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**Nutrition & Health: From science to practice**

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## **Complementary feeding: which model?**



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PhD in Paediatric nutrition**

**Happily retired**

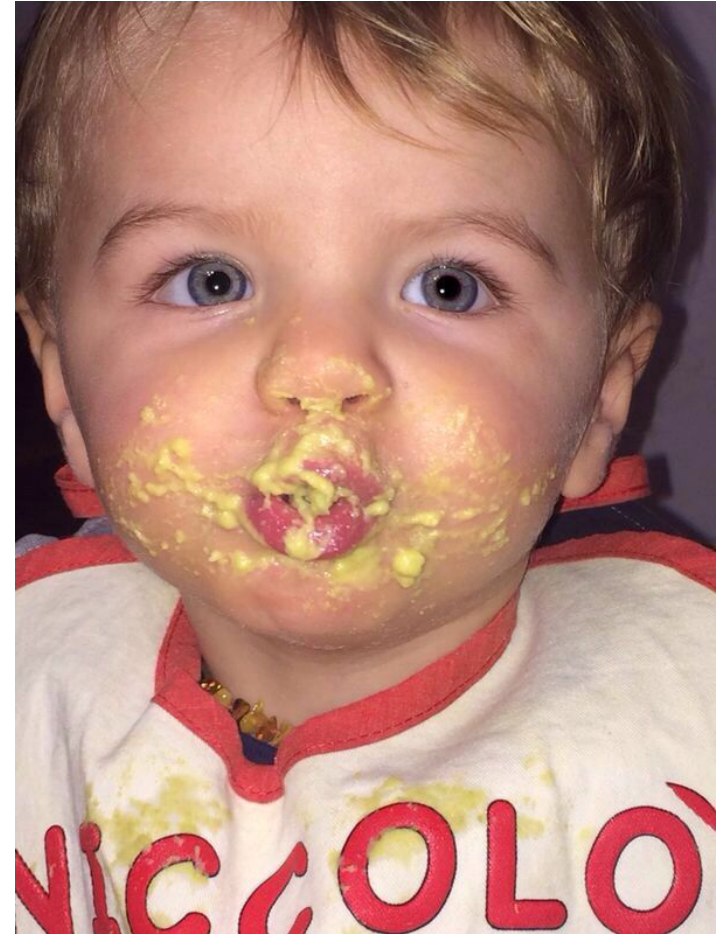
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## What is «Complementary feeding»? Also named «weaning»

Transitional period of life in which the human milk or formula ceases to be the exclusive food of the child's diet, gradually being replaced by a semi-solid meal and then by solid foods.



# Aims of complementary feeding

M Caroli

**1 offer energy and nutrients of quality and in quantities suitable for the needs of the infant**



**2 introduce and encourage the acceptance of new foods with different flavours and textures**



**3 according to our wider knowledge of nutrigenomics and epigenetics, also avoid the development of chronic diseases (hypertension, obesity, etc.)**

**Rolland-Cachera 1995, Martorell et al. 2001 Monteiro et al. 2005, Gunther et al. 2007 etc.**

**Giving the highest positive effect with the minimum of negative side effects. WHO 90**

# Breastfed babies vs formula fed babies



# Which differences?

**Formula-fed infants gain more weight than length in the first year of life, compared to breastfed infants, resulting in a higher weight-for-length and BMI**

 **The American Journal of  
CLINICAL NUTRITION**

Associations of infant feeding with trajectories of body composition and growth


Katherine A Bell,<sup>1</sup> Carol L Wagner,<sup>3</sup> Henry A Feldman,<sup>2</sup> Roman J Shypailo,<sup>4</sup> and Mandy B Belfort<sup>5</sup>

*Am J Clin Nutr* 2017;106:491–8.

## Neonatology

Growth Characteristics of Breast-Fed Compared to Formula-Fed Infants

Dewey K.G.

 Author affiliations

Keywords: Breast-fed vs. formula-fed infants, growth · Weight · Length · Adiposity · Head circumference · Infant feeding · Linear growth

*Biol Neonate* 1998;74:94–105

<https://doi.org/10.1159/000014016>

*Pediatrics*  
June 1992, VOLUME 89 / ISSUE 6  
Article


**Growth of Breast-Fed and Formula-Fed Infants From 0 to 18 Months: The DARLING Study**

Kathryn G. Dewey, M. Jane Heinig, Laurie A. Nommsen, Janet M. Pearson, Bo Lönnerdal

**The JOURNAL  
of PEDIATRICS**

July 2013 Volume 163, Issue 1, Pages 49–54

Body Fat and Bone Mineral Content of Infants Fed Breast Milk, Cow's Milk Formula, or Soy Formula during the First Year of Life

Aline Andres, PhD  Patrick H. Casey, MD, Mario A. Cleves, PhD, Thomas M. Badger, PhD

 **The American Journal of  
CLINICAL NUTRITION**

**Breast-fed infants are leaner than formula-fed infants at 1 y of age: the DARLING study**

K G Dewey , M J Heinig, L A Nommsen, J M Pearson, B Lönnerdal

*The American Journal of Clinical Nutrition*, Volume 57, Issue 2, 1 February 1993, Pages 140–145, <https://doi.org/10.1093/ajcn/57.2.140>

*Pediatrics*  
December 2000, VOLUME 106 / ISSUE 6  
Article

**Pediatrics. 2000 Dec;106(6):1355-66**

**Infant Feeding Mode Affects Early Growth and Body Composition**

Nancy F. Butte, William W. Wong, Judy M. Hopkinson, E. O'Brian Smith, Kenneth J. Ellis



# Increase of lean body mass or of fat body mass: this is the problem!

**The association between formula feeding and increased weight-for-length gain in infancy has been interpreted as representing increased adiposity**

1992



1998



Pediatrics  
June 1992, VOLUME 89 / ISSUE 6  
Article


## Growth of Breast-Fed and Formula-Fed Infants From 0 to 18 Months: The DARLING Study

Kathryn G. Dewey, M. Jane Heinig, Laurie A. Nommsen, Janet M. Pearson, Bo Lönnerdal

## Neonatology

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<https://doi.org/10.1159/000014016>

# Increase of lean body mass or of fat body mass: this is the problem!

**Compared with predominantly breastfed infants, formula-fed infants have substantially greater lean mass that is detectable as early as 3 mos of age as well as at 7 mos of age.**



The American Journal of  
CLINICAL NUTRITION

Associations of infant feeding with trajectories of body composition and growth

Katherine A Bell,<sup>1</sup> Carol L Wagner,<sup>3</sup> Henry A Feldman,<sup>2</sup> Roman J Shypailo,<sup>4</sup> and Mandy B Belfort<sup>5</sup>

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ACTA PÆDIATRICA  
NURTURING THE CHILD

Regular Article

Formula-fed infants have significantly higher fat-free mass content in their bodies than breastfed babies

Maria L. Gianni, Paola Roggero, Laura Morlacchi, Elisa Garavaglia, Pasqua Piemontese, Fabio Mosca

First published: 27 March 2014 | <https://doi.org/10.1111/apa.12643>

# **Increase of lean body mass or of fat body mass: this is the problem!**

**Formula fed infants have more visceral fat.  
Exclusive breastfeeding appears to promote subcutaneous,  
but not visceral fat in the first 6 months.**

**Impact of early infant growth, duration of breastfeeding and  
maternal factors on total body fat mass and visceral fat at 3 and  
6 months of age**

**Laura M. Breij, MD<sup>1</sup>, Marieke Abrahamse-Berkeveld, PhD<sup>2</sup>, Dennis Acton, PhD<sup>2</sup>, Emanuella  
De Lucia Rolfe, PhD<sup>3</sup>, Ken K. Ong, MD PhD<sup>3</sup>, and Anita C.S. Hokken-Koelega, MD PhD<sup>1</sup>**

*Ann Nutr Metab.* 2017 ; 71(3-4): 203–210. doi:10.1159/000481539.



# What are the nutritional basis of these differences?

M Caroli

## Human milk energy and nutrient content.

Nutrients	Value /100 ml
Energy kcal	68
Protein (g)	0.9
Fat (g)	3.5
CHO (g)	8
Ca (mg.)	23
P (mg.)	13
Iron (mg.)	0.06
Zn (mg.)	0.2

Values from MF Picciano "Representative values for constituents of human milk" Ped Clin North Am 2001 48:1 263-4

## Formulas on the market: average of nutrients and energy content

Formula	Starting	Follow up
Nutrients	Value/100 ml	Value/100 ml
Energy kcal	67	74
Protein (g)	1,4	1,8
Fat (g)	3,6	3,3
CHO (g)	7,4	9,4
Ca (mg)	45	81
P (mg)	27	46
Iron (mg)	0,7	1,3
Zn (mg)	0,5	0,91

Intakes of Human Milk adipokines differentially influence infant's Body Composition in the first year of life, which is a critical window of infant programming and may potentially influence risk of later disease via modulation of Body Composition.

FF infants had a different profile of appetite regulating hormones than BF infants.  
Lower levels of ghrelin, leptin and insulin in BF infants protect against obesity development. Leptin, ghrelin and insulin were associated with fat mass % or its changes.








*nutrients*



Article

## Human Milk Adiponectin and Leptin and Infant Body Composition over the First 12 Months of Lactation

Zoya Gridneva <sup>1,\*</sup> , Sambavi Kugananthan <sup>1,2</sup>, Alethea Rea <sup>3</sup> , Ching Tat Lai <sup>1</sup> , Leigh C. Ward <sup>4</sup> , Kevin Murray <sup>5</sup> , Peter E. Hartmann <sup>1</sup> and Donna T. Geddes <sup>1</sup>

Eur J Nutr (2017) 56:1725–1732  
DOI 10.1007/s00394-016-1219-8



ORIGINAL CONTRIBUTION

## Appetite-regulating hormones in early life and relationships with type of feeding and body composition in healthy term infants

Laura M. Breijl<sup>1</sup> · Monique T. Mulder<sup>2</sup> · Leonie C. van Vark-van der Zee<sup>2</sup> · Anita C. S. Hokken-Koelega<sup>1</sup>

# Which are the nutritional basis of these differences?

## Human milk



Low protein content

High functional protein  
content

Appetite regulating  
hormones

Different flavours according  
foods eaten

Low iron content

## Formulas



High protein content

Absence of functional  
proteins

Different pattern of appetite  
regulating hormones

Always the very same  
flavour.

High iron content

## **Breastfed infants are different from formula fed ones.**

**Since the composition and health effects of breast milk differ from those of infant formula, on a theoretical basis it may seem sensible to recommend different CFs to breast-fed versus formula-fed infants.**

**Despite these theoretical considerations, devising and implementing separate recommendations for the introduction of solid foods for BF infants and FF infants may present practical problems and cause confusion among caregivers.**

**Complementary Feeding: A Position Paper by the European Society for Paediatric Gastroenterology, Hepatology, and Nutrition (ESPGHAN) Committee on Nutrition JPGN 2017;64: 119–132**

## 7-8 months infant

Weight 7.6 – 8.6 Kg; Kcal 78-79/Kg/die; P 1.3g/Kg/die; Fe 11mg/die.

### CF with formula

Food	P	L	CHO	Fe	kcal
Follow up formula 230ml x3=690	13.2	22	63	9,9	490
Baby cereals 25 g	2.9	0,4	19	3,8	106
Olive oil 10 g		10			45
Parmesan cheese 5g	1.7	1,4			19
Vegetables 30g	0,5		3		16
Fruit 80 g	0,5	0,2	10	0,4	44
Total	18,8	34	92	14	729
g/Kg	2,4				
%	10,3	42	50,5		

kcal tot = 729/ 91Kg

### CF with human milk

Foods	P	L	CHO	Fe	kcal
Human milk 230mlx3=690ml	6,3	23	56	0,3	474
Baby cereals 25g	2.5	0,4	19	3,8	106
Olive oil 10g		10			45
Parmesan cheese 5g	1.7	1,4			19
Veal meat 10g	2,1	0,3		0,2	11
Vegetables 30g	0,5		3		16
Fruit 80g	0,5	0,2	10	0,4	44
Totale gr.	13,6	35	85	4,7	716
g/Kg	1,7				
%	7,6	44	47,5		

kcal tot 716= 89/kg

## Which models?

**Complementary feeding cannot be similar for all the babies, but has to be differentiated between breastfed vs formula fed infants**

### **Brestfed infants:**

**add foods such as fruit and  
vegs to broaden the  
perception of flavors since  
the beginning.**

**add foods rich in proteins  
and iron since the  
beginning.**

### **Formulafed infants:**

**add foods such as fruit and  
vegs to broaden the  
perception of flavors since  
the beginning.**

**No need to add foods rich  
in proteins and iron since  
the beginning.**



## Which models?

### Traditional vs baby led weaning (BLW)



## How the BLW begins?

Gill Rapley (midwife) wrote her thesis for the master's degree in 2003.

Thesis based on:



Simple observation of behavioural responses given by a wide sample ...of 5 children

to the offer of " catchy " pieces of whole food

while they were together with the family during the meal

[Rapley G., Canterbury Christ Church University College, Canterbury Kent, UK. Unpublished work, 2003]

## Baby-led weaning (BLW)

### Basic principles

- 1 The baby self-feeds from the very beginning of the weaning process.
- 2 Emphasis on exploring taste, texture, colour and smell.
- 3 Babies chose which foods and how much to eat from a plate of varied finger food.
- 4 Rejected food may be offered again at a later date.
- 5 Foods with clear danger, such as peanuts, are not offered.
- 6 Oatmeal and yoghurt may be offered with a spoon so the baby can learn to self-feed with a spoon

**None of these “basic principles” is in contrast with a complementary feeding that takes into account acute and late metabolic aspects, but no metabolic aspect is taken into account in baby-led weaning.**





## 7-8 months infant

**Weight 7.6 – 8.6 kg; kcal 78-79/kg/die; P 1.3 g/kg/die = 10.9 g/die**

### Eggy Bread (French Toast)

Eggy bread makes a great breakfast – or your baby may enjoy it cold as a snack.

*Serves 1 adult and 1 baby*

2 eggs

a little milk (optional – it makes the eggs go further)

4 slices of bread

oil or butter (preferably unsalted) for frying

In a bowl, beat the eggs and add the milk, if using. Dip the bread into the egg mix, turning as necessary to coat both sides.

Heat the oil or butter in a frying pan and fry the eggy bread on both sides over a medium to high heat until the egg is thoroughly cooked and the whole thing is golden brown.

Cut into pieces (finger shapes are usually easiest for young babies; toddlers may prefer triangles) and serve immediately, or once cool enough for your baby to handle.

#### Option

- Add a pinch of cinnamon to the beaten egg mix for a warm, spicy flavour.

56

*Storage: Eggy bread is best eaten fresh, but can be frozen and reheated in a microwave. To freeze, allow to cool completely and pack in an airtight container, separating the slices with greaseproof paper.*

	P	Fat	SAT Fat	CHO	kcal
<b>2 eggs</b>	13.1	9.2	3.4	0	
<b>4 slices of bread 70 g</b>	5.3	3.9	1.5	37	
<b>Butter 40 g</b>	0.2	25.0	14.6	0.3	
<b>Tot</b>	<b>18.6</b>	<b>38,1</b>	<b>19.5</b>	<b>37</b>	<b>563</b>
<b>1 baby serving (25%)</b>	4.6	9.5	<b>6.1</b>	10.7	141
<b>%die at 7 mos</b>	<b>41</b>				<b>21</b>



## 7-8 months infant

**Weight 7.6 – 8.6 kg; kcal 78-79/kg/die; P 1.3 g/kg/die = 10.9 g/die**

Meat is an easy first food for your baby – especially if it's tender. Stews and slow cooked dishes are ideal, and home-made sausages, burgers and patties are easy for babies to pick up and chew.

### Home-made Beef Burgers

These tasty burgers are much healthier than the fast-food version, and can be cut into wedges when cooked to make them easy for your baby to handle. Serve with hamburger buns or English muffins and sliced tomato, raw onion and Spicy Tomato Salsa (see page 154), or with potato wedges or couscous, and vegetables or salad.

**Serves 2 adults and 1 baby**

500g (1lb 2oz) lean minced beef

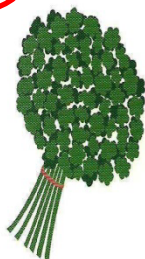
1 small onion, finely chopped

1 egg, beaten

1 tsp Dijon mustard (optional)

1 tbsp chopped fresh parsley or coriander (optional)

oil for frying (if needed)



Put all the ingredients into a bowl and mix thoroughly. Shape the mixture into balls about the size of tennis balls (flouring or wetting your hands will help to stop it sticking), then flatten them into burgers, making sure they are all roughly the same thickness. If you have time, cover the burgers and put them in the fridge to firm up for an hour or so (or until you're ready to cook them).

Heat a griddle or frying pan, with oil if needed, and fry the burgers for 5–8 minutes on each side, pressing them down if griddling, until cooked through (check by cutting one in half – there should be no pink meat). Serve warm.

	P	F	SAT Fat	CHO	kcal
<b>500 g lean beef</b>	102	25	11.4		
<b>1 egg</b>	6.6	4.6	1.7	0	
<b>30 g butter</b>	0.2	25.1	14.6	0.3	
<b>Total</b>	<b>109</b>	<b>54.6</b>	<b>27.7</b>	<b>0.3</b>	<b>930</b>
<b>1 baby serving 50 g (10%)</b>	<b>11</b>	5.4	2.8		93
<b>%die at 7 mos</b>	<b>100%</b>				<b>14</b>





## BLW favours healthier eating behaviour in later ages.

BLW group showed at 3 years healthier food preferences than those who introduced complementary foods in a traditional way. Townsend E, Pitchford NJ. Baby knows best? The impact of weaning style on food preferences and body-mass-index in early childhood in a case-controlled sample. BMJ Open 2012;2:e000298

No difference between the 2 groups. Morison BJ, et al. How different are baby-led weaning and conventional complementary feeding? A cross-sectional study of infants aged 6-8 months. BMJ Open. 2016; 6(5):e010665.

### Bias

**Different recruitment methods (websites for the BLW group and children attending already another university study). Uneven groups from the beginning for age and % of breastfeeding. Control group older than the intervention (age influences food preferences)**

Caroli M, Frelut ML, Vania A. Are we sure that baby-led weaning is nutritionally adequate and can prevent childhood obesity? BMJ Open 2012 March 12

Nambiar S. et al. Response to Article: Baby knows best? The impact of weaning style on food preferences and BMI in early childhood in a case-controlled sample. BMJ Open 2012 April 4

## BLW and obesity development

### 2) BLW prevents obesity development at older ages.

Townsend E, Pitchford NJ. Baby knows best? The impact of weaning style on food preferences and body-mass-index in early childhood in a case-controlled sample. BMJ Open 2012;2:e000298

Bias

**Higher number of breastfed in the BLW group**

**Age: BLW group about 3 years, control group about 4  
(adiposity rebound?)**

**Anthropometric measurements: BLW group from the same parents  
at home, control group by standardized medical personnel**

**Loss of approximately 30% of BLW subjects at follow-up does not  
allow for reliable conclusions to be considered.**

Caroli M, Frelut ML, Vania A. BMJ Open 2012 March 12

Nambiar S.et al. BMJ Open 2012 April 4

## Conclusions

- 1 Complementary feeding can influence future health.
- 2 Complementary feeding practices have to be based on a strong scientific evidence adapted to the local foods.
- 3 Complementary feeding should be different in BF and FF infants
- 4 Fresh vegs and fruit consumption is recommended to let the infants to appreciate since the beginning many different tastes.
- 4 Baby led weaning is not recommended since the claimed positive effects are not scientifically demonstrated.

