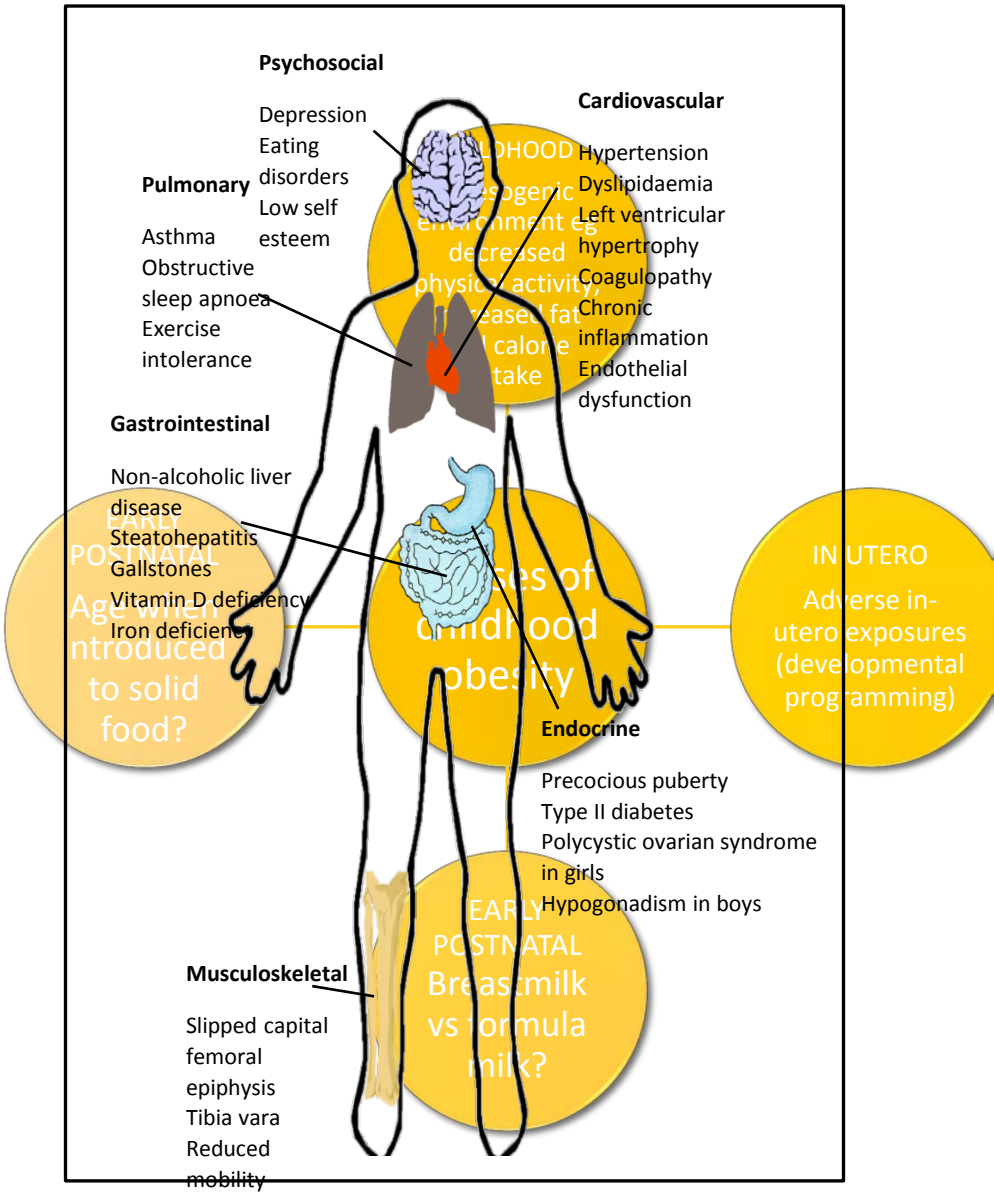
Breastfeeding Status and Timing of Solid Food Introduction: The Risk of Adiposity in 6 Month Old Infants of Obese Mothers

AUTHORS:

JESSICA ENGLER, DHARMINTRA PASUPATHY, PAUL T SEED, LUCILLA POSTON AND NASHITA PATEL ON BEHALF OF THE UPBEAT CONSORTIUM

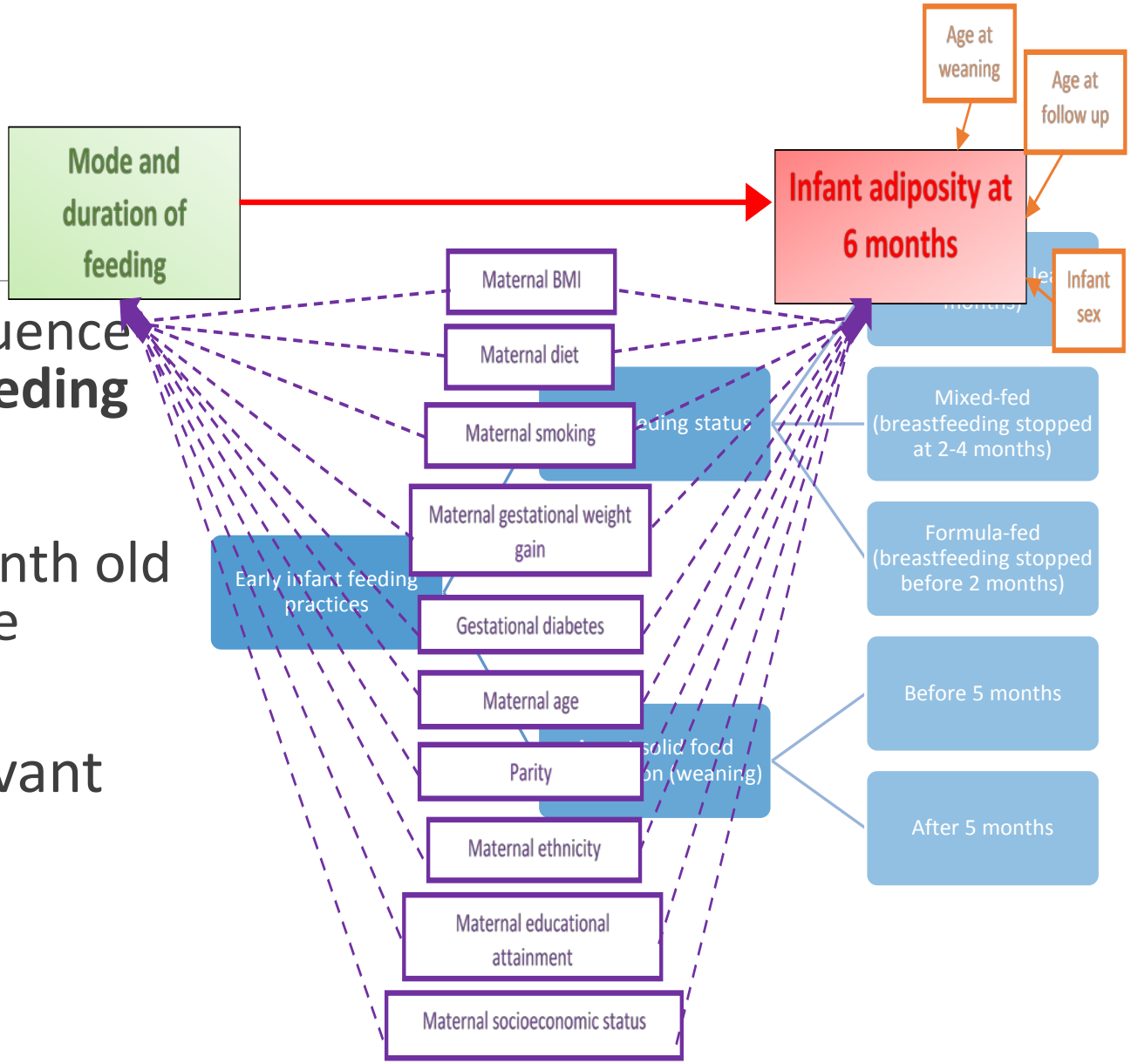
Background

- Childhood obesity is significant global public health problem - 170 million children under 18 years estimated to be obese or overweight worldwide (WHO 2012)
- Childhood obesity often tracks into adulthood with serious adverse health outcomes
- Maternal obesity is associated with childhood obesity
- Concerns that formula milk and earlier age at weaning lead to increased adiposity outcomes
- Obesity in pregnancy is associated with difficulties in breastfeeding



Aims

- What is the influence of **early infant feeding practices** on the development of adiposity in 6 month old offspring of obese women?
- Adjust for relevant confounders
- Assessed by anthropometry



Hypothesis

- Breast vs formula :
  - Breastfeeding consistently associated with reduced adiposity in infancy, childhood and adulthood
- Age at weaning:
  - WHO guidance: wean from 6 months
  - Average age of weaning in UK is 4 months (in this study, 4.6 months)
  - Some evidence to suggest earlier weaning associated with childhood adiposity
- **Hypothesis: Exclusive breastfeeding and increased duration of breastfeeding (ie later weaning) in infants of obese mothers is associated with reduced measures of adiposity compared to infants mixed-fed, exclusively formula-fed and those weaned earlier.**

Method

- Analysis of 6 month follow up of 520 mother-infants pairs from the UPBEAT trial
  - UPBEAT trial: dietary and behavioural intervention for obese pregnant women
- Infant feeding data collected using validated questionnaires
- Detailed infant anthropometric measurements taken at 6 months
- Maternal data recorded prospectively throughout trial
  - Pre-pregnancy weight
  - Gestational weight gain
  - Gestational diabetes
  - Smoking status
  - Dietary information

Results 1: Differences between feeding groups

- Breastfed infants had significantly different exposures compared to formula-fed and mixed fed

Maternal characteristic	Breastfeeding	Formula feeding	Mixed feeding	p-value	Missing data
	Mean (SD)/N(%) N=194	Mean (SD)/N(%) N=240	Mean (SD)/N(%) N=86		Mean (SD)/N(%) N=1000
Age (years)	**32.65 (4.45)**	**31.13 (5.37)**	**30.16 (5.31)**	**<0.001**	29.92 (5.62)
BMI (kg/m^2)	35.62 (4.63)	36.96 (5.00)	35.70 (5.12)	0.338	36.32 (4.70)
Ethnicity **Asian**	10 (5.15%)	8 (3.33%)	1 (1.16%)	0.243	-
Black	47 (24.23%)	35 (14.58%)	26 (30.23%)	0.003	-
Other	11 (5.67%)	12 (5%)	10 (11.63%)	0.086	-
White	126 (64.95%)	185 (77.08%)	49 (56.98%)	0.001	-
Multiparous	101 (52.06%)	102 (42.5%)	41 (47.67%)	0.138	-
No deprivation	(N=157) 34 (21.66%)	(N=177) 37 (20.9%)	(N=68) 10 (14.71%)	0.464	(N=402) 81 (20.15)
Deprivation	(N=157) 123 (78.34%)	(N=177) 140 (79.1%)	(N=68) 58 (58.29%)	-	(N=402) 321 (79.85)
<12 years education	**5 (2.58%)**	**24 (10%)**	**4 (4.65%)**	**0.005**	-
Current smoker	2 (1.03%)	9 (3.75%)	3 (3.49%)	0.194	-
UPBEAT intervention	96 (49.48%)	129 (53.75%)	45 (52.33%)	0.674	-
Diagnosis of GDM	**(N=191) 44 (23.04%)**	**(N=231) 78 (33.77%)**	**18 (21.43%)**	**0.019**	-
Total maternal GWG (kg)	(N=189) 7.07 (4.18)	(N=218) 7.61 (4.62)	(N=80) 7.58 (5.14)	0.28	(N=606) 7.59 (4.54)

Breastfed

- Older mother
- Mothers with greater educational attainment
- Increased birthweight
- Weaned ≥5 months

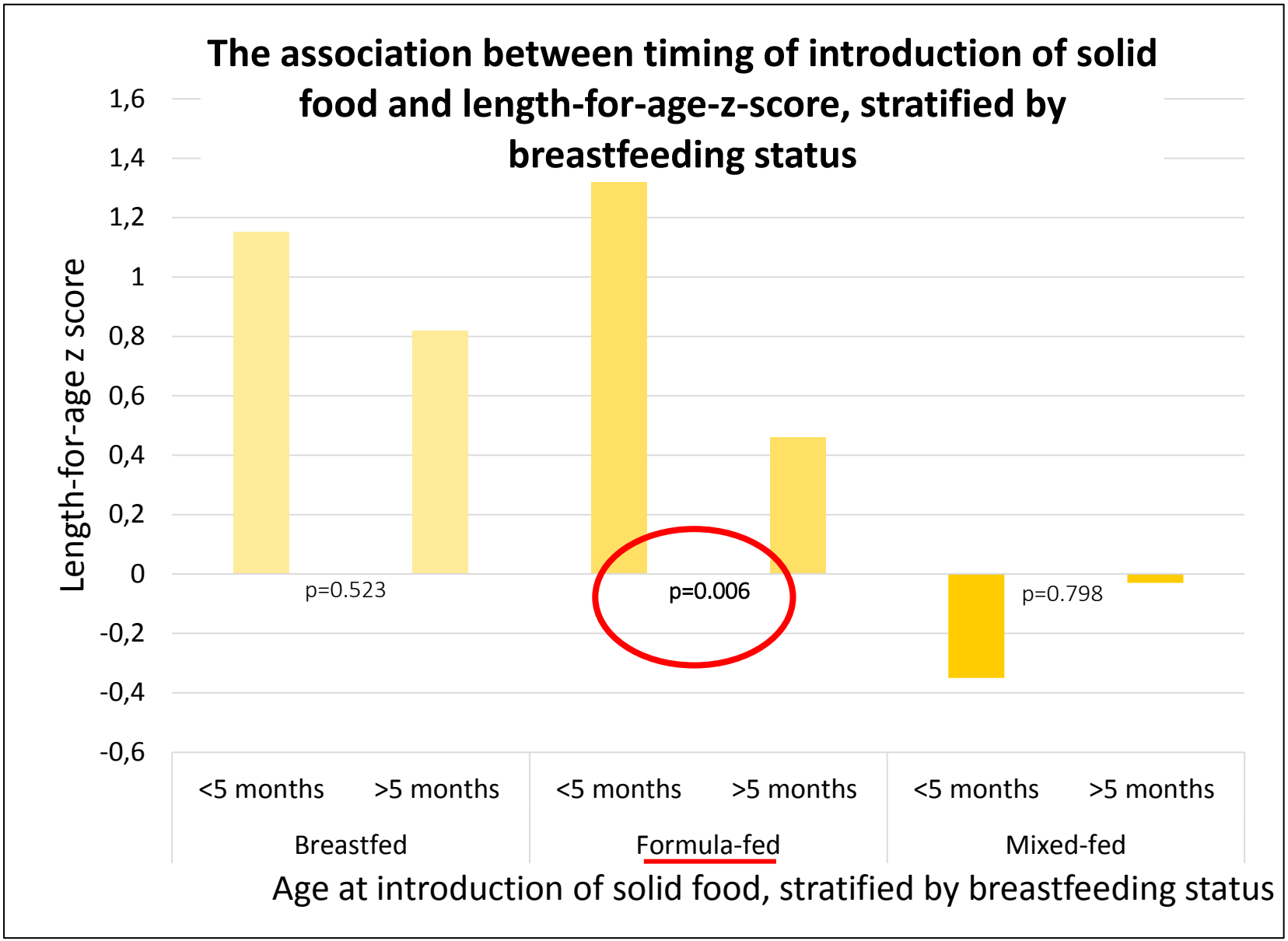
Formula or mixed fed

- Younger mothers
- Mothers with less educational attainment
- Mothers more likely to have GDM
- Weaned ≤5 months

Results 2: Association between age at solid food introduction and anthropometry; multivariate regression adjusting for all confounders*

Infant anthropometry at 6 months	Breastfeeding age at introduction of solids, months			Formula feeding age at introduction of solids, months			Mixed feeding age at introduction of solids, months		
	<5m	>5m		<5m	>5 m		<5m	>5m	
	Regression estimate (95% CIs)		p-value	Regression estimate (95% CIs)		p-value	Regression estimate (95% CIs)		p-value
Weight (kg)	0.19 (-0.55 to 0.93)	Ref	0.605	**0.78 (0.23 to 1.34)**	**Ref**	**0.007**	0.36 (-0.98 to 1.7)	Ref	0.546
Weight-for-age z-score	0.21 (-0.57 to 0.99)	Ref	0.585	**0.88 (0.28 to 1.48)**	**Ref**	**0..006**	0.38 (-1.1 to 1.87)	Ref	0.562
Height (cm)	-0.9 (-3.52 to 1.72)	Ref	0.49	**3.4 (1.2 to 5.61)**	**Ref**	**0.004**	-3.96 (-18.44 to 10.53)	Ref	0.529
Length-for-age z-score	-0.38 (-1.16 to 0.81)	Ref	0.52	**1.53 (0.54 to 2.51)**	**Ref**	**0.004**	-1.8 (-8.45 to 4.86)	Ref	0.533
BMI-for-age z score	0.45 (-0.34 to 1.25)	Ref	0.25	0.24 (-0.79 to 1.27)	Ref	0.637	1.73 (-4.55 to 8.01)	Ref	0.525
Weight-for-length z-score	0.4 (-0.38 to 1.19)	Ref	0.299	0.37 (-0.61 to 1.34)	Ref	0.452	2.26 (-6.61 to 11.12)	Ref	0.556
Waist circumference (cm)	1.49 (-0.62 to 3.6)	Ref	0.161	0.74 (-1.13 to 2.6)	Ref	0.426	-0.02 (-2.87 to 2.84)	Ref	0.99
Arm circumference (cm)	0.13 (-0.67 to 0.92)	Ref	0.749	**1.44 (0.43 to 2.45)**	**Ref**	**0.007**	0.4 (-1.34 to 2.14)	Ref	0.604
Crown-rump length (cm)	-2.14 (-4.36 to 0.08)	Ref	0.058	1.88 (-0.62 to 4.4)	Ref	0.139	-3.78	Ref	
Occipitofrontal circumference (cm)	-0.43 (-1.42 to 0.56)	Ref	0.383	0.21 (-0.84 to 1.25)	Ref	0.691	0.24 (-1.69 to 2.18)	Ref	0.773
	-0.48 (-2.85 to								

*Multivariate regression was adjusted for maternal age, BMI, ethnicity, deprivation level, intervention status, infant age at follow-up and infant sex.


The association between timing of introduction of solid food and length-for-age-z-score, stratified by breastfeeding status
Length-for-age z score
1,6
1,4
1,2
1
0,8
0,6
0,4
0,2
0
-0,2
-0,4
-0,6
p=0.523
p=0.006
p=0.798
<5 months
>5 months
<5 months
>5 months
<5 months
>5 months
Breastfed
Formula-fed
Mixed-fed
Age at introduction of solid food, stratified by breastfeeding status

However…

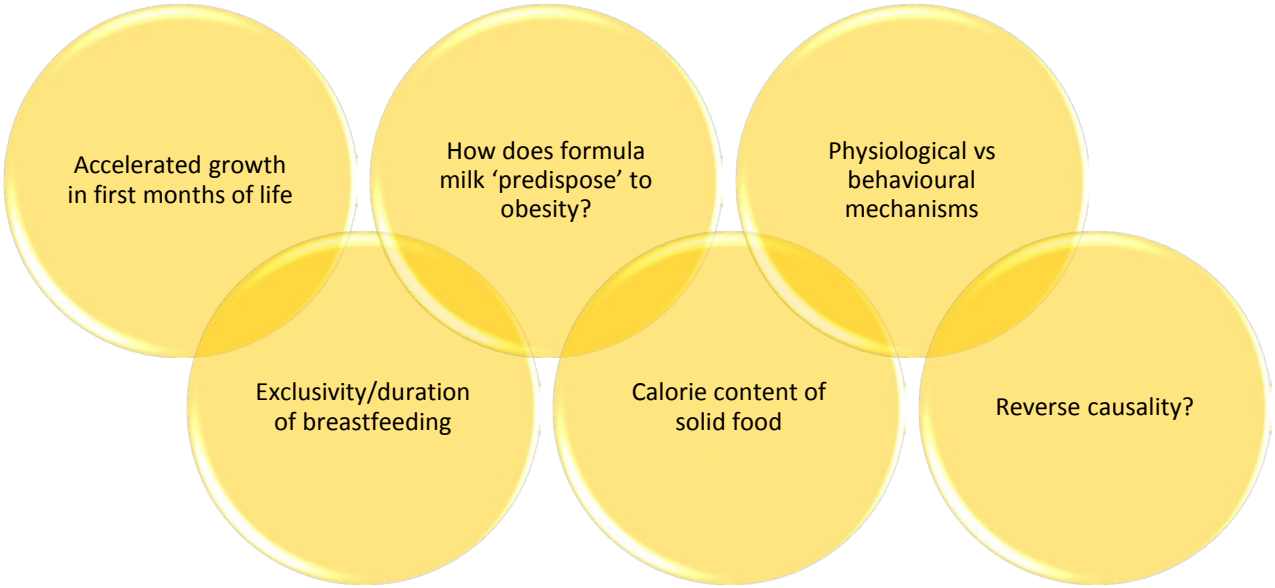
Formula fed infants who were introduced to solid foods before 5 months had increased length and height (**ie bone**) which would account for their increased weight

Infant anthropometry at 6 months	Breastfeeding age at introduction of solids, months			Formula feeding age at introduction of solids, months			Mixed feeding age at introduction of solids, months		
	<5m	>5m	Regression estimate (95% CIs) p-value	<5m	>5m	Regression estimate (95% CIs) p-value	<5m	>5m	Regression estimate (95% CIs) p-value
Weight (kg)	0.19 (-0.55 to 0.93)	Ref	0.605	0.78 (0.23 to 1.34)	Ref	0.007	0.36 (-0.98 to 1.7)	Ref	0.546
Weight-for-age z-score	0.21 (-0.57 to 0.99)	Ref	0.585	**0.88 (0.28 to 1.48)**	**Ref**	**0..006**	0.38 (-1.1 to 1.87)	Ref	0.562
Height (cm)	-0.9 (-3.52 to 1.72)	Ref	0.49	**3.4 (1.2 to 5.61)**	**Ref**	**0.004**	-3.96 (-18.44 to 10.53)	Ref	0.529
Length-for-age z-score	-0.38 (-1.16 to 0.81)	Ref	0.52	**1.53 (0.54 to 2.51)**	**Ref**	**0.004**	-1.8 (-8.45 to 4.86)	Ref	0.533
Arm circumference (cm)	0.13 (-0.67 to 0.92)	Ref	0.749	**1.44 (0.43 to 2.45)**	**Ref**	**0.007**	0.4 (-1.34 to 2.14)	Ref	0.604

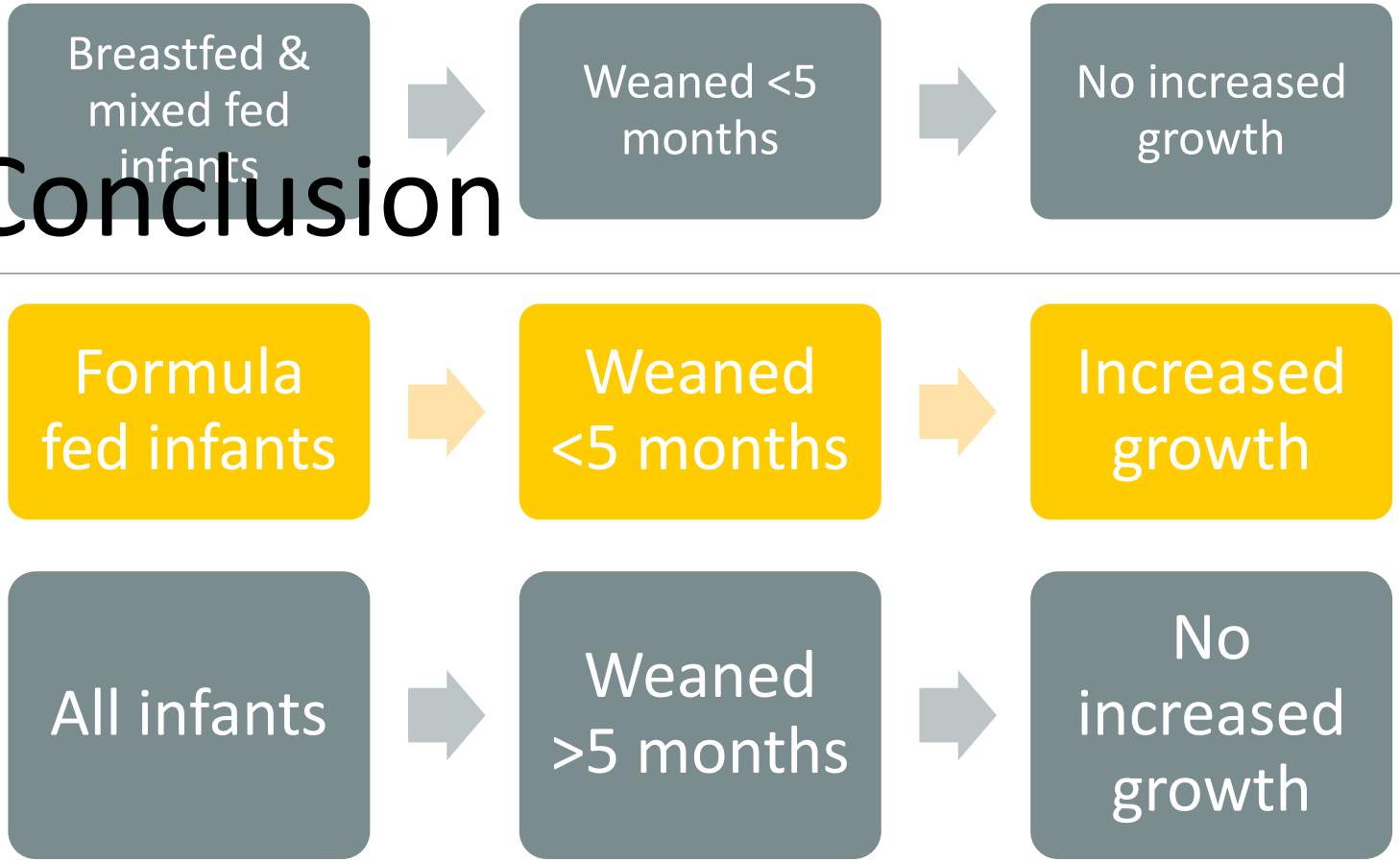
NOT MEASURES OF ADIPOSITY

Formula fed infants who were introduced to solid foods before 5 months had increased arm circumference – the only significantly increased measure of adiposity (p=0.007) which could be **muscle or fat**.

Discussion


Accelerated growth in first months of life
How does formula milk 'predispose' to obesity?
Physiological vs behavioural mechanisms
Exclusivity/duration of breastfeeding
Calorie content of solid food
Reverse causality?

Conclusion



- **Does any duration of breastfeeding 'protect' against the increased growth effects of earlier weaning and formula feeding?**

Recommendations

- Encourage new mothers to exclusively breastfeed for at least 6 months, or as long as possible, as advised by the WHO and NICE
- Introduce solid foods at 6 months

- **A potential strategy to contribute to curbing the obesity epidemic**

Thank you, any questions?

References

Poston L, Bell R, Croker H, Flynn AC, Godfrey KM, Goff L, Hayes L, Khazaezadeh N, Nelson SM & Oteng-Ntim E (2015). Effect of a behavioural intervention in obese pregnant women (the UPBEAT study): a multicentre, randomised controlled trial. *The Lancet Diabetes & Endocrinology* **3**, 767-777.

Briley AL, Barr S, Badger S, Bell R, Croker H, Godfrey KM, Holmes B, Kinnunen TI, Nelson SM & Oteng-Ntim E (2014). A complex intervention to improve pregnancy outcome in obese women; the UPBEAT randomised controlled trial. *BMC pregnancy and childbirth* **14**, 1.

World Health Organisation (2012). Population-based approached to childhood obesity prevention 2016, DOI: http://apps.who.int/iris/bitstream/10665/80149/1/9789241504782_eng.pdf?ua=1.

Harder T, Bergmann R, Kallischnigg G & Plagemann A (2005). Duration of breastfeeding and risk of overweight: a meta-analysis. *Am J Epidemiol* **162**, 397-403.