Does (rapid) early weight gain cause adult disease and obesity?

Ines M. Anchondo DrPH, RD, CSP
Ellyn Satter, MS, RD, LCSW, BCD

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Objectives

- Explain what is rapid early infant weight gain
- Describe how rapid early infant weight gain relates to childhood obesity and risk of disease later in life.
- Examine rapid early infant weight gain and growth patterns to determine typical growth distortions.
- Describe the implications of this research for the clinician, researcher, and parent.

What does the literature have to say about rapid early infant weight gain and its consequences?


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Author | Population Methods | Definition | Results

Adair | Pooled data from 3 birth cohorts n=4,335 Brazil, India, Guatemala, South Africa, Philippines measurements – 0-12, 12-24, 24-48 and 48 to mean age > 30 y | CW=conditional weight attual weight compared to expected weight given prior weights | WAZ scores in infancy and childhood higher in individual with later high HTN CW strongly predicted adult BMI, but not BP The WAZ scores assoc. what not significant after adult height adjustment

Barker | Longitudinal study of 13, 917 born in Helsinki 1924-44 | Change in W/A z score 3-11 yrs | SGA and pre term LBW assoc with CVD risk. Preemies decrease wt after birth (3-11yrs) followed by fast increase in wt due to high calorie/nutrient enriched feeding

Bouhours Nouet | Studied BW – HBW, LBW and insulin met. and whether catch-up weight after 2 yrs and increased fat increases insulin resistance and risk of CVD n = 117 obese children 10 – 12 yrs | HBW: >90th percentile weight for age LBW: <10th percentile weight for age | HBW had higher adiponectin, insulin sensitivity, and lower insulin resistance

Ekelund | Stockholm Weight Development Study 128 males 0-17 yrs | Change in W/A z score 0-6 mo of age Rapid weight gain 0.67 z score W/A (n=32) | W/A increase 0-6 mo Assoc with higher BP at 17 yrs of age

Eriksson 2006 | 2,003 indiv. born in Helsinki 1934-44 | Less than expected given prior weights | T2DM and IGT assoc. with low weight gain both 0-2 yrs (greatest effect in LBW)

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Annotated Reference List

"Size at birth, weight gain in infancy and childhood, and adult – and middle-income-country cohorts: when does weight gain nal of Clinical Nutrition 89(5): 1383-1392.
Promoting catch-up growth in malnourished children has health ent evidence suggests that accelerated child weight gain hronic disease risk. OBJECTIVE: We aimed to determine how birth weight gain to midchildhood relate to blood pressure (BP) in (SGA). We pooled data from birth cohorts in Brazil, Guatemala, ines, and South Africa. We used conditional weight (CW), a nt weight regressed on prior weights, to represent deviations eight gain from 0 to 12, 12 to 24, 24 to 48 mo, and 48 mo to BP and risk of prehypertension or hypertension (P/HTN) were and after adjustment for adult body mass index (BMI) and ns of CWs with small size-for-gestational age (SGA) at birth were . Higher CWs were associated with increased BP and odds of ficients proportional to the contribution of each CW to adult r adult height and BMI, no child CW was associated with adult BW was related to a 0.5–mm Hg lower systolic BP and a 9% lower BW and CW associations with systolic BP and P/HTN were not n adults born SGA and those with normal BW, but higher CW at iated with higher diastolic BP in those born SGA. CONCLUSIONS: ain at any age relates to elevated adult BP, but faster weight and young childhood do not pose a higher risk than do gains at

irth cohorts (Brazil, Guatemala, India, Philippines, and South yzed to test whether CONDITIONAL WEIGHT (difference eight and expected weight) and HTN were associated. Once adjusted for adult height, CW was not associated to BMI. Rapid early weight gain does not associate with HTN.

Researcher	Rapid Early Weight Gain Definition
Eid et al. 1970	W/A ≥ 90th percentile at 6 weeks, 3 mo, and 6 mo of age
Ong et al. 2000	≥ 0.67 ↑ in W/A z-score at birth, 2 y, and 5 y
Stettler et al. 2003	≥ 1.00 ↑ in W/A z-score at 4 mo, 12 mo, and 7 y
Baird et al. 2005	Obesity definition varied - measured between 3 months and 2 years of age
Stettler et al. 2005	Change in W/A z score between 8 d. and 112 d of age
Leunissen et al. 2009	Change in W/A z score > 0.5 z score in first 3 mo

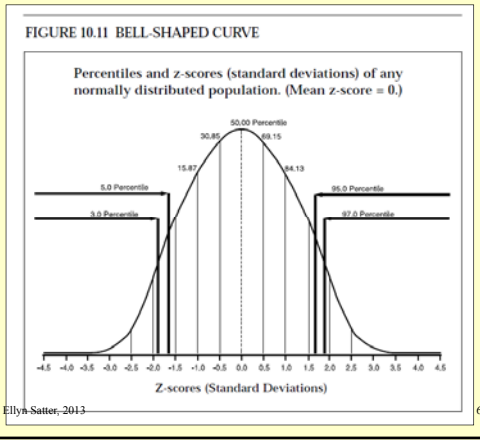
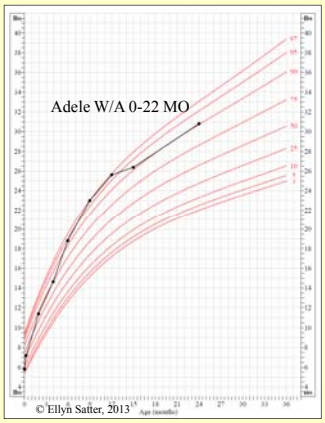


FIGURE 10.11 BELL-SHAPED CURVE

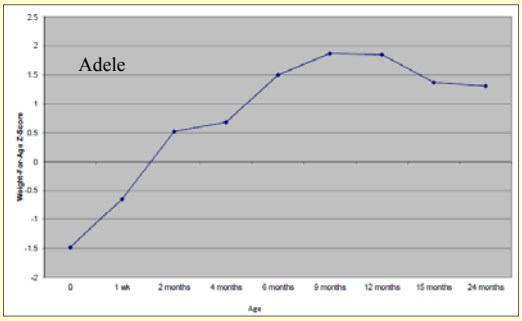
Percentiles and z-scores (standard deviations) of any normally distributed population. (Mean z-score = 0.)

50.00 Percentile
30.85
69.15
15.87
84.13
5.0 Percentile
95.0 Percentile
3.0 Percentile
97.0 Percentile
-4.5 -4.0 -3.5 -3.0 -2.5 -2.0 -1.5 -1.0 -0.5 0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5
Z-scores (Standard Deviations)



W/A ≥ 90th percentile at 6 weeks, 3 mo, and 6 mo of age

Obesity measured between 3 mo and 2 yr of age



- W/A z score ↑ between 8 d and 112 d of age
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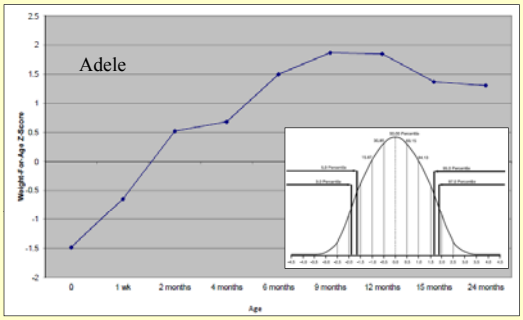
- ≥ 0.67 W/A z-score ↑ at birth, 2 yr, and 5 yr
- ≥ 1.00 W/A z-score ↑ in at 4 mo, 12 mo, and 7 yr



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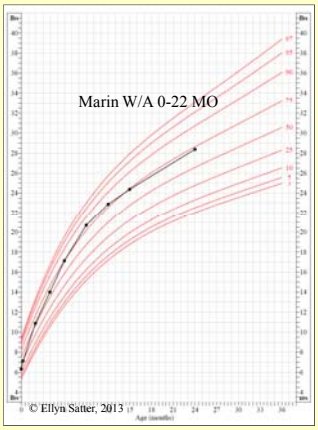

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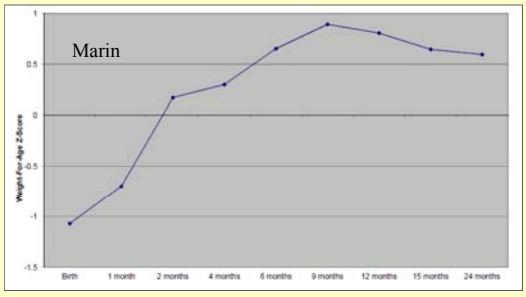

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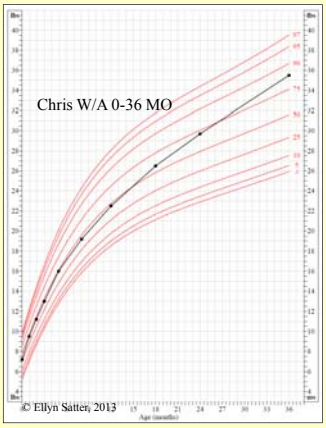

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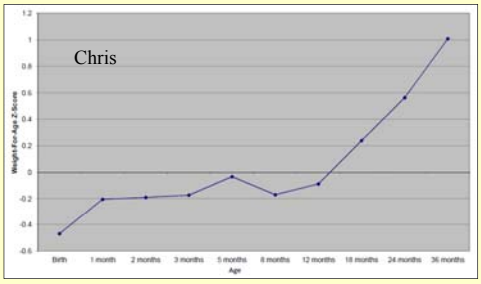

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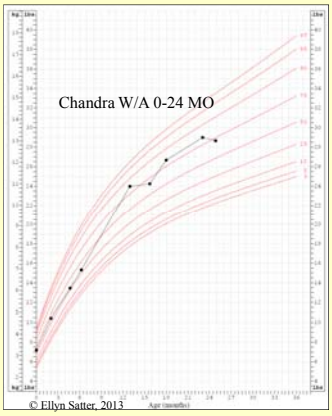

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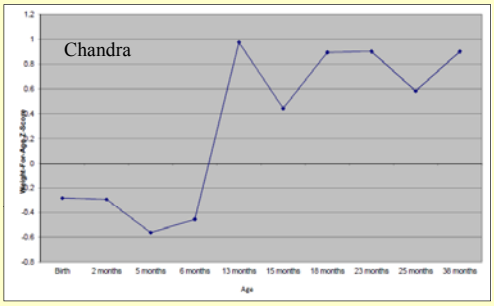

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Rapid early infant weight gain

Correlations with adult disease

- CVD
- High Blood Pressure
- Insulin Resistance
- Obesity

Rapid early infant weight gain

Cardiovascular disease

Lipid profile

Leunissen *et al*. (2009)

Significant association between rapid early weight gain (first 3 mo.) and several cardiovascular *risk factors.*

Kajantie *et al.* (2008)

Significant association between rapid early weight gain (first 6 mo.) and *higher* HDL and lower LDL, VLDL, etc.

Rapid early infant weight gain

Cardiovascular disease

C-reactive protein (CRP)

Nazmi *et al*. (2009)

- Weight gain during first year of life associates with high CRP in women.
- Large study of Brazilian adults.

Rapid early infant weight gain

High Blood Pressure

Jarvelin *et al*. (1966)
- Catch-up weight related to blood pressure.

Ekelund *et al.* (2007)
- Rapid weight gain 0-6 mo. relates to high blood pressure at 17 years of age.

Adair *et al*. (2009)
- Increased risk of high blood pressure for each period of weight gain in infancy and childhood.
- This association was no longer significant after adjustment for adult height.

Rapid early infant weight gain

High Blood Pressure

Leunissen *et* al. (2009)
- No effect of rapid early weight gain on BP at 21 years.

Law *et al*. (2002)
- No association between weight gain during 1st year of life and BP at 22 years.

LBW and risk of CVD

Barker (1993)
- LBW (due to SGA or preterm birth) associates with high cardiovascular disease risk.

Singhal *et al*. (2007)
- Rapid infant weight gain in SGA, promoted by nutrient-enriched diet PROGRAMS children for high blood pressure.

Leunissen *et al.* (2009)
- LBW and SGA *corrected for gestational age* do not correlate with cardiovascular disease later in life.

Preterm and risk of CVD

Kerkhof *et al*. (2012)
- Individuals born preterm had higher unadjusted BP and heart rate.
- No association when adjusted for HR

Cardiovascular disease and high blood pressure:

What does all of this mean?

Rapid early infant weight gain

Correlations with adult disease
Insulin resistance

Leunissen *et al*. (2009)
- Rapid early weight gain in first 3 mo. associates with decreased insulin sensitivity.

Eriksson *et al.* (2003)(2006)
- High weight **&** length: birth-3 mo & -6 mo. relates to *decreases* prevalence of insulin resistance and incidence of T2DM.
- Low weight gain birth to 2 years of age *increases* risk of T2DM.

Rapid early infant weight gain

Correlations with adult disease

Insulin resistance

Kerkhof *et al*. (2012)

Higher early weight gain (0-3 mo) associated with several cardiovascular disease risk factors.

Norris *et al.* (2012)

Lower BW & fast weight gain 24-48 mo associated with insulin resistance.

Rapid early infant weight gain

Correlations with adult disease

Insulin resistance

Fabricius-Bjerre et al. (2011)

Rapid early weight gain in first 3 mo. associates with impaired glucose metabolism.

Singhal et al. (2003)

Adolescents born preterm (also healthy babies), fed nutrient enriched diets, and with higher weight gain at 2 weeks of age had more insulin resistance.

Rapid early infant weight gain

Correlations with adult disease

Insulin resistance

Woods *et al.* (2002)

Insulin resistance also occurs in short SGA who did not achieve catch up growth.

Bouhours Nouet *et al*. (2009)

HBW babies had higher adiponectin, insulin sensitivity, and lower insulin resistance.

Larnkjaer *et al*. (2010)

There is NO association between infant weight and insulin resistance in adolescence.

Rapid early infant weight gain

Reality check

- Rapid weight gain definition is arbitrary
- *Risk* may not be reality
- Outcomes and measures not abnormal but only shifted
- Studies: epidemiological observational
- Confounding factors and systematic bias not always considered
- Differences in follow up age and study populations

Rapid early infant weight gain

Positive effects

Horta *et* al. (2009)

Brazilian women with rapid weight gain in first 20 mo. of life delivered higher birth weight infants.

Martorell *et al*. (2010)

Weight gain in first 2 years of life associates with longer schooling and lower rate of school failure.

We must lose what we think we know so that we can come to see what we least expect.

Christopher Kimball

The strongest determinant of size and shape is *genetics*.

What are clinicians to do about rapid early infant weight gain?

Rapid early infant weight gain

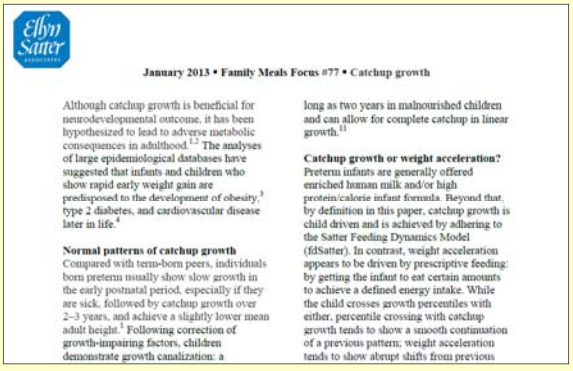
Conclusion

- Inconsistent and uncertain definition of rapid early weight gain
- Inconsistent and uncertain about the time period of early weight gain
- Ignoring Feeding Dynamics as determinants of early weight gain
- Ignoring methodological issues

Rapid early infant weight gain

Conclusion

- Incorrect assumption that rapid early weight gain is maladaptive
- Genetic basis of weight gain, growth ignored
- Feeding dynamics not considered in assessing weight gain



January 2013 • Family Meals Focus #77 • Catchup growth

Although catchup growth is beneficial for neurodevelopmental outcome, it has been hypothesized to lead to adverse metabolic consequences in adulthood.[1,2] The analyses of large epidemiological databases have suggested that infants and children who show rapid early weight gain are predisposed to the development of obesity,[3] type 2 diabetes, and cardiovascular disease later in life.[4]

Normal patterns of catchup growth

Compared with term-born peers, individuals born preterm usually show slow growth in the early postnatal period, especially if they are sick, followed by catchup growth over 2–3 years, and achieve a slightly lower mean adult height.[5] Following correction of growth-impairing factors, children demonstrate growth canalization: a long as two years in malnourished children and can allow for complete catchup in linear growth.[11]

Catchup growth or weight acceleration?

Preterm infants are generally offered enriched human milk and/or high protein/calorie infant formula. Beyond that, by definition in this paper, catchup growth is child driven and is achieved by adhering to the Satter Feeding Dynamics Model (fdSatter). In contrast, weight acceleration appears to be driven by prescriptive feeding: by getting the infant to eat certain amounts to achieve a defined energy intake. While the child crosses growth percentiles with either, percentile crossing with catchup growth tends to show a smooth continuation of a previous pattern; weight acceleration tends to show abrupt shifts from previous

Catchup growth