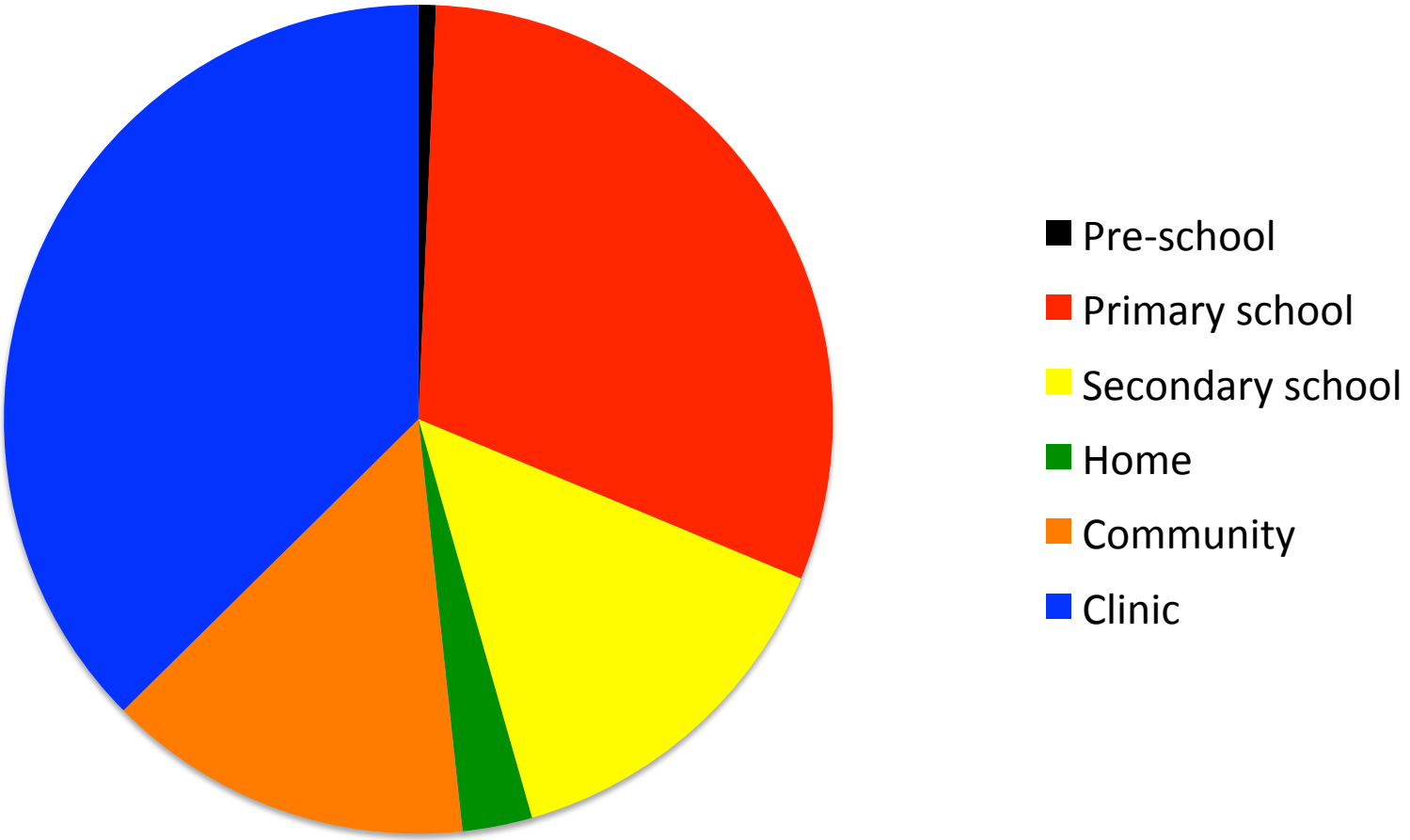
But weight gain in infancy also influences child obesity *independent* of birth weight



- Individual level meta-analysis using 10 large cohort studies (n > 47,000)

Ped Perinatal Epidemiol 2012;26:19

Where is most child obesity research focused?



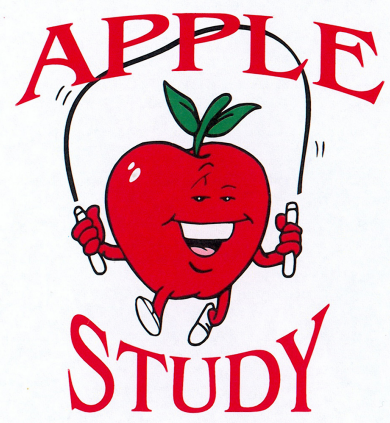
Flynn Obes Rev 2006

School-based obesity prevention can be successful (n=554)

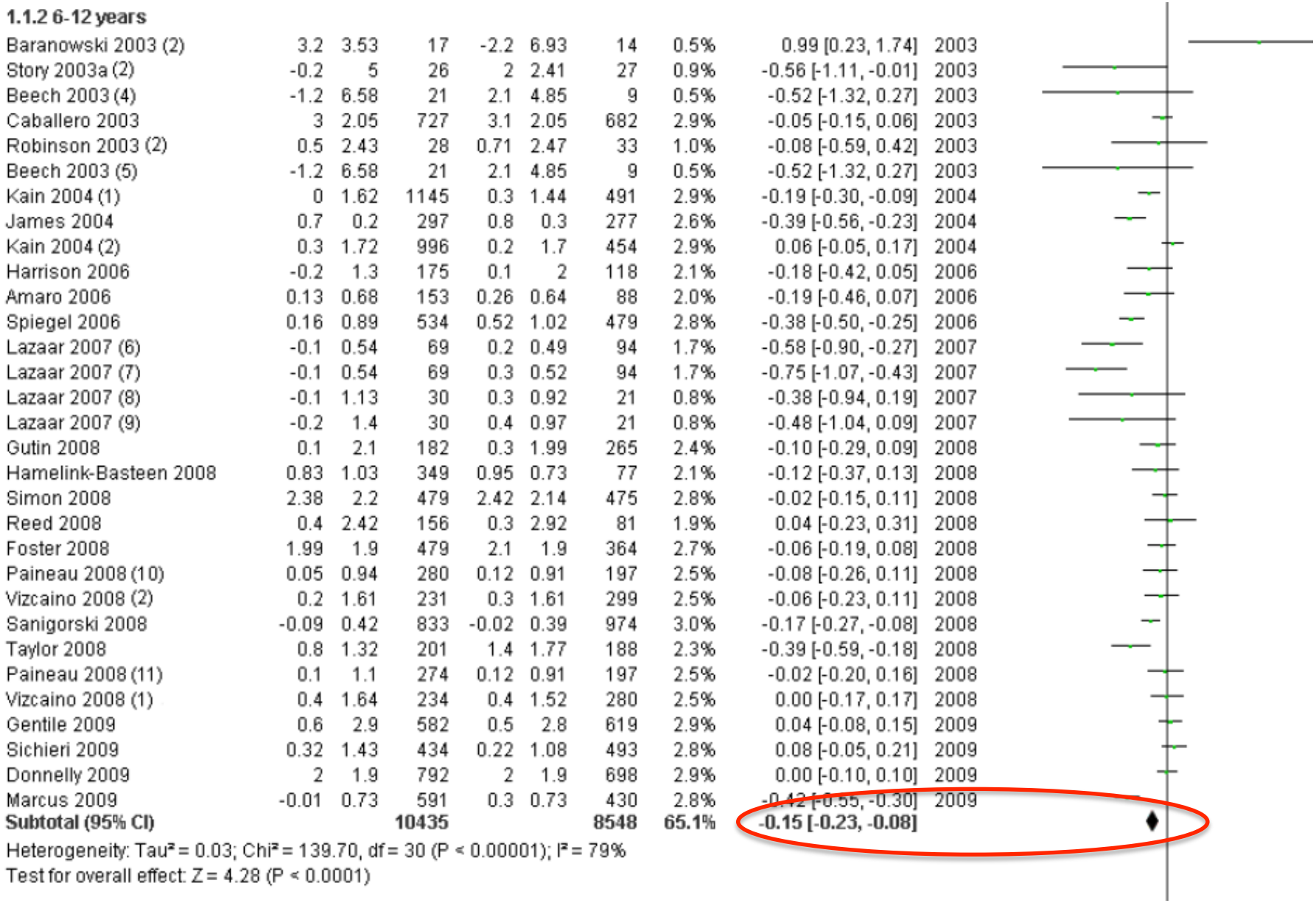
	End of intervention	Follow-up
BMI z-score	-0.25 (-0.32 -0.19)	-0.17 (-0.25, -0.08)
Prevalence of overweight	0.73 (0.64, 0.83)	0.85 (0.71, 1.01)

Data presented as difference or RR between intervention and control children adjusted for age, sex, baseline, clustering, length of time in study and whether still at intervention school

AJCN 2008



Studies in primary school children



1.1.2 6-12 years									
Baranowski 2003 (2)	3.2	3.53	17	-2.2	6.93	14	0.5%	0.99 [0.23, 1.74]	2003
Story 2003a (2)	-0.2	5	26	2	2.41	27	0.9%	-0.56 [-1.11, -0.01]	2003
Beech 2003 (4)	-1.2	6.58	21	2.1	4.85	9	0.5%	-0.52 [-1.32, 0.27]	2003
Caballero 2003	3	2.05	727	3.1	2.05	682	2.9%	-0.05 [-0.15, 0.06]	2003
Robinson 2003 (2)	0.5	2.43	28	0.71	2.47	33	1.0%	-0.08 [-0.59, 0.42]	2003
Beech 2003 (5)	-1.2	6.58	21	2.1	4.85	9	0.5%	-0.52 [-1.32, 0.27]	2003
Kain 2004 (1)	0	1.62	1145	0.3	1.44	491	2.9%	-0.19 [-0.30, -0.09]	2004
James 2004	0.7	0.2	297	0.8	0.3	277	2.6%	-0.39 [-0.56, -0.23]	2004
Kain 2004 (2)	0.3	1.72	996	0.2	1.7	454	2.9%	0.06 [-0.05, 0.17]	2004
Harrison 2006	-0.2	1.3	175	0.1	2	118	2.1%	-0.18 [-0.42, 0.05]	2006
Amaro 2006	0.13	0.68	153	0.26	0.64	88	2.0%	-0.19 [-0.46, 0.07]	2006
Spiegel 2006	0.16	0.89	534	0.52	1.02	479	2.8%	-0.38 [-0.50, -0.25]	2006
Lazaar 2007 (6)	-0.1	0.54	69	0.2	0.49	94	1.7%	-0.58 [-0.90, -0.27]	2007
Lazaar 2007 (7)	-0.1	0.54	69	0.3	0.52	94	1.7%	-0.75 [-1.07, -0.43]	2007
Lazaar 2007 (8)	-0.1	1.13	30	0.3	0.92	21	0.8%	-0.38 [-0.94, 0.19]	2007
Lazaar 2007 (9)	-0.2	1.4	30	0.4	0.97	21	0.8%	-0.48 [-1.04, 0.09]	2007
Gutin 2008	0.1	2.1	182	0.3	1.99	265	2.4%	-0.10 [-0.29, 0.09]	2008
Hamelink-Basteen 2008	0.83	1.03	349	0.95	0.73	77	2.1%	-0.12 [-0.37, 0.13]	2008
Simon 2008	2.38	2.2	479	2.42	2.14	475	2.8%	-0.02 [-0.15, 0.11]	2008
Reed 2008	0.4	2.42	156	0.3	2.92	81	1.9%	0.04 [-0.23, 0.31]	2008
Foster 2008	1.99	1.9	479	2.1	1.9	364	2.7%	-0.06 [-0.19, 0.08]	2008
Paineau 2008 (10)	0.05	0.94	280	0.12	0.91	197	2.5%	-0.08 [-0.26, 0.11]	2008
Vizcaino 2008 (2)	0.2	1.61	231	0.3	1.61	299	2.5%	-0.06 [-0.23, 0.11]	2008
Sanigorski 2008	-0.09	0.42	833	-0.02	0.39	974	3.0%	-0.17 [-0.27, -0.08]	2008
Taylor 2008	0.8	1.32	201	1.4	1.77	188	2.3%	-0.39 [-0.59, -0.18]	2008
Paineau 2008 (11)	0.1	1.1	274	0.12	0.91	197	2.5%	-0.02 [-0.20, 0.16]	2008
Vizcaino 2008 (1)	0.4	1.64	234	0.4	1.52	280	2.5%	0.00 [-0.17, 0.17]	2008
Gentile 2009	0.6	2.9	582	0.5	2.8	619	2.9%	0.04 [-0.08, 0.15]	2009
Sichieri 2009	0.32	1.43	434	0.22	1.08	493	2.8%	0.08 [-0.05, 0.21]	2009
Donnelly 2009	2	1.9	792	2	1.9	698	2.9%	0.00 [-0.10, 0.10]	2009
Marcus 2009	-0.01	0.73	591	0.3	0.73	430	2.8%	-0.42 [-0.55, -0.30]	2009
Subtotal (95% CI)			**10435**			**8548**	**65.1%**	**-0.15 [-0.23, -0.08]**	

Heterogeneity: Tau² = 0.03; Chi² = 139.70, df = 30 (P < 0.00001); I² = 79%

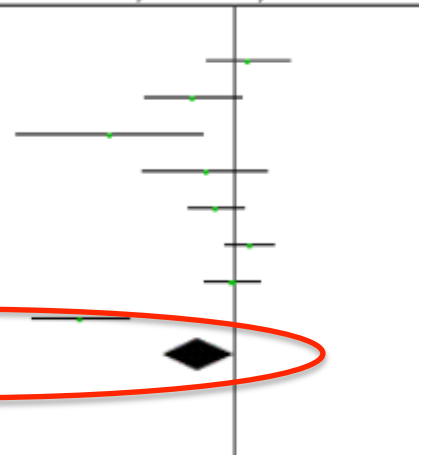
Test for overall effect: Z = 4.28 (P < 0.0001)

Does intervening at a younger age offer more promise?

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI	Year
1.1.1 0-5 years									
Mo-Suwan 1998 (1)	-0.33	1.23	82	-0.44	1.06	88	1.8%	0.10 [-0.21, 0.40]	1998
Mo-Suwan 1998 (2)	-0.67	0.85	65	-0.39	0.99	57	1.5%	-0.30 [-0.66, 0.05]	1998
Harvey-Berino 2003 (3)	-0.27	0.52	17	0.31	0.7	20	0.6%	-0.91 [-1.59, -0.23]	2003
Dennison 2004	-0.24	1.64	43	0.12	1.75	34	1.1%	-0.21 [-0.66, 0.24]	2004
Fitzgibbon 2005	0.05	0.67	179	0.14	0.68	183	2.3%	-0.13 [-0.34, 0.07]	2005
Reilly 2006	0.07	0.45	231	0.02	0.46	250	2.5%	0.11 [-0.07, 0.29]	2006
Fitzgibbon 2006	0.11	1.54	196	0.13	1.5	187	2.3%	-0.01 [-0.21, 0.19]	2006
Keller 2009	-0.15	0.23	49	0.11	0.23	134	1.5%	-1.13 [-1.47, -0.78]	2009
Subtotal (95% CI)			**862**			**953**	**13.7%**	**-0.26 [-0.53, 0.00]**	

Heterogeneity: Tau² = 0.12; Chi² = 47.90, df = 7 (P < 0.00001); I² = 85%

Test for overall effect: Z = 1.94 (P = 0.05)



Overall effect -0.26 (-0.53, 0.00)

Cochrane review 2011

Table 1: Summary of intervention strategies undertaken in pre-schools.

Physical activity interventions	Healthy eating interventions
• Structured twice-weekly fundamental movement skill development through prescribed games suitable for a wide age range. • Playground environment review and alterations to encourage more active movement and better access to sports equipment during free play times. • Small grants for sports equipment. • Workshop for parents on limiting sedentary time, promoting physical activity and FMS. • A monthlyfour page newsletter contains tips of healthy eating and active playing ideas was provided to each parent.	• Review and adjustment of food and nutrition policies to explicitly identify appropriate and inappropriate foods in lunchboxes. • Communication of new policy to parents along with lunchbox displays. • Colourful posters on "better foods" and "foods better left out" on display all year. • Distribution of the Family Feud/ Food DVD which models practical ways to improve childrens eating habits, for their parent library. • Parents workshops on positive parenting in relation to healthy eating and feeding 'fussy' eaters. • Simple consistent messages for children about 'sometimes' and 'everyday' foods; puppets, staff in fruit and vegetable costumes, stories, role-play, growing, cooking, and taste testing fruit and vegetables were all used to reinforce this message. • Staff acting as role models and giving positive reinforcement to children about eating healthy food and drinking water. • Drinking water made more accessible.

Tooty fruity vege – intervention in Australian preschools

Health Promot J Aust 2012;23:10

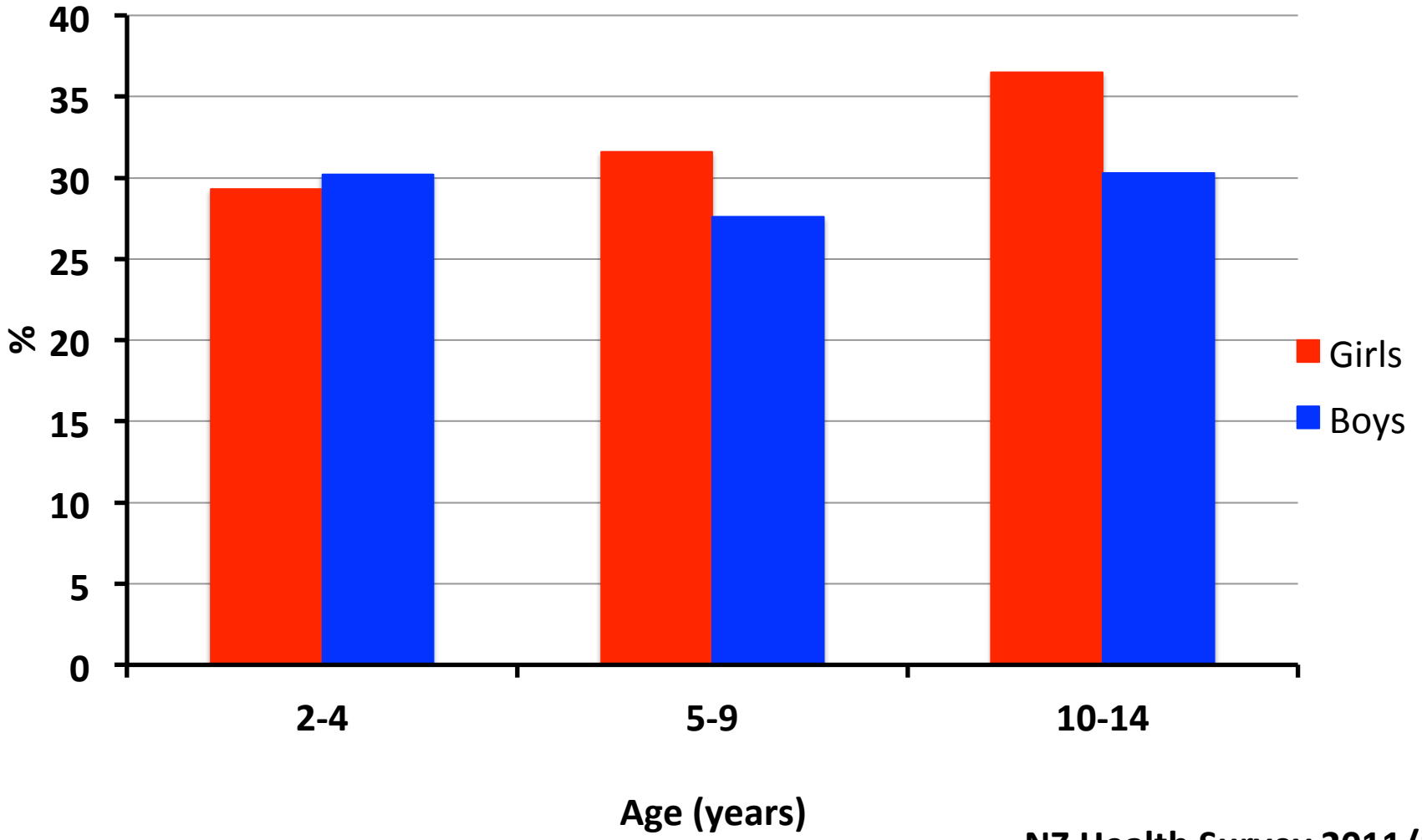
Table 3: Adjusted differences in FMS, dietary indicators and anthropometric measures between control and intervention children at follow-up.

Variable	Difference	Standard Error	*P*
Movement Skills Quotient	14.79	2.07	<0.0001
Fruit and vegetable serves in lunch box	0.61	0.14	0.0013
% children with 0 EDNP items in lunch box	29.1%	*	<0.0001
% children with 2+ EDNP items in lunch box	-24.5%	*	<0.0001
BMI Z scores	-0.15	0.07	0.022
Waist circumference	-0.80	0.35	0.020

** Standard errors for size of difference (relative change) could not be derived from the multinomial model. See Table 2 for standard errors of baseline and follow-up values.*

Should we be starting even earlier?

Obesity is a problem *throughout* childhood and adolescence



NZ Health Survey 2011/12

EPOCH – Early Prevention of Obesity in CHildren

- Prospective meta-analysis of early obesity prevention initiatives
- Does early intervention impact on BMI z-score at 18-24 months of age?
- ~1800 infants

Prevention of Overweight in Infancy

poi nz

healthy BEGINNINGS

nourish

your child's future health, today.

infant

	HBT	Nourish	Infant	POI
N	667	698	559	803
Baseline	Antenatal	4-6m	3m	Antenatal
Primary outcome	Height & weight at 24m	Height & weight at 24m	Height & weight at 18m	Height & weight at 24m
Control group	Usual care + written home safety/tobacco intervention	Usual care + quarterly newsletter on general health messages	Usual care + quarterly newsletter on general health messages	Usual care
Intervention timing	8 home visits	6 fortnightly group sessions at 4-7m and 13-16m	Six 2-hour sessions within existing mothers groups	Sleep – 2 sessions FAB – 7 home visits

BMC Public Health 2010:728

Early intervention can make a difference – Healthy Beginnings Trial

Outcomes at 2 years	Int – Con (95% CI)	P
BMI – complete cases (n = 483)	-0.38 (-0.68, -0.08)	0.01
BMI – imputation (n = 667)	-0.29 (-0.55, -0.02)	0.04
Secondary outcomes – yes *v* no	% difference (95% CI)	
Vege ≥ 1 serve/d	7 (1, 13)	0.03
Fruit ≥ 2 serve/d	-2 (-7, 3)	0.43
Food for reward	-9 (-17, -1)	0.03
Sweet drinks	-3 (-10, 5)	0.48
Water > 3 cups/d	6 (-1, 13)	0.12
Outdoor play ≥ 2 h/d	1 (-8, 9)	0.90
TV > 60 mins/d	-8 (15, -1)	0.02
TV on during meal	-12 (-21, 3)	0.02

Nourish – outcomes at 14 months

	Control	Intervention	P
	275	254	
6m BMI z-score	-0.26 (0.98)	-0.36 (0.98)	0.18
14m BMI z-score	0.42 (0.85)	0.23 (0.93)	< 0.01
Awareness of infant hunger/ satiety cues	4.1 (0.5)	4.2 (0.5)	0.007
Disguise food	67%	46%	< 0.001
Turn mealtime into a game	67%	29%	< 0.001
Offer food rewards	15	4%	0.001
Use responsive feeding strategies	33%	47%	0.017
Use of food to calm fussiness	2.2 (0.7)	2.2 (0.7)	0.38
Offer non-food rewards	10%	8%	0.52

Should we be starting EVEN earlier?

Gestational weight gain - Collaborative Perinatal Project

Pre-pregnancy BMI	IOM recommended GWG	Actual gestational weight gain (%)		
		Insufficient	Recommended	Excessive
< 19.8	12.5 - 18	74	22	4
19.8-26.0	11.5 - 16	67	24	9
26.0-29.0	7 – 11.5	39	33	28
> 29.0	≥ 6.8	45	29	26

AJCN 2008;87:1818

Excessive weight gain increases the risk of childhood obesity at 7 years

Gestational weight gain	Unadjusted	Adjusted	Additional adjustment for birth weight
Each additional kg gained	1.02 (1.00, 1.03)	1.03 (1.02, 1.05)	1.03 (1.01, 1.05)
Excessive vs recommended	1.62 (1.25, 2.12)	1.48 (1.06, 2.06)	1.40 (1.00, 1.95)

Data presented as odds ratios (95% CI)

AJCN 2008;87:1818

Intervening in pregnancy to limit GWG

Study or Subgroup	Experimental Mean [kg]	Experimental SD [kg]	Experimental Total	Control Mean [kg]	Control SD [kg]	Control Total	Weight	Mean Difference IV, Fixed, 95% CI [kg]
Asbee (21)	13.02	5.67	57	16.15	7.03	43	4.5%	-3.13 [-5.70, -0.56]
Claesson, Sydsjö (15)	8.7	5.51	143	11.3	5.8	161	18.4%	-2.60 [-3.87, -1.33]
Gray-Donald (18)	12	6.4	112	13.2	8.3	107	7.7%	-1.20 [-3.17, 0.77]
Guelinckx (active) (31a)	9.8	7.6	42	10.6	6.9	21	2.1%	-0.80 [-4.54, 2.94]
Guelinckx (passive) (31b)	10.9	5.6	37	10.6	6.9	21	2.5%	0.30 [-3.16, 3.76]
Hui (16)	14.2	5.3	24	14.2	6.3	21	2.5%	0.00 [-3.43, 3.43]
Kinnunen (19)	14.6	5.4	49	14.3	4.1	56	8.6%	0.30 [-1.55, 2.15]
Olson (39)	14.1	4.51	179	14.8	4.68	381	45.2%	-0.70 [-1.51, 0.11]
Polley (normal) (17a)	15.4	7.1	30	16.4	4.8	31	3.2%	-1.00 [-4.05, 2.05]
Polley (overweight) (17b)	13.6	7.2	27	10.1	6.2	22	2.1%	3.50 [-0.25, 7.25]
Shirazian (22)	8.06	7.4	21	15.42	7.52	20	1.4%	-7.36 [-11.93, -2.79]
Wolff (20)	6.6	7.2	23	13.3	7.5	27	1.8%	-6.70 [-10.78, -2.62]
Total (95% CI)			**744**			**911**	**100.0%**	**-1.19 [-1.74, -0.65]**

Heterogeneity: $\chi^2 = 32.03$, df = 11 ($P = 0.0008$); $I^2 = 66\%$

Test for overall effect: $Z = 4.29$ ($P < 0.0001$)

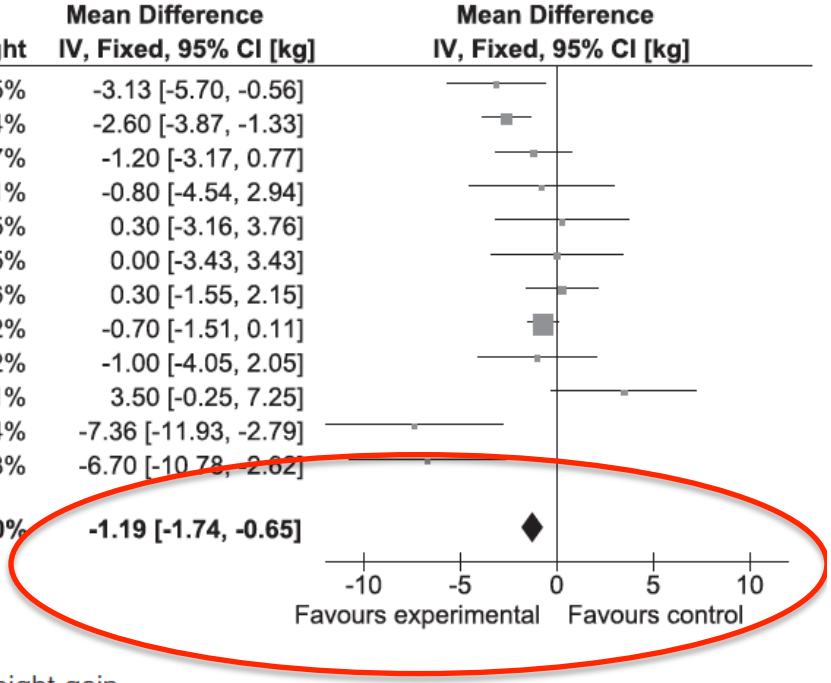
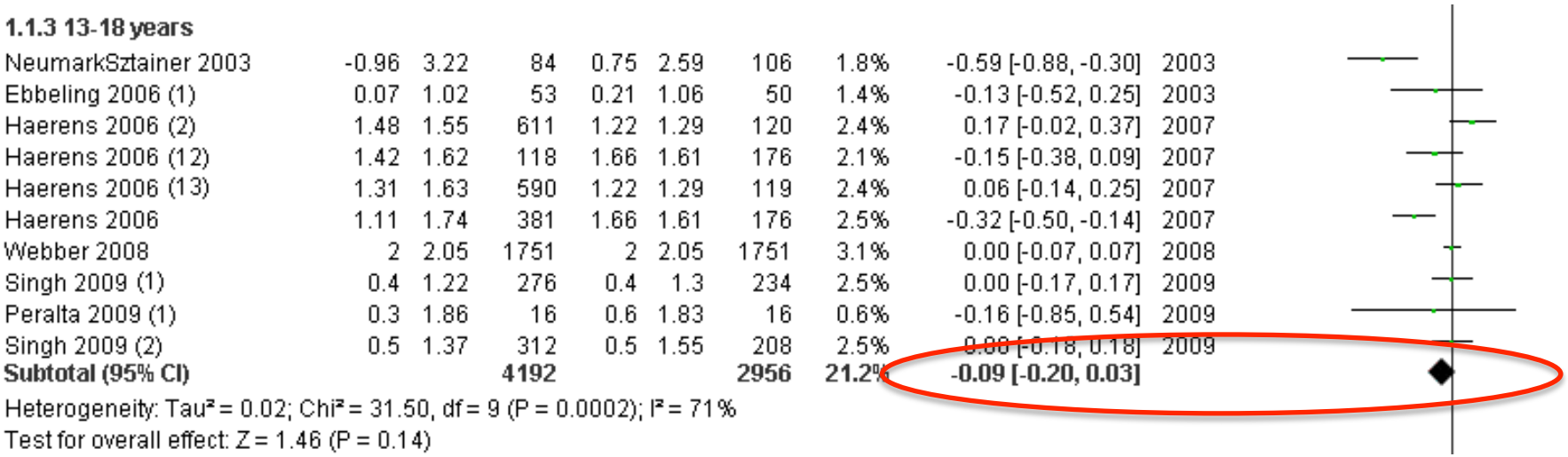


Figure 1 Meta-analysis of effects of behaviour change interventions on gestational weight gain.

Overall effect -1.19 (-1.74, -0.65)

Obes Rev 2011;e615

Obesity prevention studies in adolescents



1.1.3 13-18 years									
NeumarkSztainer 2003	-0.96	3.22	84	0.75	2.59	106	1.8%	-0.59 [-0.88, -0.30]	2003
Ebbeling 2006 (1)	0.07	1.02	53	0.21	1.06	50	1.4%	-0.13 [-0.52, 0.25]	2003
Haerens 2006 (2)	1.48	1.55	611	1.22	1.29	120	2.4%	0.17 [-0.02, 0.37]	2007
Haerens 2006 (12)	1.42	1.62	118	1.66	1.61	176	2.1%	-0.15 [-0.38, 0.09]	2007
Haerens 2006 (13)	1.31	1.63	590	1.22	1.29	119	2.4%	0.06 [-0.14, 0.25]	2007
Haerens 2006	1.11	1.74	381	1.66	1.61	176	2.5%	-0.32 [-0.50, -0.14]	2007
Webber 2008	2	2.05	1751	2	2.05	1751	3.1%	0.00 [-0.07, 0.07]	2008
Singh 2009 (1)	0.4	1.22	276	0.4	1.3	234	2.5%	0.00 [-0.17, 0.17]	2009
Peralta 2009 (1)	0.3	1.86	16	0.6	1.83	16	0.6%	-0.16 [-0.85, 0.54]	2009
Singh 2009 (2)	0.5	1.37	312	0.5	1.55	208	2.5%	0.00 [-0.18, 0.18]	2009
Subtotal (95% CI)			**4192**			**2956**	**21.2%**	**-0.09 [-0.20, 0.03]**	

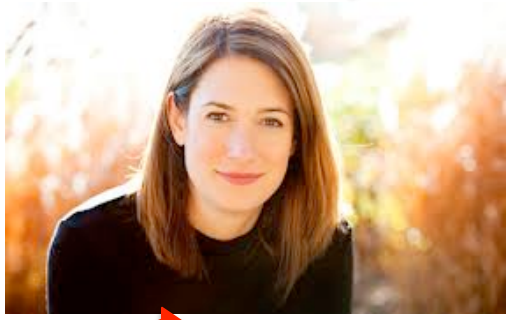
Heterogeneity: Tau² = 0.02; Chi² = 31.50, df = 9 (P = 0.0002); I² = 71%

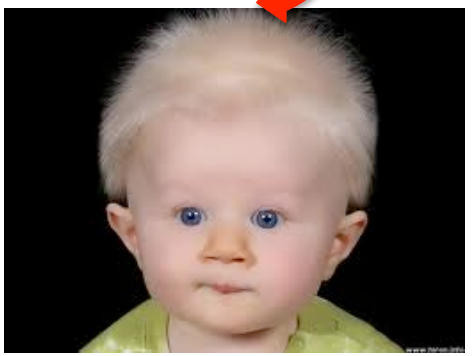
Test for overall effect: Z = 1.46 (P = 0.14)

Overall effect -0.09 (-0.20, -0.03)

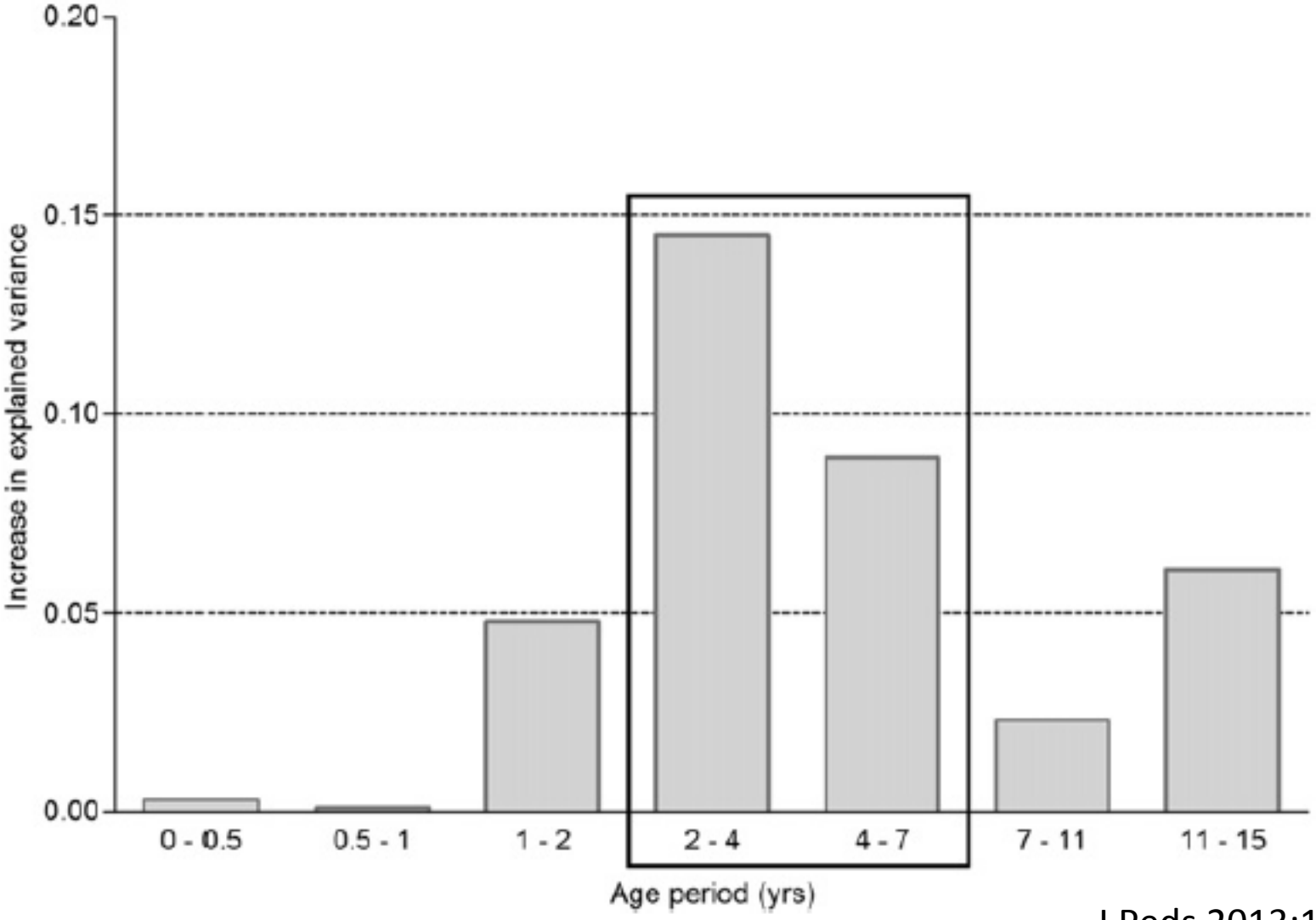
Cochrane review 2011

Obesity prevention





Increase in variance explained from change in weight SDS on BMI at 16y



J Peds 2013;162:287

Weight change targets over 1 year to shift children to normal weight

	Age (y)	Baseline height (cm)	90th	95th	97th
Boys	8-9	134	2.44	-0.04	-2.14
	9-10	140	2.99	-0.16	-2.88
	10-11	144	2.75	-1.01	-4.28
	11-12	150	3.21	-1.22	-5.05
	12-13	155	3.90	-1.15	-5.49
Girls	8-9	133	3.22	0.47	-1.82
	9-10	140	3.36	-0.05	-2.90
	10-11	145	3.57	-0.52	-3.93
	11-12	151	3.30	-1.53	-5.55
	12-13	156	2.65	-2.91	-7.55

JAMA Pediatr 2013;167:21

Conclusions

- 1/3 of 2-4 year old children being overweight or obese implies prevention should start early
- Intervention during infancy/toddlerhood showing promise
- Large trials underway in pregnancy
- Focus on first few years shouldn't negate focus on other groups – lifecourse approach

- Prevention should be for all – is simply healthy living