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**Binns, C.W., Lee, M.K. and Oddy, W. (2003) Breastfeeding and the prevention of obesity. Asia Pacific Journal of Public Health, 15 Sup . S22-26.**

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## Breastfeeding and the Prevention of Obesity

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Obesity will be the greatest challenge for nutrition and is probably the greatest overall challenge to public health facing us in the next few decades. Being overweight or obese is a risk factor for many chronic diseases and the impact on wellbeing and mortality is demonstrated in the right hand arm of the BMI (body mass index)-morbidity U-shaped curve (Allison, Faith et al. 1997). In the USA a survey by the US Centers for Disease Control and Prevention, with a sample size of 200,000 has shown a 5.6% growth in obesity in the United States in adults in the single year 2001–02, and a massive increase of 74% since 1991. 20.9% of adults now have a BMI of greater than 30 and 2.3% over 40.(Mokdad, Ford et al. 2003)

In Australia the rate of increase in obesity is almost as dramatic. The results of the 1995 National Nutrition Survey showed that 55.2% of Australians aged 19 years or more were overweight or obese (BMI>25). For males the figure was 63.7% compared to 47% for females. Being overweight or obese reached a peak at 50–54 years for men and 60–64 years for women. A comparison of the results of the 1983 and 1995 National Nutrition Surveys showed that (after making appropriate adjustments to make the two surveys comparable), the mean BMI and energy intakes had increased. This analysis (Tables One and Two) is only available for adults aged 25 to 64 years living in capital cities. (Cook, Rutishauser et al. 2001)

**Table One: Mean BMI in Adults in the 1983 and 1995 National Nutrition Surveys.**

Males	Mean BMI	95% CI:
1983	25.5	25.3–25.6
1995	27.2	27.0–27.5
Females		
1983	24.3	24.2–24.5
1995	26.8	26.5–27.1

Reference:(Cook, Rutishauser et al. 2001)

The mean energy intake had also increased as shown in Table 2.

**Table Two: Mean energy intakes in Adults in the 1983 and 1995 National Nutrition Surveys.**

Males	Mean energy intake	95% CI:
1983	10 824 kilojoules	10 685 – 10 963)
1995	11 195 kilojoules	10 956 – 11 434
Females		
1983	7299	7204–7395o
1995	7624	7464–7785

Reference:(Cook, Rutishauser et al. 2001)

Between 1983 and 1995 the proportion of adult women who were overweight or obese increased by 41 per cent and the proportion of adult men increased by 29 per cent (Cook, Rutishauser et al. 2001).

The increasing prevalence of obesity has led to a re-focussing of the 2003 edition of the Australian Dietary Guidelines. Emphasis is now much more on preventing the development of obesity. For example “variety in nutrition” remains a cornerstone of good nutrition to supply all nutrients and minimise risk, but the guidelines now discuss variety within the context of moderating serving sizes.

The immediate question is why is Australia, and most of the rest of the world facing an epidemic of obesity? Obesity obviously reflects an imbalance between energy intake and expenditure. Has the “set point” regulation of energy intakes been reset in some way? In fact the actual balance between energy intake and expenditure needs only to be very small, perhaps 1-2 %, to result in a weight increase of 1-2kg per year. (Sorensen 2000; Cook, Rutishauser et al. 2001) However, as can be seen in Table 2 the increase in energy consumption has been closer to 3.5% for men and 4.5% for women. At the same time our lives have become even more sedentary, with the resultant increase in the prevalence of obesity, a pattern similar to many other countries.

The 1997 and 1999 National Physical Activity Surveys—telephone-administered surveys of 4824 (in 1997) and 3841 (in 1999) adult Australians aged 18 to 75 years—show that the proportion of Australian adults participating in sufficient physical activity to provide a health benefit declined from 62% to 57%, a drop of 5 percentage points in just two years. The proportion of Australian adults who reported not doing any physical activity at all increased from 13% to 15% (Armstrong, Bauman et al. 2000). It will be interesting to see if these trends continue.

The factors that have been shown to be important in the global epidemic include:  
Sedentary lifestyle, including the number of hours sitting watching TV (Hernandez, Gortmaker et al. 1999; Salmon, Bauman et al. 2000)  
Increase in energy intake, possible as a consequence of increasing nutrient density  
In children the excess consumption of carbohydrates in soft drinks has been shown to be a factor. (Ludwig, Peterson et al. 2001)

But the problem is not confined to just the western developed world and it now is a commonplace in many developing countries for governments to be facing simultaneously the problems of under nutrition and obesity.

**Table Three: Changes in Obesity levels in Asian countries**

<b>China BMI &gt;25</b>	<b>% of population</b>	-
Urban (all of China)		-
1982	9.7 %	-
1989	12 %	-
1992	14.9 %	-
Rural (all of China)		-
1982	6 %	-
1989	7.5 %	-
1992	8.4 %	-
<b>Philippines BMI &gt;25</b>		-
1982	N/A	
1987	10.6 % (m)	16.0 % (f)
1993	14.4 % (m)	18.6 % (f)

Source: (International Diabetes Institute 2000)

The assessment of obesity in persons of non-Europid ethnicity has been the subject of many studies and much debate. Most studies have been done on subjects of Asian origin. At this time there is no international agreement on the cutoff levels to be used for determining obesity. However in Singapore the following levels have been proposed Table 4 and a new classification of BMI levels is under discussion between the Asian countries (Table 5)

**Table Four: A comparison of the levels of BMI in different ethnic groups**

The levels of BMI with the same proportion of body fat as a Caucasian with a BMI of 30 are:

Caucasian	30
Chinese	27.5
Malay	27
Indian	26

Source: (Deurenberg-Yap, Schmidt et al. 2000)

**Table Five: Proposed classification of weight by BMI in adult Asians**

Classification	BMI (kg/m <sup>2</sup> )	Risk of co-morbidities
Underweight	<18.5	Low (but increased risk of other clinical problems )
Normal range	18.5 – 22.9	Average
Overweight	>23	
At risk	23 – 24.9	Increased
Obese I	25 - 29.9	Moderate
Obese II	>30	Severe

Source: (International Diabetes Institute 2000)

There is no doubt that obesity has become a major world problem. It must be the ultimate frustration for a public health planner to be faced with the problems of both

malnutrition and obesity in the same country or even in the same district. Yet this is what we have in the Aboriginal population of Australia and in most of the countries in our region. Some emerging evidence on links between breastfeeding and obesity may explain some of these trends and provide an avenue for intervention.

### **Emerging evidence on breastfeeding**

How important is the relationship between overweight in infancy and later overweight and obesity and does the method of infant feeding make a difference? Conventional wisdom was that there was a period of relative grace. “Chubby” babies were a sign of good health in many societies in the early years of life, before obesity became a concern. Children who were overweight at 1 and 3 years old were thought to have no increased risk of obesity as adults, but after that age the risk increases regardless of parental weight (Dietz 2001). However a large multicentre trial of 20,000 infants followed in detail for seven years showed that rapid weight gain during the first 4 months of life was associated with an increased risk of overweight status at age 7 years (Stettler, Zemel et al. 2002). Also of concern is that more than 60% of overweight children have at least one additional risk factor for cardiovascular disease, such as raised blood pressure, hyperlipidaemia, or hyperinsulinaemia (Fagot-Campagna, Pettit et al. 2000).

There has been interest in feeding methods and the growth of infants and child and adult obesity for many years. However in early studies the difficulty of isolating confounding factors led to inconclusive results. For example, in a paper in 1980, Kramer recognised the difficulty of studying obesity and breastfeeding, and in particular, the difficulty of isolating the effects of social class and associated factors (Kramer 1981). To overcome these difficulties Kramer undertook a further study and found that being overweight at 12 months was related to feeding method – breastfed babies were lighter (Kramer, Barr et al. 1985).

Recent studies have applied more rigorous epidemiology to larger sample sizes with an increase in the quality of the evidence. Von Kries analysed cross-sectional data from 9400 German children to assess the relationship between obesity and a history of breastfeeding (von Kries, Koletzko et al. 1999). Obesity was assessed as having a BMI above the 97<sup>th</sup> percentile. The prevalence of obesity in children who had never been breastfed was 4.5% compared to 2.8% in breastfed children. The OR for obesity was 0.75 (0.57-0.98) and for overweight 0.79(0.68-0.93).

Gillman and colleagues studied 15,000 children whose mothers were participants in the Nurses Health Study. The wealth of data available in this study allowed for adjustment for a range of potentially confounding factors. The results were summarised “*Our findings indicate that infants who were predominantly fed breast milk in the first 6 months of life had a lower prevalence of overweight 9 to 14 years later. Compared with infants predominantly fed infant formula, the estimated relative reduction in risk was approximately 22%. In addition, the apparent protective effects were larger with increasing duration of breastfeeding.*”(Gillman, Rifas-Shiman et al. 2001)

The NHANES III survey provided further evidence for an association between breastfeeding and obesity. Hediger analysed a sample of 2,685 US-born children between the ages of 3 and 5 years (Hediger, Overpeck et al. 2001). After adjusting for potential confounders, there was a reduced risk of being at risk of overweight in “ever breastfed” children, adjusted odds ratio of 0.63 (0.41-0.96).

The most recent major study, and possibly the most rigorous, came from Scotland, where the incidence of breastfeeding is lower than in the USA or Germany. A population-based sample of 32,200 Scottish children was studied at age 39-42 months in 1998 and 1999. The prevalence of obesity was significantly lower in breastfed children, and the association persisted after adjustment for socioeconomic status, birthweight, and sex. The adjusted odds ratio for obesity (BMI > or = 98th percentile) was 0.70 (0.61-0.80) (Armstrong and Reilly 2002).

Taken together these studies provide powerful support for the hypothesis that breastfeeding, and particularly, exclusive breastfeeding is protective against the development of obesity into adolescence. Since it is known that obese adolescents are very likely to be obese adults the importance of breastfeeding as a preventive measure can be seen.

### **Breastfeeding and Obesity in Australia**

There are few databases in Australia that allow us to explore the relationship between breastfeeding and later growth in Australia. However some information is available from National Nutrition Survey undertaken on 14,000 persons around Australia. By linking several databases it was possible to identify 405 children aged 2-3 years where data on feeding history and some parental health data was also available. The BMI of the children was calculated and was classified as normal or overweight according to the classification proposed by Cole (Cole, Bellizzi et al. 2000). This corresponds to a level of BMI greater than 25 in adults.

The significant factors were found to be: (See Table 6)

Exclusive breastfeeding to 24 weeks was protective

The age of introduction of cows milk - later age was protective

Parents BMI was correlated to child BMI

**Table Six Selected characteristics of feeding practice in children with and without Coles overweight in NNSRE**

	< Coles overweight		Coles overweight		<i>P-value</i> †
	No.	(%)	No.	(%)	
Exclusive breastfeeding to 24 weeks	187	77.9	53	22.1	0.06
No	65	87.8	9	12.2	
Yes					
Age introduced cow milk	20	57.1	15	42.9	0.001
Before 37 weeks	215	83.0	44	17.0	
After 37 weeks					
Relationship in household to child	88	73.9	31	26.1	0.04
Husband with dependent child(ren)	100	84.7	18	15.3	
Wife with dependent child(ren)					
Parents BMI	95	85.6	16	14.4	0.026
≤25	87	73.7	31	26.3	
>25					

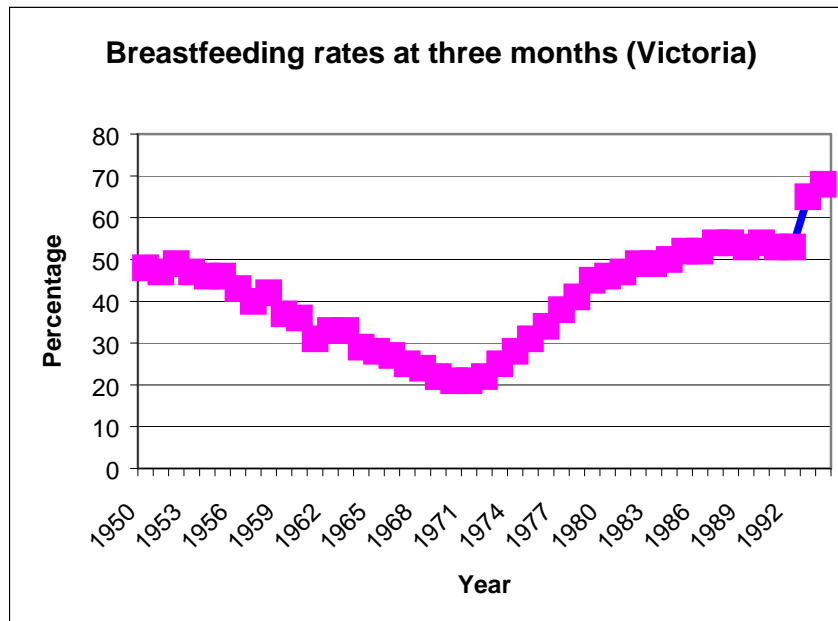
† Differences between with and without Coles overweight assessed using Chi-square test for categorical variables

In a further study participants from the Perth Infant Feeding study were followed up (Scott, Binns et al. 1996; Scott, Aitkin et al. 1999). A total of 137 infants were followed up after a period of nine years. The children were again classified according to the Cole criteria. Breastfeeding to more than 24 weeks was associated with being overweight in both boys and girls.

Data from a prospective birth cohort study of 2,432 children born in Perth were followed up at one-year-of-age (Oddy, Binns et al. 2003). Unconditional logistic regression was used to model the association between infant feeding and BMI, allowing for possible confounders (gender, birth weight and maternal factors - smoking during pregnancy, education, body mass index and age). After adjustment, breastfeeding (per additional month of feeding) was significantly associated with a decreased BMI at one year (Coeff - .097; 95%CI -.029 -.009;  $p < 0.0005$ ). Factors associated with an increased BMI included male gender, smoking in pregnancy, higher maternal BMI and maternal education. Associated risk factors for overweight were formula introduction before four months (OR 1.40 95% CI 1.05, 1.87  $p = 0.035$ ) and smoking during pregnancy (OR 1.37 95% CI 1.02, 1.83  $p = 0.024$ ). In summary, the early introduction of formula milk leads to an increase in child BMI

Data on trends in breastfeeding in Australia were summarised in Australia's Food and Nutrition (Lester 1994). Breastfeeding rates in Australia plummeted in the 1950's and 60's before recovering in the 1980's and later decades. This is reflected in the series of data available from the state of Victoria in Australia as shown in Figure One.

Figure One. Breastfeeding rates in Victoria, Australia 1950-92



Source: (Lester 1994)

The decline in breastfeeding in Australia also coincided with a trend towards the early introduction of solid foods. It is possible that the current epidemic of overweight and obesity in Australia reflects in part these changes in infant feeding patterns.

### Breastfeeding as an intervention for Obesity Prevention

Dietz summarised the current assessment of programs for childhood obesity: “*only reducing the number of hours children watched television qualified as a potentially effective preventive and therapeutic strategy for childhood obesity.*” (Dietz 2001) He then stated that recent studies show that “*breastfeeding may be added as a preventive intervention.*” (Dietz 2001).

How much could be gained in Australia by increasing the prevalence of exclusive breastfeeding to six months? It is possible to extrapolate the Gilman results to Australia, where currently around 30% of Australian infants are exclusively breastfed to six months. Assuming this could be increased to 80% or 90%, this would represent a reduction of 10% or 13% in the prevalence of adolescent obesity.

For younger children the results of Armstrong and colleagues from Scotland suggest a risk reduction of about 30% in obesity at 39-42 months in breastfed children. If these rates hold in later follow-up, this suggests an even more powerful effect for breastfeeding than the Gilman results.

### Conclusion

To summarise our current knowledge:

Overweight infants are more likely to become overweight children, adolescents and adults.



Breastfeeding to six months of age reduces the rate of overweight and obesity in children and adolescents.

Given the other known benefits of breastfeeding, increasing the rate of exclusive breastfeeding to six months would be a very worthwhile public health measure.

The Barker Hypothesis provides a link between antenatal nutrition, postnatal growth and subsequent adult disease. The fetal origins hypothesis links the high prevalence of low birth weight and recent increasing obesity to explain the emerging epidemic of chronic disease. One public health strategy to challenge this epidemic is the promotion of the breastfeeding of all infants. Breastfeeding has been shown to protect against childhood obesity, and is "dose related", the longer an infant is breastfed, the lower the risk of obesity. Breastfeeding has many benefits to both mother and infant and it now appears to be a practical means of preventing the development of obesity.

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