Breastfeeding and the prevention of obesity and diabetes: What does the research say about the link?

Exclusive Breastfeeding: The Baby Friendly Way
Winnipeg, MB: September 24, 2010

Patricia J. Martens IBCLC, PhD
Director, MCHP; Professor, University of Manitoba
CIHR/PHAC Applied Public Health Chair

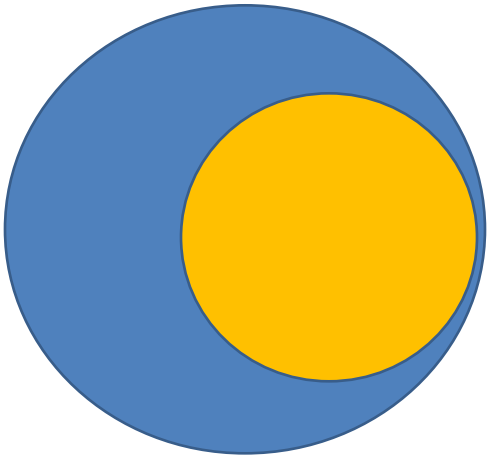
Objectives

- Explain how systematic reviews and meta-analyses look at the existing literature to summarize associations
- Explain at least 2 cautions
- Summarize findings of relationship between breastfeeding and a reduced risk of overweight and obesity, and comment on possible mechanisms
- Summarize findings of relationship between breastfeeding and type 2 diabetes, and comment on possible mechanisms
- So what? Relating it to programs/policies at the family, community, provincial and national level

Quick Lesson #1: what does p<.05 mean?

- p means “probability”, .05 means .05 times out of 1, or 5 times out of 100, i.e., 5%
- < is a mathematical symbol for “less than”
- p<.05
  - The probability of seeing a difference this big, just by chance alone, is less than 5%
  - so … Statisticians consider this “rare”, so they will conclude that there’s a real difference (i.e., they have found a “statistically significant result”)

Quick Lesson #2: Systematic reviews and meta-analyses



Systematic review looks at existing literature on a topic, and summarizes it. Authors have strict criteria for inclusion, and check for potential biases.

Subset: Meta-analysis does a mathematical calculation to determine the size of an effect if all the studies included were in one BIG study.

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Why do you need to "combine" studies?

- the more people in your study, the less likely that you will make the mistake of concluding there is no effect, when in reality there was
  - So a meta-analysis combines studies, as if they were one big study!
- Less risk of a type 2 error

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Quick Lesson #3: what is type 1 and type 2 error?

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Type I error

- The "over-enthusiast" error
- You conclude there IS a statistically significant finding (alternate hypothesis, H_1) even though at the population level you would have found no difference (null hypothesis, H_0)
- The p-value tells you about Type I error
  - p<.05: you'll make a type I error 5% of the time
    - Yikes – that's 1 time out of 20 (important when reading research studies)

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Type 2 error

- The "pessimist" or skeptic error
- You conclude "not statistically significant" and stick with the null hypothesis ($H_{0)}$ even though at the population level you would have found a difference (H_1)
  - Often the result of not enough people in your study ("low power")

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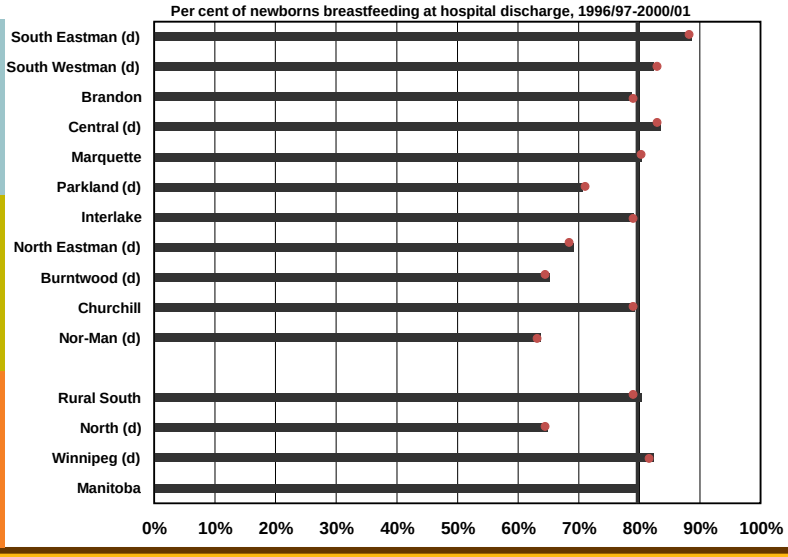
Quick Lesson #4: How much uncertainty is in your study?

- 95% Confidence Intervals
  - Studies only estimate an average value, and different studies will give you slightly different answers. So when you estimate an average value from ONE study, you also need to give an indication of how much faith you put into your "answer" (95% CI of the mean)
  - Where you expect to find the true population estimate, 95% of the time
  - This is the "wiggle factor": the smaller the sample size, the bigger the wiggle factor of uncertainty in your result.
    - Sound familiar??? Polls – "Accurate to within 3 percentage points,19 times out of 20" (this is telling you that the 95% CI is 3% either side of the given result)



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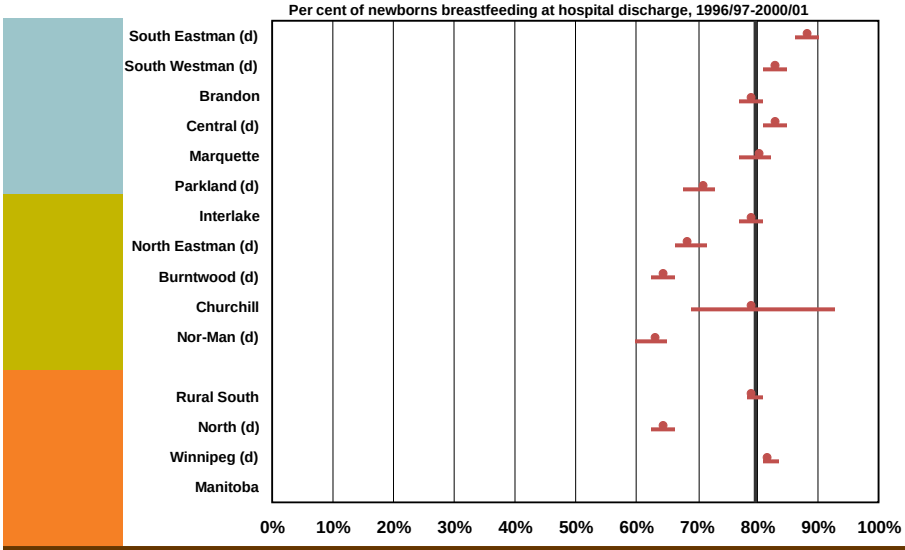
Breastfeeding Initiation Rates by Regional Health Authority



'd' indicates area's rate was statistically different from Manitoba average

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Quick Lesson #5: What do RR and OR mean?

- RR is a “rate ratio” or “relative risk”
- OR is an “odds ratio”

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A note about Relative Risk (RR) and Odds Ratio (OR)

- RR = the relative "risk" of a certain outcome for the exposed group versus the non-exposed group
  - RR = 3 is three times the risk of getting the disease if you are exposed to the risk compared to not being exposed
  - RR = 0.8 is only .8 times the risk (ie, less risk) of getting the disease if you are exposed compared to not being exposed
- OR = the relative "odds" (odds ratio)
  - Similar to RR **ONLY if the prevalence is small** (in which case, you can talk about "three times the risk" etc.)
  - Odds are NOT the same as risk, but often are talked about in a similar way

The meaning of RR and OR

- **"1" is a very important number (the null hypothesis) – greater than 1 means the risk is increased, less than 1 means it is decreased upon exposure, but don't just look at the number. Look at the 95% CI of the RR or OR!**
  - If the 95% CI cross over 1, then it's not statistically significant!! (e.g. 0.8 to 1.2)
  - If the 95% CI is <1, then decreased risk (e.g. 0.5-0.8)
  - If the 95% CI is >1, then increased risk (e.g. 1.2-1.7)

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Mercer AM, Teasley SL, Hopkinson J, McPherson DM, Simon SD, Hall RT. **Evaluation of a Breastfeeding Assessment Score in a Diverse Population.** J Hum Lact 2010 26: 42-48.

Table 3. Adjusted Odds Ratios and Significance of the 8 Variables for Prediction of Cessation of Breastfeeding at 7 to 10 Days of Age After Controlling for Hospital of Birth

	Current Study (N = 1182)		
Variable	*P Value*	*Odds Ratio*	*95% Confidence Interval*
Maternal age	<.001	1.96	1.59-2.44
Breastfed before	<.001	1.92	1.49-2.50
Latching difficulty	<.001	1.89	1.49-2.38
Frequency breastfed in hospital, every q h	<.001	2.50	1.96-3.23
Number of bottles in hospital	<.001	1.75	1.43-2.17
Breast surgery	.454	0.79	0.42-1.47
Pregnancy-induced hypertension in current pregnancy	.024	1.32	1.04-1.69
Vacuum vaginal delivery	.885	0.97	0.65-1.45
Total breastfeeding assessment score	<.001	1.45	1.35-1.59

Note: how is the p-value and the OR telling you the same thing?

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Quick Lesson #6: how is a meta-analysis diagrammed?

- OR or RR are diagrammed for each selected study in the meta-analysis, showing the 95% CI of each study
  - If that crosses over 1, then the study concluded "not statistically significant", BUT …
  - The combined OR or RR is shown at the bottom, as if it were one big study (and so the 95% CI is much smaller)

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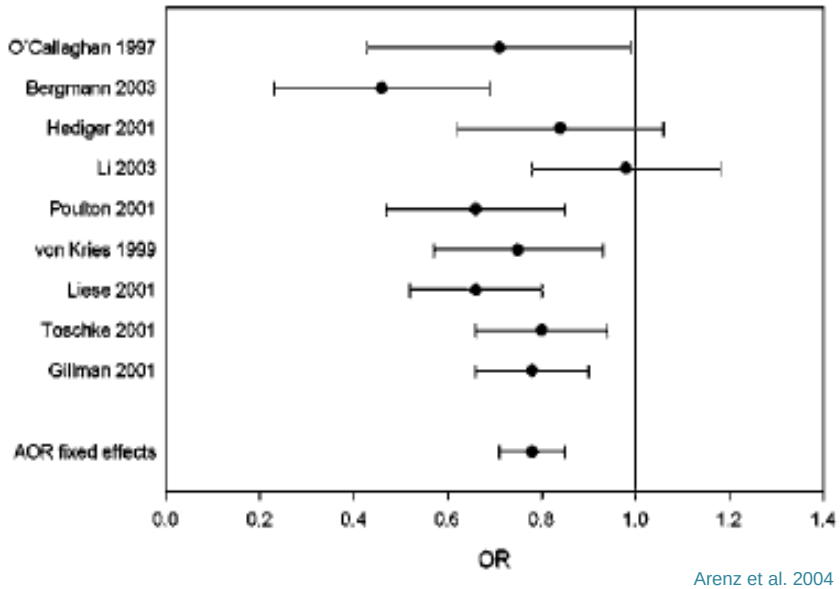

Arenz et al. 2004

Figure 3 Effect of breast-feeding *vs* formula feeding on childhood obesity: covariate-adjusted odds ratios of nine studies and pooled odds ratio.

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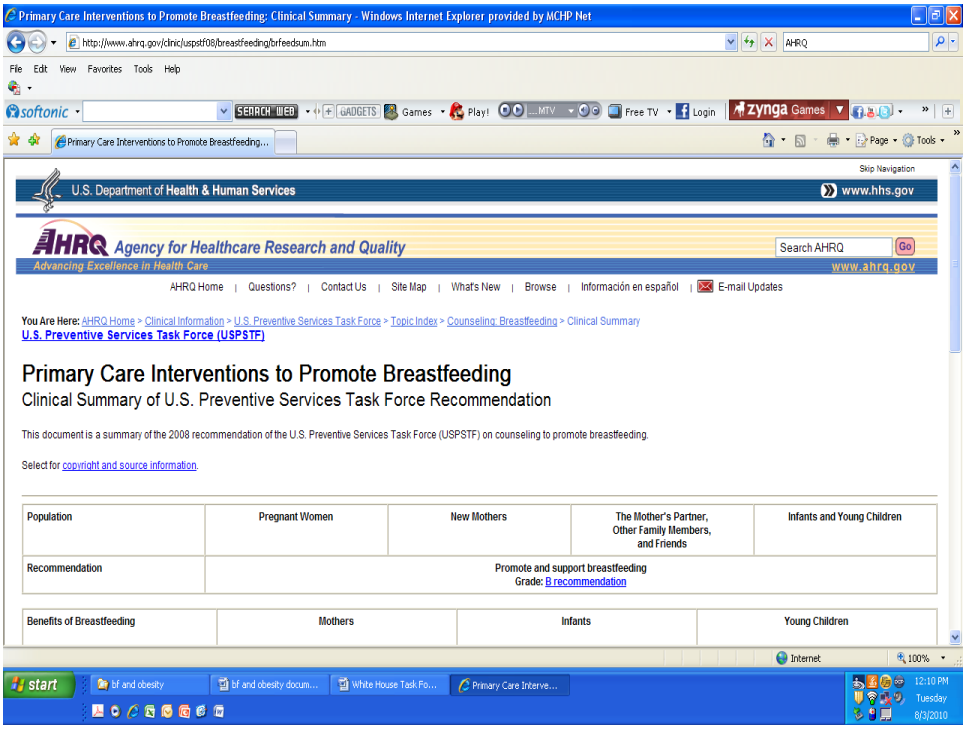
So, here we go!

- Breastfeeding and protection against obesity or overweight
  - Four major meta-analyses
    - Arenz et al. (2004, 2009) – 9 studies
    - Harder et al. (2005) – 17 studies
    - Owen et al. (2005) – 28 studies, various studies analyzed for particular subsets
    - Horta et al. (2007) for the WHO – 33 studies
  - One major critique of first three (AHRQ Report by Ip et al. 2007)

Breastfeeding and protection against obesity or overweight

- Who is the AHRQ?
  - Agency for Healthcare Research and Quality (USA Department of Health and Human Services)
- How did they rate the meta-analyses?
  - Arenz et al. 2004: Grade A
  - Harder et al. 2005, and Owen et al. 2005: Grade B (suboptimal for potential confounding)



Arenz et al. 2004: Grade "A" by AHRQ

- Included prospective, cross-sectional and case-control studies; English, Italian, French, Spanish, German; 1966-2003
  - had to control for at least 3 "confounders" (birth weight, parental overweight, parental smoking, dietary factors, physical activity, socioeconomic status or parental education)
  - OR or RR, and age at last followup of 5-18 yr
  - Feeding mode reported, obesity by BMI percentiles
- Found 954 studies, 28 met criteria, 19 not eligible, 9 studies (n=69,000) kept in final calculation

Arenz et al. 2004

- No evidence of publication bias or heterogeneity
- Comparing any breastfeeding to no breastfeeding, a protective effect on obesity
  - Crude OR 0.67 (95% CI 0.62-0.73)
  - Adjusted OR 0.78 (0.71-0.85)
- Protective effect of breastfeeding was more pronounced in studies with adjustment for less than 7 potential confounders, but BOTH significant
  - 0.69 (0.59-0.81) with less confounder adjustment
  - 0.78 (0.70-0.87) with more adjustment
- Arenz 2009: aOR 0.77 (0.72-0.82), similar to previous finding but included more studies in the meta-analysis

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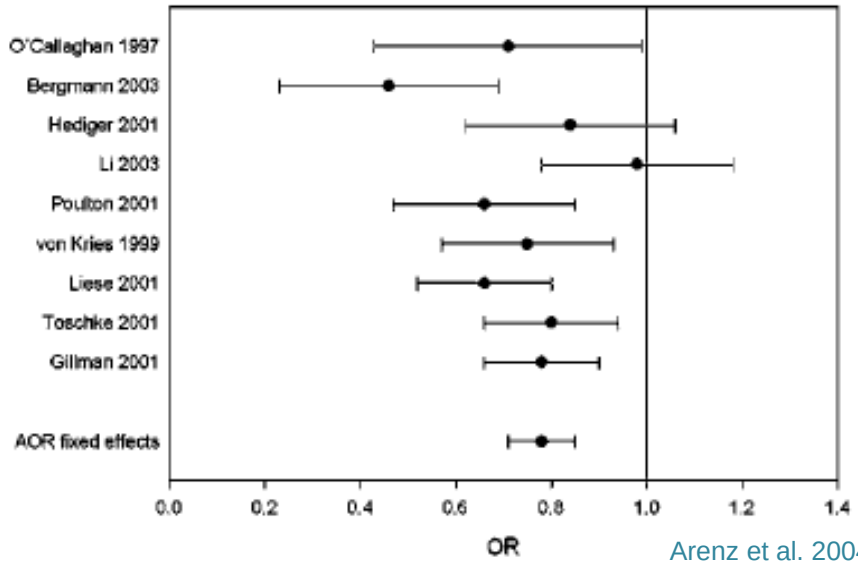

Arenz et al. 2004

Figure 3 Effect of breast-feeding *vs* formula feeding on childhood obesity: covariate-adjusted odds ratios of nine studies and pooled odds ratio.

NOTE: comparing never breastfed to ever breastfed

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Arenz et al. 2004 (page 1253)

"It has been reported that breast-feeding does not shift the whole distribution of BMI to the left, but only the upper tail as clearly shown in the publication of Koletzko et al. We are not aware of other studies on the interdependencies of breast-feeding and childhood obesity taking into account both an effect on the median and the upper tail of the distribution. Therefore, we can only hypothesize that the impact on the upper tail of the distribution is the genuine effect of breastfeeding. Interestingly, the obesity epidemic in children as opposed to adults is predominantly caused by an increase of the BMI distribution in the upper percentiles. Therefore, it appears reasonable to consider exposures which affect the upper tail mainly."

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Why measure % obese or overweight? (Dewey 2003)

- There may be little change in the overall MEAN of the BMI of a population
- But there may be dramatic changes in the % in a certain category (like obese)

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Dewey 2003 (page 11)

- "The outcomes must have included the percentage of children who were overweight, not just the mean weight for length or body mass index (BMI: weight (kg)/height (m)2). **This criterion is included because our interest is in the right-hand tail of the distribution, not the central tendency [i.e., mean].** **It is possible that breastfeeding reduces the extremes at both ends—both overweight and underweight— which would result in a reduced prevalence of overweight but no difference in mean BMI."**

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Quick Lesson #7: normal distributions and “shifts”

The importance of a population perspective on public health

Rose's Theorem: "a large number of people at small risk may give rise to more cases of disease than a small number who are at high risk"

– Rose, G. The Strategy of Preventive Medicine. Oxford, England: Oxford University Press; 1992.

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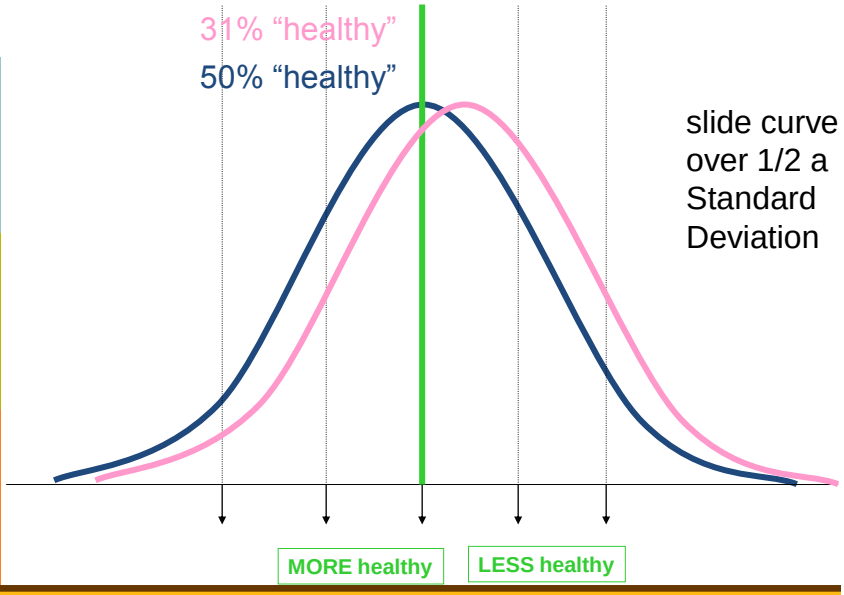
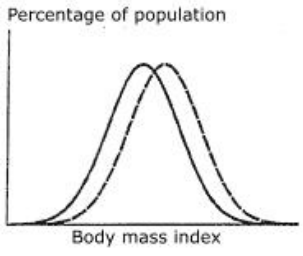
The importance of a population-based approach



slide curve over 1/2 a Standard Deviation



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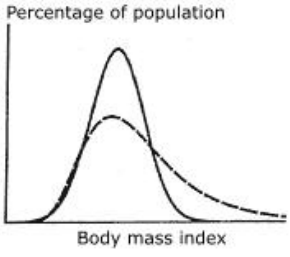

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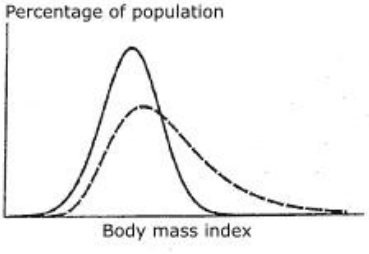

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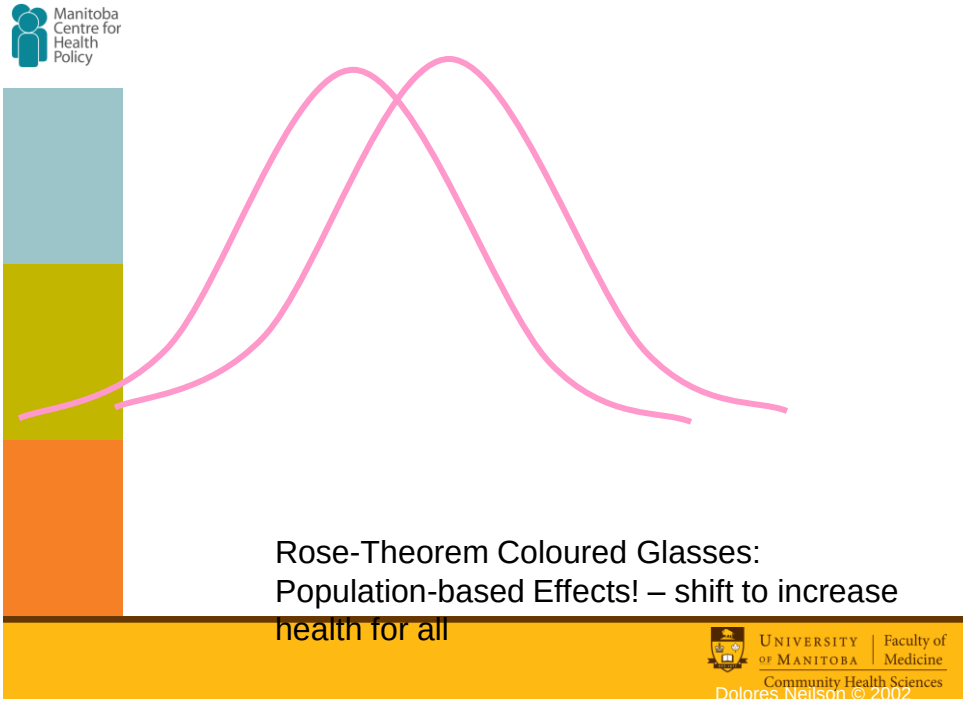
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Rose-Theorem Coloured Glasses:
Population-based Effects! – shift to increase health for all
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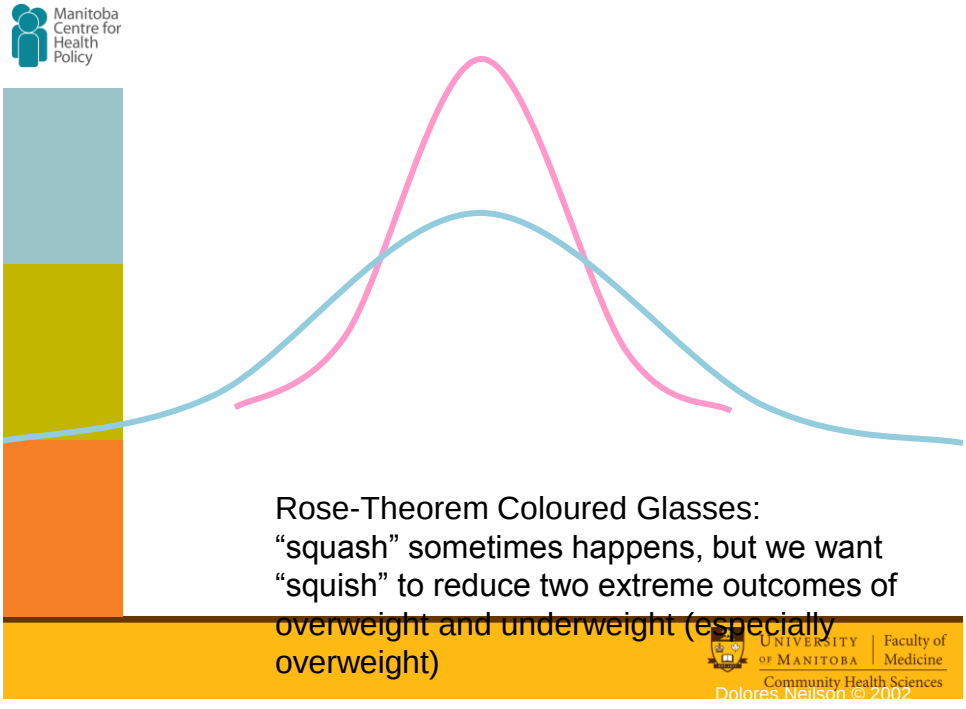
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Rose-Theorem Coloured Glasses:
"squash" sometimes happens, but we want "squish" to reduce two extreme outcomes of overweight and underweight (especially overweight)
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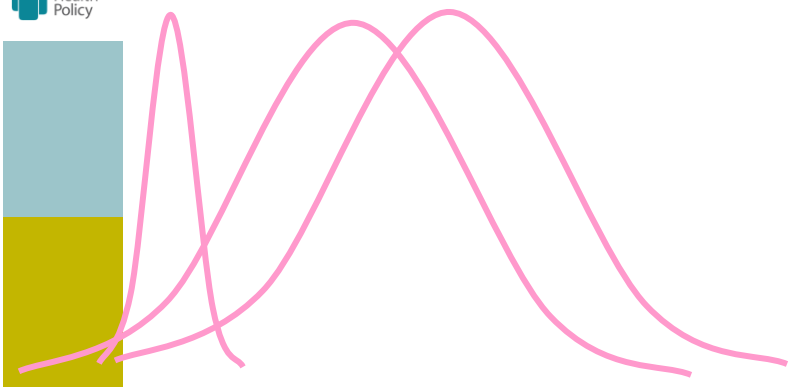

Rose-Theorem Coloured Glasses:
Population-based Effects! – shift and “squish” to increase health and reduce inequity

Dolores Neilson © 2002

Harder et al. 2005 (remember – Grade B)

- 17 studies, n=120,831
  - Must compare breastfed with exclusively formula fed; must report duration of breastfeeding; risk of overweight
  - Dose-response found
  - OR 0.94 (0.89-0.98) per MONTH of breastfeeding, lasting up to 9 months duration of breastfeeding (i.e., odds of overweight reduced by 4% per month)
  - For 9+ months of breastfeeding, the OR is 0.68 (0.50-0.91)

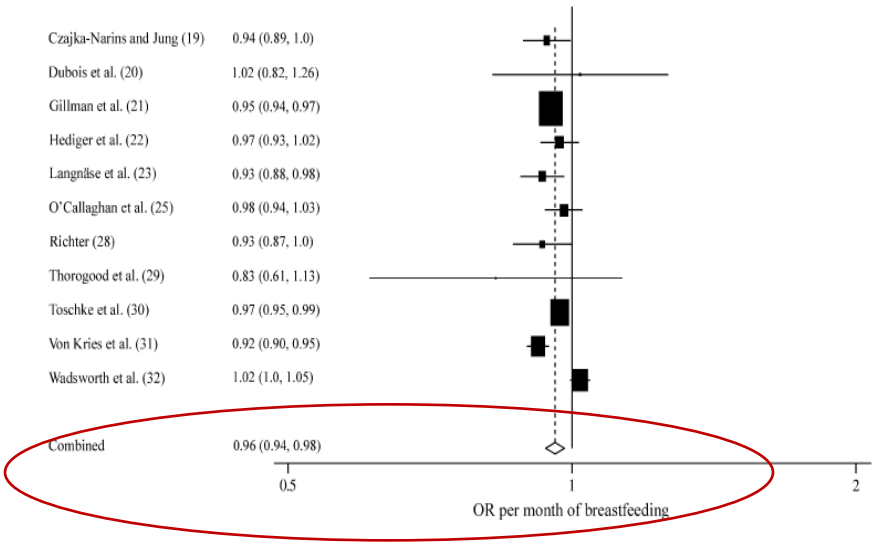

FIGURE 2. Odds ratios (with corresponding 95% confidence intervals in parentheses) for overweight, per month of breastfeeding. Studies are ordered alphabetically by first author. The pooled or "combined" odds ratio (OR) was calculated by a random-effects model.

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Harder et al. 2005

TABLE 3. Duration of breastfeeding and risk of overweight: categorial analysis (random-effects model)

	Duration of breastfeeding				
	<1 month	1–3 months	4–6 months	7–9 months	>9 months
No. of duration-specific study estimates	5	14	15	11	7
Odds ratio for overweight	1.0	0.81	0.76	0.67	0.68
95% confidence interval	0.65, 1.55	0.74, 0.88	0.67, 0.86	0.55, 0.82	0.50, 0.91

Am J Epidemiol 2005;162:397–403

NOTE: comparison group is exclusively formula-fed babies

Owen et al. 2005 (Grade B)

- 28 studies (n=298,900)
  - OR = 0.87 (0.85-0.89)
  - Where info available on breastfeeding duration:
    - OR 0.81 (0.77-0.84) for breastfeeding 2+ months versus never breastfed

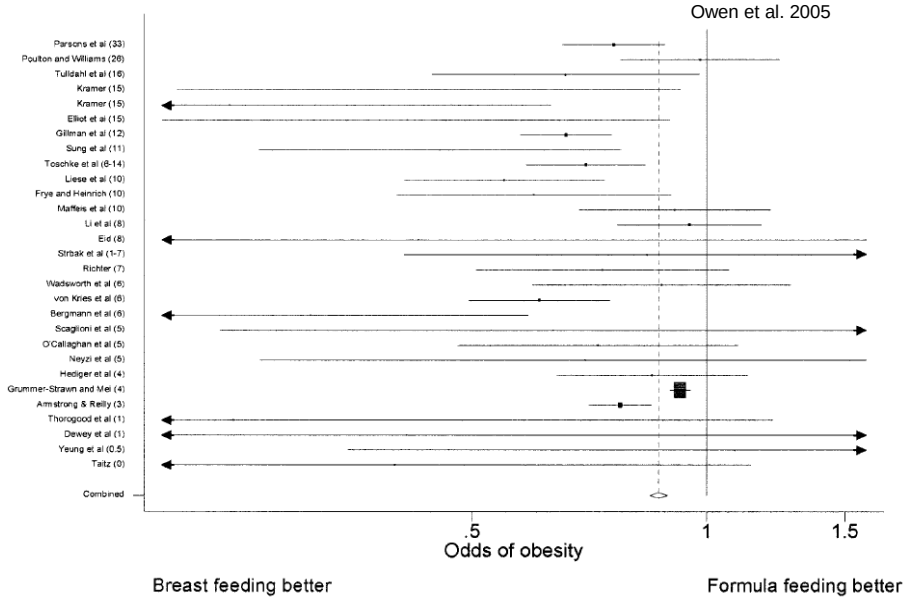

Fig 1. Odds ratio and 95% CIs of being defined as obese, comparing those who were breastfed versus formula fed (values of <1 show a protective effect of breastfeeding against obesity). The box area of each study is proportional to the inverse of the variance, with horizontal lines showing the 95% CI of the odds ratio. The study authors are indicated on the *y*-axis in ascending order of age at which obesity status was measured. Mean ages (in years) are shown in parentheses. The pooled estimate based on a fixed-effects model is shown with a dashed vertical line and diamond (95% CI).

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Ip et al. 2007 (AHRQ report)

- Findings from the three studies suggest that breastfeeding is associated with a reduced risk of obesity in later life.

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Horta et al. 2007 (WHO)

- 33 studies, 39 estimates (some evidence of publication bias); followup from 1 to 66 years
  - OR=0.78 (0.72-0.84) comparing breastfed to not breastfed for risk of overweight and obesity
  - Conclude: small protective effect on prevalence of obesity, in spite of evidence of publication bias
    - » (rebuttal from Cope and Allison 2008)

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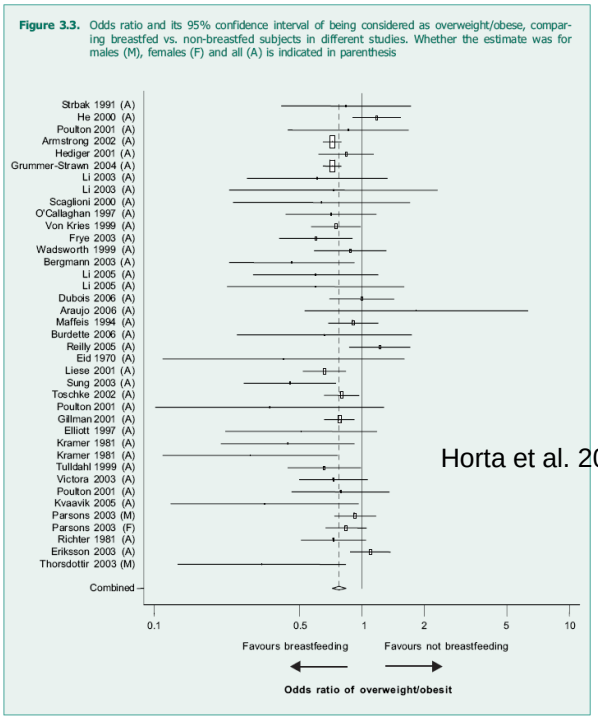

Horta et al. 2007 (WHO)

Twells and Newhook 2010

- N=1,025 children born in 2001, attending the Newfoundland/Labrador Pre-Kindergarten Health Fair, 10 sites around St. John's (62% of children attend this). Mean age of child was 4.5 years. 73% were breastfed, 42.6% exclusively breastfed at 3 months
- Compares exclusively breastfed for 3 months to non-breastfed babies, controlling for child's gender, preterm or full term, child age, mother's education, maternal smoking.
- AOR = 0.66 (0.45-0.97).

Table 2. Adjusted Logistic Regression Model: Dependent Variable Childhood Obesity (BMI ≥95th percentile) Compared to Normal (BMI <85th percentile) as per CDC

Breastfeeding	n	%	Adjusted OR*	95% CI
EBF to 3 months*	435	42.6	0.66	0.45-0.97
Male infant†	537	52.3	1.01	0.70-1.45
Full term‡	957	93.3	0.72	0.34-1.53
Child's age	1026		1.30	0.90-1.85
Mother's education				
High school§	826	80.5	0.77	0.47-1.25
Maternal smoking‖	132	13.1	1.48	0.90-2.44

Unadjusted OR 0.67, 95% CI 0.47-0.96
* compared to exclusive formula feeding
† compared to female infant
‡ compared to preterm infant
§ compared to ≤high school
‖ compared to non-smoker
Adjusted for gender, age, mother's education and smoking status, and whether the baby was preterm or full term

Twells and Newhook 2010

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So what about contradictory findings?

- Kramer et al. 2007 and Kramer et al. 2009 (PROBIT study in Belarus)
  - No statistically significant difference in BMI between RCT's intervention and control site births (15.6 kg/m^2 in both at age 6 ½ years)

TABLE 2 Cluster-adjusted differences in anthropometry and BP results[1]

Outcome	Experimental	Control	Difference (95% CI)
Height, *cm*	121.1	120.2	+0.7 (−0.3, +1.7)
BMI, *kg/m²*	15.6	15.6	+0.1 (−0.2, +0.3)
Waist circumference, *cm*	54.6	54.2	+0.3 (−0.8, +1.4)
Triceps SF, *mm*	9.9	10.0	−0.4 (−1.8, +1.0)
Subscapular SF, *mm*	5.9	5.8	0.0 (−0.4, +0.5)
Systolic BP, *mm*	97.8	96.7	+0.2 (−2.9, +3.3)
Diastolic BP, *mm*	57.3	57.8	+0.2 (−1.8, +2.2)

[1] Adapted from Kramer et al. (1). Reprinted with permission from the American Society for Nutrition.

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Possible reasons for different findings in Kramer et al.

- Didn't really do a study on obesity directly, but rather on the effects of being at a BFHI hospital
- Only women who began breastfeeding were enrolled in this cohort (so no formula-fed only for comparison)
  - Small differences in percentages breastfed between intervention and control sites
- Only looked at mean BMI, not percentage obese or overweight

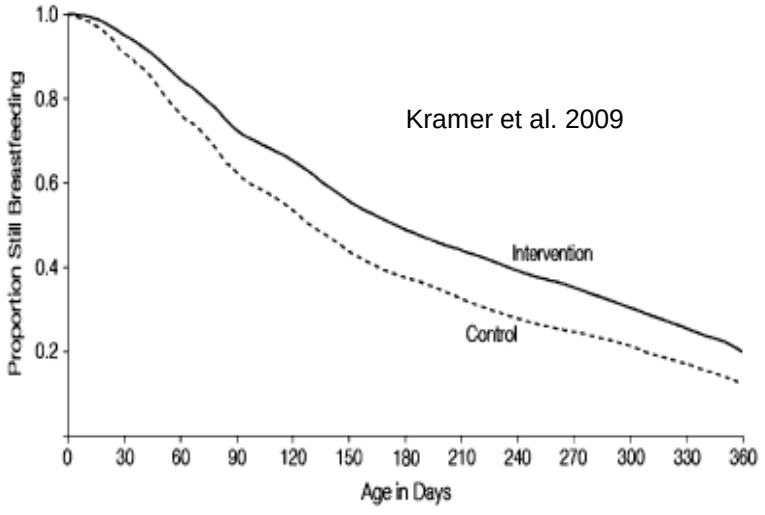

FIGURE 1 Duration of breast-feeding. Reprinted from Kramer et al. (9), with permission from JAMA.

Possible reasons for different findings in Kramer et al. 2007

- So kind of like comparing apples and apples!
- Far less problem with overweight/obesity in Belarus compared to Canada
- obesity and overweight is higher in the HIGH SES group in Belarus, totally contradictory to what we find in Canada

HOWEVER … good observation by Kramer (2009:420S)

"But I would like to make a point about the obesity epidemic. If breast-feeding had a potent effect on preventing obesity, would we be living the obesity epidemic at the same time as we have witnessed a renaissance in breast-feeding? When parents started putting their babies on their backs to sleep, the SIDS rate went down; when people stopped smoking, lung cancer rates went down; when people started using seatbelts, deaths from automobile accidents went down. No one ever said that breastfeeding is the ''cure-all'' preventive measure for obesity. But if it were having a potent effect, would we have seen the epidemic we are witnessing now? Another way of rephrasing that is, whether or not breast-feeding has a small effect in any country, countries such as ours that are experiencing this epidemic have to come up with better ways of controlling it."

- What to say to this? Is breastfeeding maybe mitigating what could be a worse epidemic? Is it so complex that no single intervention shows huge effects?

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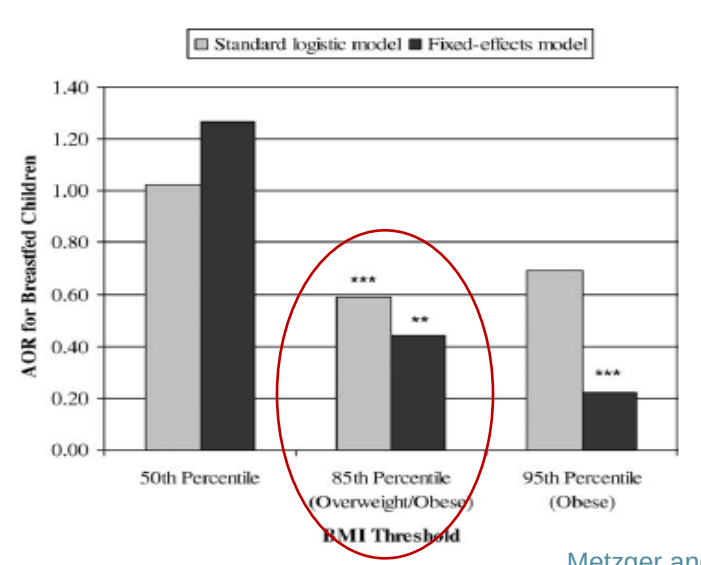
Metzger and McDade 2010

- 2,907 children, but within this, 488 sibling pairs (one breastfed, one not) aged 9-19, recall data of ever breastfed
- Controlled for reasons for not breastfeeding, age of mother, SES, birth order, return to work.

– Only a small difference (but p<.05) in average BMI, but …

– When predicting 85th percentile, breastfeeding was associated with an aOR of 0.59 (p<.01) for whole study, and stronger for sibling study



Note. AOR=adjusted odds ratio. BMI=body mass index. *** $P<.01$, ** $P<.05$.

Metzger and McDade 2010

Fig. 1. Adjusted odds ratios for breastfeeding when predicting three BMI thresholds.

Possible mechanisms: Dewey 2003

– Formula fed infants versus breastfed:

- higher plasma insulin levels, and prolonged insulin response at 6
  - » Higher insulin stimulates greater adipose tissue
- consume 66% to 70% more protein at 3-6 months, and 5-6 times more at 12 months.
  - » Protein stimulates higher insulin secretion
- Leptin is a key regulator of appetite and body fat
  - » Greater body fat during infancy programs the leptin-dependent feedback loop to be less sensitive to leptin later in life.

Ip et al. 2007:62 (AHRQ report)

- Mechanisms?
  - Differences in food composition (breastmilk versus formula): diet-related differences in leptin, ghrelin, insulin-like growth factor etc. differ
  - Food delivery (breast versus bottle)
  - Food “lifestyle” (breastfeeding versus formula feeding)
  - Food behaviour (self-regulation and feeding on demand versus set schedules of feeding of predetermined amounts)

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Ip et al. 2007:62 (AHRQ report)

- Mechanisms?
  - Breastmilk results in different growth kinetics, with formula-fed infants having higher weight gains
    - Systematic review of 19 studies in developed countries: formula fed infants weighed 600-650 grams more than breastfed infants at one year old

Arenz et al. 2009

- Formula fed infants have higher plasma-insulin concentrations compared to bf infants; could stimulate fat deposition and lead to early development of adipocytes.
  - Bioactive factors in breastmilk might modulate growth factors which inhibit adipocyte differentiation in vitro.
- Protein intake and energy metabolism is lower in breastfed than in formula fed infants.
  - positive association between early protein intake and later BMI, suggesting that a higher protein intake early in life may increase obesity.

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Possible mechanisms

- Learned self-regulation of energy intake (Li et al. 2010)
  - Percentage of babies in the second half of the year that emptied the bottle or cup, by feeding type in first 6 months
    - 27% if exclusively fed at breast
    - 54% if fed at breast and by bottle
    - 68% if fed only by bottle
  - Infants may be born with some ability to regulate intake in response to appetite cues. But it may be disrupted by the feeding mode.

TABLE 3 Percentage of Infants Completely Emptying Their Bottle or Cup of Formula or Expressed Milk During the Second Half-Year of Infancy According to Feeding Mode During the First Half-Year of Infancy, IFPS II: United States, May 2005 to June 2007

Feeding Mode in Early Infancy	Infants Finishing the Bottle in Late Infancy	
	n	% Yes (95% Confidence Interval)
Only fed at the breast (exclusive direct breastfeeding)	22	27.3 (8.7–45.9)
Fed at the breast and bottle	920	53.8 (50.6–57.0)
Direct breastfeeding + expressed milk	226	46.9 (40.4–53.4)
Direct breastfeeding + formula	179	55.3 (48.0–62.6)
Direct breastfeeding + expressed milk + formula	515	56.3 (52.0–60.6)
Fed only by bottle	542	67.9 (64.0–71.8)
Only fed expressed milk	3	66.7 (13.3–120.0)
Only fed formula	513	68.0 (64.0–72.1)
Fed both expressed milk and formula	26	65.4 (47.1–83.7)
All infants	1484	58.6 (56.1–61.1)

Li et al. 2010

- Rzehak et al. 2009
  - Velocity of weight gain, overweight and obesity were reduced in fully-breastfed infants (for at least 4 months), but not length, compared to formula-fed or mixed fed infants.
  - Although differences were only 1-2%, these remained for the whole study period (6 years) even after adjustment
  - Breastfeeding didn't shift the entire distribution, but only the upper tail

Possible mechanisms (continued)

- Adiposity rebound (Chivers et al. 2010)
  - Exclusive breastfeeding for >4 months associated with lower adolescent obesity
  - <4months: overweight 22%, obese 10%
  - >4months: overweight 17%, obese 6%
  - The timing of adiposity rebound was earlier (63 vs 74 months) and BMI higher for those breastfeeding <4 months.

Possible mechanisms (continued)

- Lipoprotein profile (Singhal et al. 2004)
  - Preterm babies randomized to receive breastmilk or formula; followup to adolescence to look at lipoproteins
  - Better LDL/HDL profiles in breastmilk cohort

Possible mechanisms: Martens and Romphf 2007

- In-hospital weight loss:
  - exclusively breastfed 5.49% (95% CI 5.23-5.74); partially breastfed 5.52% (5.16-5.88); formula-fed 2.43% (2.02-2.85), all controlled for demographic and delivery-related variables.
    - » exclusive formula feeding had the largest impact, with 3.1% less weight loss than exclusive breastfeeding (i.e., formula fed babies were “overfed”).
- Possible mechanism for future obesity??
  - Animal studies: overfeeding and rapid neonatal weight gain in the first few days of life lead to long-term obesity
  - Human studies: Stettler et al. (2005): first week critical, with each 100 g increase in absolute weight gain associated with a 28% (95% CI 8-52%) increase in the odds of becoming an overweight adult.

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Possible mechanisms (continued)

- Seach et al. 2010
  - Measured both duration of exclusive and any breastfeeding AND introduction of solids
    - At age 10 years, prevalence of overweight and obesity associated with timing of solid foods:
      - » 5 or less months: 34.7% overweight/obese
      - » 6+ months: 19.4%
    - for every 6.5 children who delay the start of solids to 6+ months, 1 could benefit by having a healthy weight at age 10

What about breastfeeding and type 2 diabetes?

- Three meta-analyses
  - Owen et al. 2006: 7 studies, n=76,744 (given a Grade A by AHRQ)
    - OR = 0.61 (95% CI 0.44-0.85) comparing breastfed to formula fed
    - Similar OR when using 3 studies adjusted for birthweight, parental diabetes, SES, individual body size, maternal body size (OR = 0.55)
  - Taylor et al. 2005: only a systematic review (Grade C by AHRQ)
  - Horta et al. 2007 (WHO): 5 studies
    - OR = 0.63 (95% CI 0.45-0.89) comparing breastfed to formula fed

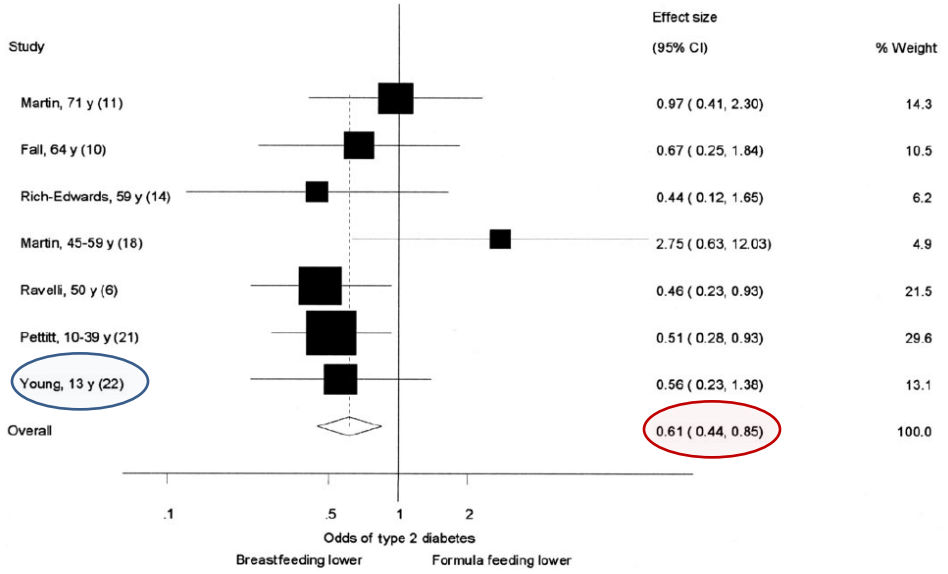
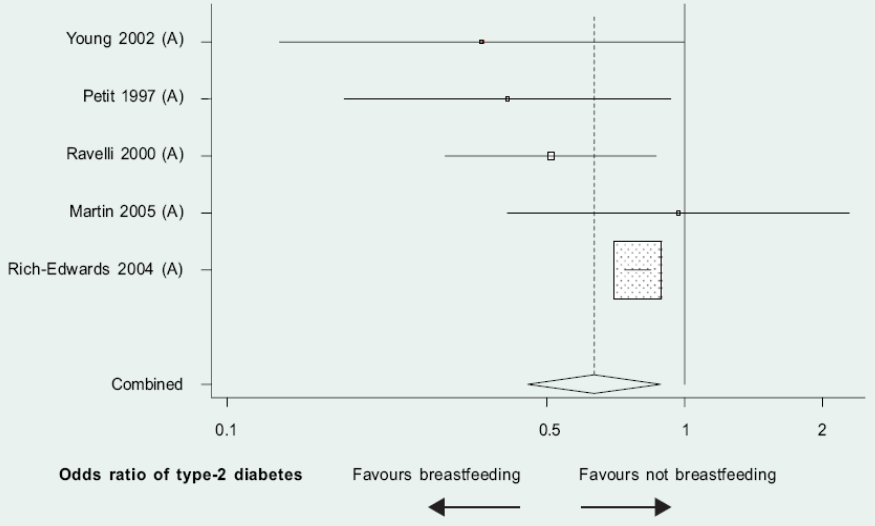


FIGURE 2. Odds ratios (95% CIs) of type 2 diabetes in a comparison of breastfed and formula-fed participants. Values <1 signify a protective effect of breastfeeding. Boxes are proportional to the inverse of the variance, with horizontal lines showing the 95% CI of the odds ratio. The first author of each study is indicated on the *y* axis. The mean age (in y) of each study's subjects is shown in ascending order of age at which type 2 diabetes was measured. Reference numbers are shown in parentheses. The dashed vertical line and diamond (95% CI) represent the pooled estimate calculated with a fixed-effects model. The solid vertical line is the null value.

Figure 4.1. Odds ratio and 95% confidence interval of having type-2 diabetes in different studies, comparing breastfed vs. non-breastfed subjects. Whether the estimate was for males (M), females (F) and all (A) is indicated in parenthesis.

Horta et al. 2007 (WHO)



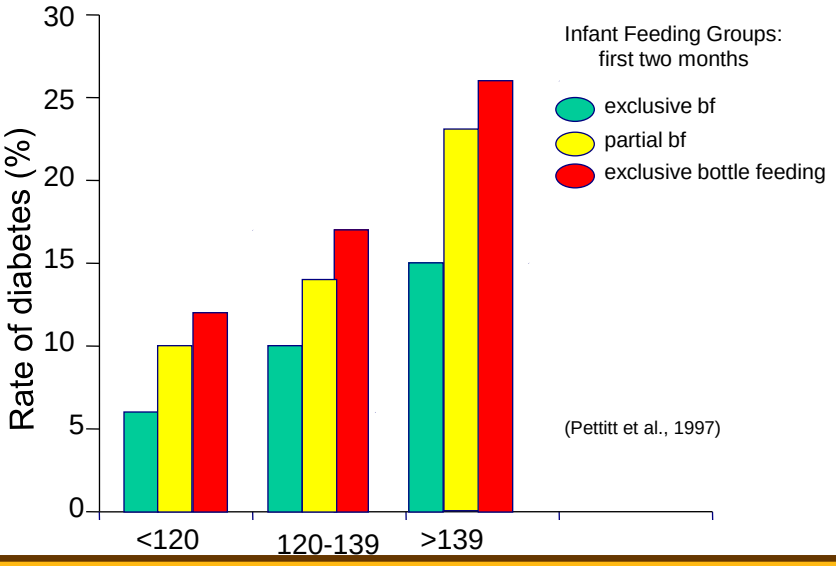
Ip et al. 2009 (AHRQ)

- Breastfeeding and maternal type 2 diabetes:
  - Lactation has a beneficial effect on glucose and lipid metabolism, and improved pancreatic beta-cell function in women with gestational diabetes.
  - Nurses' Health Study II: each year of exclusive bf by the woman was associated with aRR of 0.63 (95% CI 0.54-0.73) for type 2 diabetes; each year of any breastfeeding aRR 0.76 (0.71-0.81).

Two favourite studies

- Pettitt et al. 1997 and 1998
  - Accurate information on feeding modes for first 2 months of life in Pima Indian cohort, followed for 10 to 39 years (n=720)
  - Comparing exclusively breastfed for 2 months compared to formula fed: aOR = 0.41 (95% CI 0.18-0.93)

Rate of Type 2 diabetes by infant feeding group



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Two favourite studies(continued)

- Young, Martens et al. 2002
  - First Nations Manitoba adolescents (46 cases, 92 age- and sex-matched controls)
  - Compared to formula fed, breastfeeding was protective against early onset type 2 diabetes.
    - 12 months or longer: OR 0.24, 95% CI 0.07-0.84
    - 6 months or longer: OR 0.36, 95% CI 0.13-0.99

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Mechanisms?

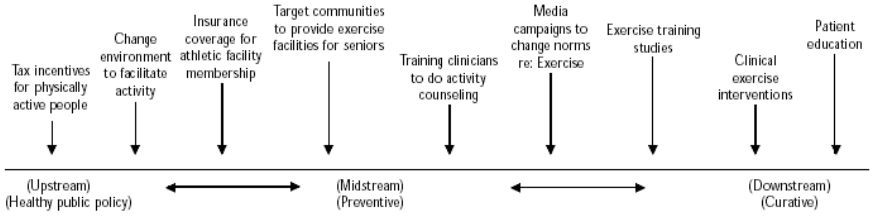
- Chertok et al. 2009
  - Early breastfeeding may facilitate glycaemic stability in infants born to women with gestational diabetes
    - Breastfed versus formula fed for first feed
      - » Higher mean blood glucose level (3.2 vs. 2.7 mmol/L, p<.002)
      - » Lower rate of borderline hypoglycaemia in delivery room (10% vs. 28%, p<.05)

Mechanisms?

- Owen et al. 2006
  - Breastfed infants compared to formula fed infants
    - Lower blood glucose (12 studies, n=560) by 0.17 mmol/L
    - Lower insulin (7 studies, n=291) by 2.86 pmol/L

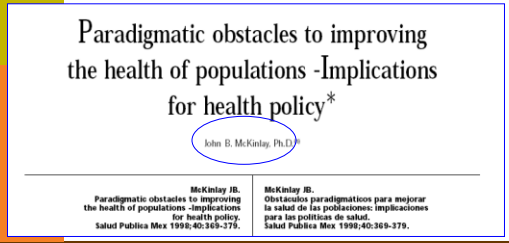
Mechanisms?

- Vaag 2009, Cripps et al. 2005:
  - SGA, low birth weight and rapid infant catch-up growth may be risks for type 2 diabetes, obesity and metabolic syndrome
    - Must be careful when promoting rapid growth by using enriched formula, and rather promote breastfeeding for more appropriate growth



From: Jette, 1994

FIGURE 3. POINTS OF INTERVENTION FOR PHYSICAL INACTIVITY



Paradigmatic obstacles to improving the health of populations -Implications for health policy*

John B. McKinlay, Ph.D.[a]

McKinlay JB.
Paradigmatic obstacles to improving the health of populations -implications for health policy.
Salud Publica Mex 1998;40:369-379.

McKinlay JB.
Obstaculos paradigmaticos para mejorar la salud de las poblaciones: implicaciones para las politicas de salud.
Salud Publica Mex 1998;40:369-379.

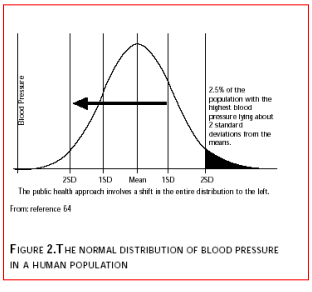


FIGURE 2. THE NORMAL DISTRIBUTION OF BLOOD PRESSURE IN A HUMAN POPULATION

John B. McKinlay, 1998

Karanja et al. 2010

- TOTS community intervention to prevent overweight in American Indian toddlers
  - Need both a community level intervention AND a family level intervention to get the most effect

So what now? Some preventable risks

RISKS to be prevented:

- Early feeds
  - Exposure to formula
  - Too much volume
- Early solids
- Non-self-regulation
  - Use of bottles

- Need to work with individuals, families, communities, provincial/national policies
  - BFHI
  - Good support pre- and postnatally through peers and health care providers
  - Family/community support through education

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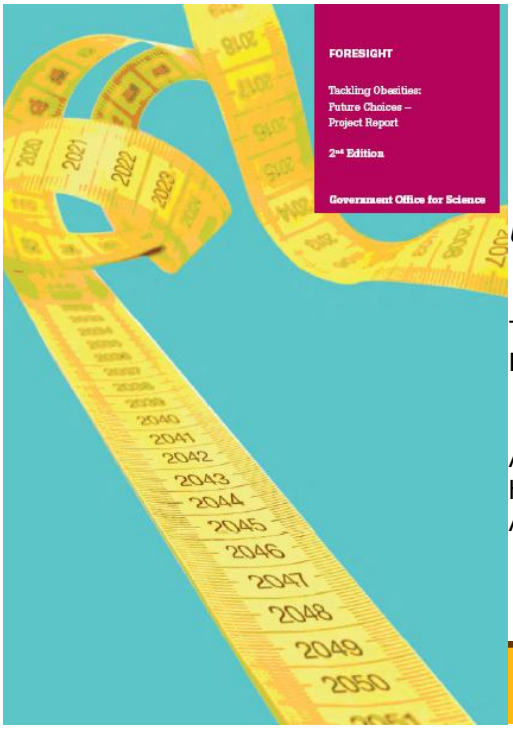
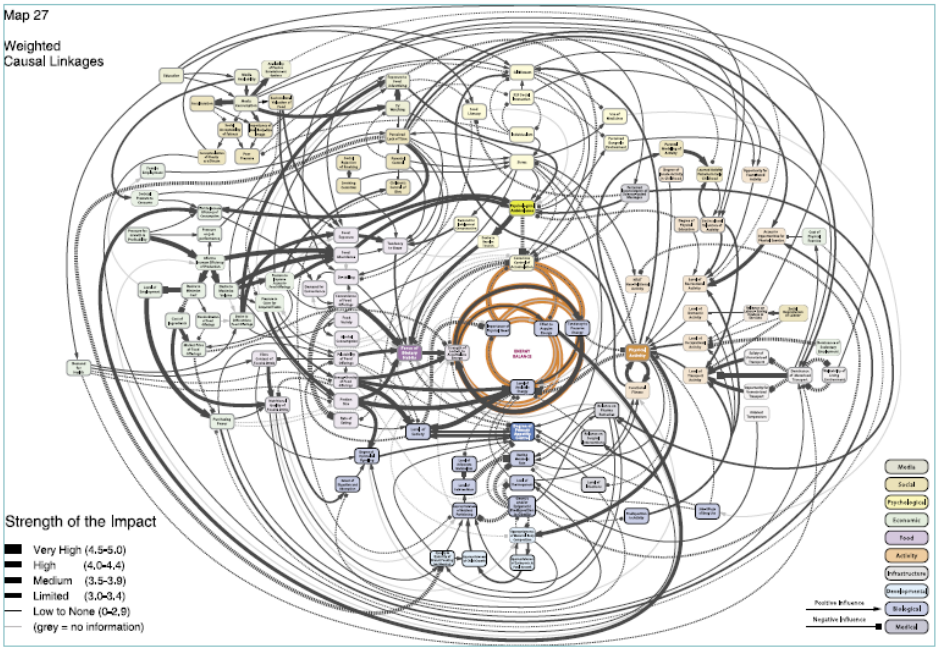


UK Government's Foresight Program

Tacking Obesities: Future Choices – Project Report 2nd edition

Available at http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp

Figure 5.4: The full obesity system map indicating the strength of the relationships between variables (see main text for discussion).[17,18] A qualitative scale of 0–5 was used (a rating of 5 meaning that small changes in the tail variable lead to large changes in the head variable). Linkages were assigned a rating where possible or left 'grey' where there was no information (see key). Variables are represented by boxes, positive causal relationships are represented by solid arrows and negative relationships by dotted lines. The central engine is highlighted in orange at the centre of the map.



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Important message about the normal distribution and public health

- THINK BIG
  - Downstream, midstream and upstream
  - The Rose Theorem is important to all of us … Even a small population "mean" shift can have profound effects on the % of the population who become healthy or unhealthy

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It's important to have the right tools when reading the literature

But you don't have to be a genius to read the literature: Use common sense and a bit of statistics!

-what are they comparing?
-what definitions are being used?
-how good is the comparison group?
-is it only one study, or a meta-analysis?
-what is the outcome measure (e.g., % overweight/obese or just the mean?)

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