

SHORT REPORT

Breast feeding is related to C reactive protein concentration in adult women

M J A Williams, S M Williams, R Poulton

J Epidemiol Community Health 2006;60:146–148. doi: 10.1136/jech.2005.039222

Objective: To assess the influence of infant breast feeding on C reactive protein (CRP), a marker of low grade inflammation associated with cardiovascular mortality independent of serum cholesterol concentrations.

Design: Serum CRP, total cholesterol, anthropometric, and blood pressure measurements were performed along with assessment of infant breast feeding duration, birth weight, smoking status, adult socioeconomic status, number of health problems, and hormonal contraceptive use.

Setting: A New Zealand predominantly European descent community birth cohort.

Participants: 822 men and women aged 26 years.

Main results: There was a significant linear relation ($p < 0.001$) between duration of breast feeding and adult CRP level in women. The geometric means (IQR) for CRP were 2.22 (1, 4) mg/l for women breast fed for six months or more and 3.95 (2, 8) mg/l for women not breast fed (ratio, 95% confidence interval (CI): 0.69 (0.55 to 0.87)). The linear association between cholesterol and breast feeding was also significant ($p = 0.01$), the geometric mean (IQR) total cholesterol levels being 4.62 (4.10, 5.10) for those breast fed for six months or more and 5.04 (4.5, 5.80) for those not breast fed (ratio, 95% CI: 0.92 (0.87, 0.98)). There was no relation between CRP or total cholesterol and duration of breast feeding in men.

Conclusions: The findings of lower CRP with an increased duration of breast feeding in women suggest early postnatal nutrition may influence long term cardiovascular risk.

C reactive protein (CRP), a marker of longstanding low grade inflammation, has recently been shown to predict cardiovascular mortality independent of serum low density lipoprotein cholesterol concentrations.¹ A relation has been reported between infant breast feeding, adult cholesterol levels, and cardiovascular mortality.^{2–4} These findings suggest early childhood nutrition is an important determinant of adult cardiovascular risk.

Few studies investigate the influence of early childhood feeding on markers of low grade inflammation such as CRP. Recently, a randomised study of adolescents born before term has reported that those randomised to breast milk feeding had lower CRP concentration and low density to high density lipoprotein ratio.⁵ It is not known whether these findings apply to a broader population of children assessed in adulthood. We addressed this question in a well characterised community cohort of young adults.

METHODS

Participants were members of the Dunedin multidisciplinary health and development study, a longitudinal investigation of health and behaviour in a birth cohort. The study members

($n = 1037$) were born in Dunedin, New Zealand between April 1972 and March 1973, and represent the full range of socioeconomic status in the general population of New Zealand's South Island. They are primarily of European descent. Follow ups have been carried out at ages 3, 5, 7, 9, 11, 13, 15, 18, 21, and most recently at age 26 years when we assessed 980 (96%) of the 1019 study members still alive.

The study was approved by the Otago ethics committee and participants gave written informed consent. At the age 26 assessment venepuncture was performed between 4.15 to 4.45 pm. Ninety per cent ($n = 882$) consented to venepuncture, with complete results available for 866 participants. Pregnant women, those who had low BMI (< 18.5), and those who refused anthropometry (total $n = 44$) were excluded from the analysis, leaving complete observations for 822 participants. Non-fasting serum CRP (Boehringer Mannheim immunoturbidimetric assay, lower detection limit 1 mg/l), total cholesterol (homogenous enzymatic colorimetric assay), anthropometric, and blood pressure measurements were performed along with assessment of smoking status (those who had smoked daily for a month or more during the previous year were considered smokers), adult socioeconomic status (SES) using the Elley-Irving scale,⁶ number of health problems during the previous five years (anaemia, arthritis, cancer, diabetes, epilepsy, heart trouble, kidney/bladder infections, and major surgery), and current hormonal contraceptive use.

Participants were categorised by the duration of breast feeding as; none (bottle fed), 0–3 months, 3–6 months, or 6 months or more using data collected by interviewing the mother at the 3 year old assessment (response rate 99.8%). These maternal reports were validated against prospective records made by Plunket nurses who completed regular home visits between birth and age 3 years.⁷ Because of the skewed nature of the distribution, data for CRP were log transformed after adding 1 to each value. Geometric means and the interquartile range are reported for CRP and cholesterol for each category of breast feeding. Multiple regression analysis, adjusting for birth weight, adult waist circumference, SES, smoking status, and oral contraceptive use, with an interaction term between sex and breast feeding was used to compare the relation between CRP and cholesterol with duration of breast feeding in men and women. Significance for all analyses was defined as $p < 0.05$.

RESULTS

Table 1 details the characteristics of the study participants. Women had higher CRP levels than men but similar levels of serum cholesterol. There were no differences in adult waist girth, systolic and diastolic blood pressures for men or women breast fed for six months or more compared with the remainder of the sample.

There was no relation between infant breast feeding and CRP levels in men. In contrast there was a strong relation between duration of breast feeding for three or more months

Table 1 Characteristics of the study participants

	Men (n=447)	Women (n=375)	p Value
C reactive protein (mg/l)*	1.8 (1, 3)	3.3 (1, 7)	0.004
Total cholesterol (mmol/l)	5.0 (1.0)	5.0 (1.0)	0.58
Waist circumference (cm)	84.5 (8.4)	75.7 (9.3)	<0.001
Systolic blood pressure (mm Hg)	121.7 (10.4)	111.6 (8.9)	<0.001
Diastolic blood pressure (mm Hg)	73.3 (10.2)	70.0 (7.9)	<0.001
Smokers†	172 (38.6)	143 (38.0)	0.81
Low socioeconomic status (5 or 6)†	144 (32.3)	70 (18.6)	<0.001
Health problems (2 or more)†	28 (6.2)	69 (18.4)	<0.001
Combined oral contraceptive use†		152 (40.4)	

All data expressed as mean (SD) unless noted. *Geometric mean (interquartile range). †Number (%).

and lower CRP levels in women (table 2). A multivariate analysis adjusting for, birth weight, adult waist girth, smoking, adult SES, number of health problems, and hormonal contraceptive use showed infant breast feeding was independently associated with adult CRP levels in women. Waist girth and oral contraceptive use were also associated with CRP.

Women breast fed for six months or more had lower total cholesterol levels compared with women not breast fed, ratio 0.92, (95% confidence interval (CI): 0.87 to 0.98). Total cholesterol levels in men breast fed for six months or more were similar to the remainder of the study sample, ratio 0.99 (95% CI: 0.93, 1.04). The sex interaction for trend was not significant (p = 0.07).

Missing values

The 822 participants did not differ from the remainder of the sample for sex, birth weight, being before term (less than 37 weeks gestation), small for gestational age, SES at birth, or for the breast feeding categories used in this study. Differences in waist, systolic, and diastolic blood pressure at age 26 years were not statistically significant between this sample and those not included.

DISCUSSION

These results underscore the importance of infant nutrition as an influence on cardiovascular risk factors in adult life. Our findings confirm a previous study showing a relation between adult total cholesterol level and duration of breast feeding in women.² Furthermore, we have shown that duration of infant breast feeding in women seems to favourably influence adult levels of CRP, a marker of low grade longstanding inflammation and predictor of long term cardiovascular risk.¹ These findings extend those of previous

reports where CRP concentration in adolescence was influenced by breast milk feeding in before term infants.⁵

It is unclear why the duration of breast milk feeding seemed to influence CRP levels in women and not men. The results do not seem to be influenced by differences in

What this paper adds

- C reactive protein (CRP) has been shown to be related to long term cardiovascular risk independent of serum cholesterol. Infant nutrition has been suggested to influence long term cardiovascular risk. In before term infants breast feeding seems to lower adult CRP levels, however it is unknown whether this effect is also seen in community based infant birth cohorts.
- This study shows that infant breast feeding is associated with lower adult CRP levels in women independent of anthropometric and blood pressure measurements, birth weight, smoking status, adult socioeconomic status, number of health problems, and hormonal contraceptive use. The findings suggest breast feeding should be encouraged with a possible benefit of reducing adult cardiovascular risk in women breast fed as infants.

Policy implications

Our findings suggest infant breast feeding should be encouraged to improve long term cardiovascular risk.

Table 2 Association between duration of breast feeding, CRP, and cholesterol at age 26 years for men and women

Duration of breast feeding	Men			Women		
	Number	CRP* (mg/l)	Ratio (95% CI)†	Number	CRP* (mg/l)	Ratio (95% CI)†
None	203	1.80 (1, 3)	1.00	148	3.95 (2, 8)	1.00
Less than 3 months	124	1.64 (1, 3)	0.91 (0.77, 1.08)	124	3.45 (1, 8)	0.91 (0.76, 1.09)
3–6 months	49	2.14 (1, 4)	1.09 (0.87, 1.38)	49	2.56 (1, 6)	0.76 (0.60, 0.97)
6 or more months	71	1.64 (1, 2)	1.00 (0.81, 1.22)	54	2.22 (1, 4)	0.69 (0.55, 0.87)
			p(trend)=0.84			p(trend)<0.001‡
		Cholesterol* (mmol/l)			Cholesterol* (mmol/l)	
None	203	4.96 (4.40, 5.70)	1.00	148	5.04 (4.50, 5.80)	1.00
Less than 3 months	124	5.05 (4.50, 5.50)	0.99 (0.95, 1.03)	124	4.91 (4.35, 5.55)	0.98 (0.94, 1.02)
3–6 months	49	5.06 (4.50, 5.80)	1.02 (0.96, 1.08)	49	4.84 (4.20, 5.40)	0.97 (0.91, 1.02)
6 or more months	71	4.85 (4.20, 5.60)	0.99 (0.93, 1.04)	54	4.62 (4.10, 5.10)	0.92 (0.87, 0.98)
			p(trend)=0.83			p(trend)=0.01§

*Data are geometric mean (interquartile range). †Ratio compared with no breast feeding after adjustment for birth weight, adult waist girth, smoking, adult socioeconomic status, health problems, and hormonal contraceptive use. ‡p Value for an interaction effect or difference between men and women = 0.006. §p Value for an interaction effect or difference between men and women = 0.07.

abdominal obesity as our analysis controlled for waist measurement. Similarly we controlled for serum cholesterol and other known influences of CRP levels. A potential explanation for the findings may relate to either the different hormonal milieu in adult men or women or alternatively different sensitivities to constituents of breast milk during early infancy. A limitation of the study was the use of a low sensitivity CRP assay and the absence of adjustment for a family history of cardiovascular disease or physical activity.

There is evidence that early postnatal nutrition can influence long term cardiovascular risk factors and the propensity for developing cardiovascular disease.²⁻⁵ It has been hypothesised that accelerated early growth may explain the adverse long term cardiovascular effects of a nutrient enriched diet in infancy.⁸ Breast fed infants have slower early growth and subsequently have a lower risk of multiple cardiovascular risk factors than formula fed infants.⁸ Our findings of lower CRP with an increased duration of breast feeding in women are consistent with the growth acceleration hypothesis.

Authors' affiliations

M J A Williams, Department of Medical and Surgical Sciences, University of Otago, Dunedin, New Zealand

S M Williams, R Poulton, Department of Preventive and Social Medicine, University of Otago

Funding: data collection was supported by grants from the National Heart Foundation of New Zealand, the University of Otago (Otago

Research Grant), NIMH Grants MH45070 and MH49414, and the WT Grant Foundation. The funding sources had no involvement in the performance of the study or the writing of the manuscript.

Competing interests: none declared

Correspondence to: Dr M Williams, Department of Medical and Surgical Sciences, University of Otago, 201 Great King Street, Dunedin, New Zealand; michael.williams@otago.ac.nz

Accepted for publication 17 October 2005

REFERENCES

- 1 **Ridker PM**, Rifai N, Rose L, *et al*. Comparison of C-reactive protein and low-density lipoprotein cholesterol levels in the prediction of first cardiovascular events. *N Engl J Med* 2002;**347**:1557-65.
- 2 **Marmot MG**, Page CM, Atkins E, *et al*. Effect of breast-feeding on plasma cholesterol and weight in young adults. *J Epidemiol Community Health* 1980;**34**:164-7.
- 3 **Kolacek S**, Kapetanovic T, Zimolo A, *et al*. Early determinants of cardiovascular risk factors in adults. A. Plasma lipids. *Acta Paediatr* 1993;**82**:699-704.
- 4 **Fall CH**, Barker DJ, Osmond C, *et al*. Relation of infant feeding to adult serum cholesterol concentration and death from ischaemic heart disease. *BMJ* 1992;**304**:801-5.
- 5 **Singhal A**, Cole TJ, Fewtrell M, *et al*. Breastmilk feeding and lipoprotein profile in adolescents born preterm: follow-up of a prospective randomised study. *Lancet* 2004;**363**:1571-8.
- 6 **Elley WB**, Irving JC. The Elley-Irving socio-economic index 1981 census revision. *N Z J Educ Stud* 1985;**29**:115-28.
- 7 **Sears MR**, Taylor DR, Poulton R. Breastfeeding and asthma: appraising the controversy—a rebuttal. *Pediatr Pulmonol* 2003;**36**:366-8.
- 8 **Singhal A**, Lucas A. Early origins of cardiovascular disease: is there a unifying hypothesis? *Lancet* 2004;**363**:1642-5.