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## Knowledge Exchange Seminar Series (KESS)

### **Breastfeeding Promotion as an Economic Investment**

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#### **Introduction: Economic Benefits of Public Health Programmes**

Public health programmes play an important role in contributing to the wellbeing of a country's population. Cost-effective interventions which have direct effects on population health are likely to be a productive use of government funds, particularly where there are long run benefits which allow returns to accumulate over time. While improving population health is often a policy goal on its own, being healthy also conveys advantages for other aspects of our lives, including, but not limited to, socialising, leisure, and engaging in economic activity such as labour market participation. Because the health of a population is important for productivity, an economic case can be made for investing in public health programmes. Evaluating the return on investment of public funds spent on public health programmes is important for providing policy makers with a means of comparing the costs and benefits associated with spending in different domains.

***“An economic perspective is essential to provide policymakers and service commissioners with information to use in decision-making about spending priorities, especially in times of severe resource constraints.”***

(UNICEF UK, 2012 p.17)<sup>1</sup>

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<sup>1</sup> Preventing disease and saving resources: the potential contribution of increasing breastfeeding rates in the UK. Renfrew, Mary J.; Pokhrel, Subhash; Quigley, Maria; McCormick, Felicia; Fox-Rushby, Julia; Dodds, Rosemary; Duffy, Steven; Trueman, Paul; Williams, Anthony. London: UNICEF UK, 2012. 102 p.

[https://www.unicef.org.uk/babyfriendly/.../Preventing\\_disease\\_saving\\_resources.pdf](https://www.unicef.org.uk/babyfriendly/.../Preventing_disease_saving_resources.pdf)

Promotion of breastfeeding is one such public health programme for which the evidence supports substantial returns on investment. Social science and medical research indicates that experiences in childhood and infancy, including health and cognitive development, have lasting effects across the life cycle. It follows that the conditions experienced in childhood can have a long run impact in adulthood.

Because breastfeeding conveys important benefits for both children and mothers, it is important to consider these long run impacts when evaluating the effectiveness of interventions aimed at increasing breastfeeding. Furthermore, the health and economic effects of breastfeeding are also relevant for tackling socioeconomic inequalities in children's developmental potential. If opportunities to be breastfed are not equally distributed across groups, the advantages may be concentrated among a subset of the population. If children from families with greater resources are more likely to be breastfed, and breastfeeding subsequently conveys socioeconomic advantages in adulthood, these disparities can contribute to intergenerational transmission of disadvantage.

***“Thus not being breastfed is both a consequence and a cause of social inequalities, since babies who are not breastfed are more likely to develop ill health.”***

(UNICEF UK, 2012 p.17)<sup>1</sup>

In a context such as Northern Ireland where current rates of breastfeeding are low and there is substantial inequality according to parental background, economic returns to breastfeeding promotion programmes may be particularly high. This is important from a public health point of view because it suggests there are potential health and economic benefits that are being missed because of these low breastfeeding rates.

The purpose of this briefing is to provide a summary of the existing research on the health benefits of breastfeeding, as well as present new evidence on the direct long run effects of breastfeeding.

***“The health and economic costs of suboptimal breastfeeding are largely unrecognised. Investments to promote breastfeeding, in both rich and poor settings need to be measured against the cost of not doing so.”***

(The Lancet *Breastfeeding Series*, 2016 p.1)<sup>2</sup>

## Low rates of breastfeeding in Northern Ireland

A number of studies have highlighted the relatively low rates of breastfeeding in Northern Ireland, which has the lowest rates of breastfeeding within the United Kingdom, and also compares less favourably to the Republic of Ireland. The most recent data reported by the Institute of Public Health (based on the 2015/16 Northern Ireland Child Health System - CHS) show that 46% of babies in Northern Ireland received any breastmilk on discharge from hospital, with 21% receiving some breastmilk at three months. This contrasts with 58% (based on the 2015 National Perinatal Reporting System) and 35% (based on data from the Health Service Executive), respectively, in the Republic of Ireland.<sup>3</sup> According to a recent report from the Royal College of Paediatrics and Child Health, 73% of women in England initiated breastfeeding in 2015/6.

Moreover, at 6 months only 13% of babies were breastfed in Northern Ireland (according to the 2014/5 CHS), compared to 34% in the UK as a whole. Other European countries perform substantially better, for example in Norway the corresponding figure is 71%. To put this in context, the World Health Organisation recommends exclusive breastfeeding for the first 6 months, and then complementary foods and continued breastfeeding up to two years and beyond (Kramer and Kakuma, Cochrane Review, 2009).

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<sup>2</sup> Rollins, N.C., Bhandari, N., Hajeerhoy, N., Horton, S., Lutter, C.K., Martines, J.C., Piwoz, E.G., Richter, L.M., Victora, C.G., 2016. Why invest, and what it will take to improve breastfeeding practices? *The Lancet* 387, 491–504.

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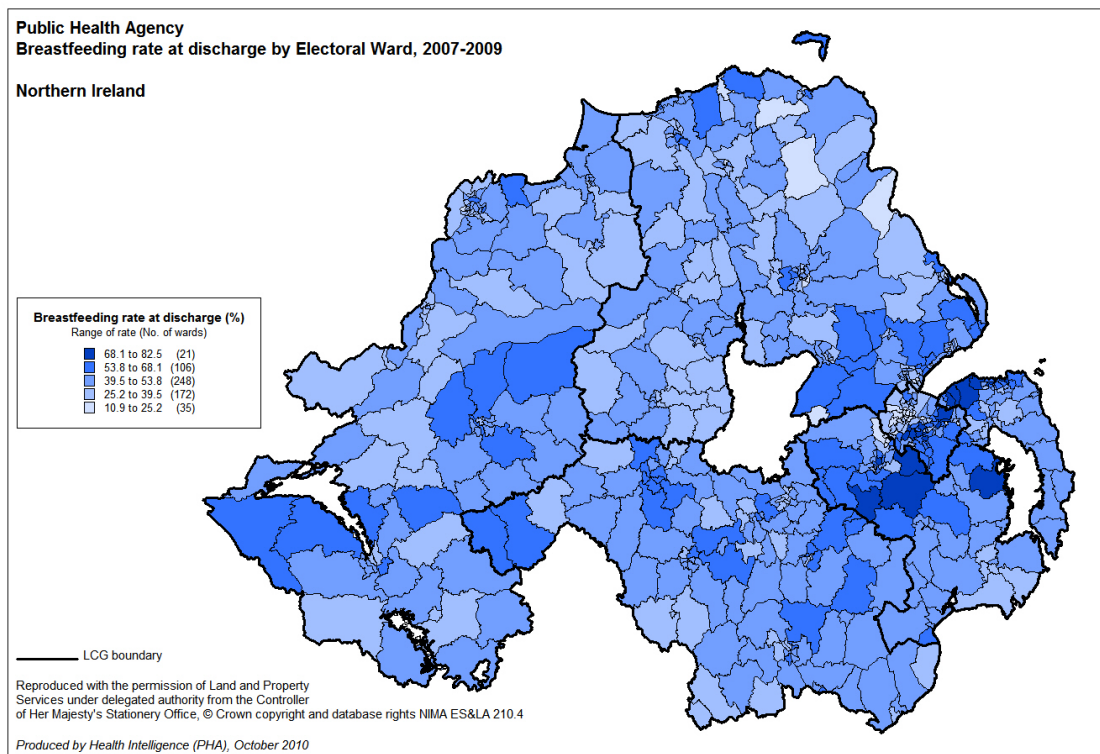
<sup>3</sup> Purdy, J. McAvoy, H. Cotter, N. (2017). Breastfeeding on the island of Ireland. Dublin: Institute of Public Health in Ireland.

[https://www.publichealth.ie/sites/default/files/2017105%20Breastfeeding%20on%20the%20island%20of%20Ireland%20report%20finalf\\_0.pdf](https://www.publichealth.ie/sites/default/files/2017105%20Breastfeeding%20on%20the%20island%20of%20Ireland%20report%20finalf_0.pdf)

There is also substantial variation within Northern Ireland. According to the breastfeeding strategy report by the Department of Health, Social Services and Public Safety (published in 2013), breastfeeding rates at discharge in the period 2007-2009 ranged from around 25% in some electoral wards to over 75% in others. These data are shown in **Figure 1** below.<sup>4</sup>

These differences are strongly patterned by family socioeconomic status: those in the least deprived wards were on average twice as likely to breastfeed as those from the least deprived wards. This finding was supported in the latest available data from Northern Ireland. In 2015, rates of (attempted) breastfeeding were 41.4% among mothers from the most deprived Super Output Areas (SOAs), compared to 71.0% among those living in the least deprived SOAs (Public Health Agency, 2016).

*Figure 1 Geographic Variation in Breastfeeding in Northern Ireland (Source: DHSSPS, 2013)*



## Health Benefits of Breastfeeding for Mothers and Children

There is a substantial body of evidence which supports the existence of important health benefits of breastfeeding, both for mothers and for children. Importantly, these effects are not only present in the short run, but also apply in the medium and long terms, which will be relevant when considering the economic benefits of breastfeeding. There are a number of recent reviews of this literature which summarise the research on this topic. For example, the 2016 Lancet series on breastfeeding concluded that extending breastfeeding to near universal levels could save around 800,000 child deaths per annum worldwide. In addition, because of the protective effects of breastfeeding for cancer, this could save a further 20,000 deaths per year among mothers.

***“Findings from studies done with modern biological techniques suggest novel mechanisms that characterise breastmilk as a personalised medicine for infants.”***

<sup>4</sup> Breastfeeding - A Great Start. A Strategy for Northern Ireland 2013-2023. Department of Health, Social Services and Public Safety. 2013. <https://www.health-ni.gov.uk/sites/default/files/publications/dhssps/breastfeeding-strategy-2014.pdf>

(The Lancet *Breastfeeding Series*, 2016 p.2)<sup>5</sup>

In a 2017 review, the Institute for Public Health reported on the evidence of the effects of breastfeeding on health. For children, strong support was found for a protective link between breastfeeding and the following health conditions: otitis media (ear infection), diarrhoea, respiratory infections, allergic rhinitis, Sudden Infant Death Syndrome, and childhood overweight. For women, support was found for a protective link between breastfeeding and breast cancer, ovarian cancer, and type 2 diabetes. There are also other potential effects which have not yet been assessed with sufficient evidence, for example on osteoporosis and blood pressure. Further research on this topic is important for quantifying the magnitude and extent of health benefits of breastfeeding, but even those already documented imply substantial health improvements.

## Benefits of Breastfeeding for Child Cognitive Development

There are several studies which examine the link between breastfeeding and child development, particularly the short run impact on child brain development and intelligence. The highest quality evidence comes from randomised control trials of breastfeeding interventions. The nature of randomised trials allows us to be more confident that the effect being measured is due to breastfeeding alone. Experimental evidence evaluating the effect of breastfeeding on child IQ comes from an analysis of a large-scale trial of maternity hospitals in Belarus, in which some hospitals were randomised to receive a breastfeeding promotion intervention modelled on the UNICEF and World Health Organisation Baby-Friendly Hospital Initiative (BFHI). The BFHI emphasises health care worker assistance with initiating and maintaining breastfeeding and providing postnatal breastfeeding support. Compared to mothers in control hospitals, mothers in intervention hospitals had higher rates of exclusive breastfeeding at 3 months and their children had higher intelligence measures at 6.5 years (Kramer et al., 2001).

There is also experimental evidence pointing to potential mechanisms through which the effect of breastfeeding on cognition operates. These include the provision of nutrients required for rapid brain development, namely long-chain polyunsaturated fatty acids that are not provided in formula milk. Animal and human research supports the hypothesis that these fatty acids are the vital components necessary to support development of the new-born brain. Other possible mechanisms exist including hormones and growth factors, cholesterol, or some combination of factors. One study randomised mothers of preterm infants who chose to breastfeed but were having difficulty to 3 interventions: standard formula, nutrient rich formula, or banked breast milk. They then conducted MRI scans of the participants in adolescence. They found that breast milk promotes brain development, particularly white matter growth, in a dose-response relationship (Isaacs et al., 2010).

## Previous Evidence on the Economic Effects of Breastfeeding

The health and cognitive benefits described above have corresponding economic benefits, by way of decreases in morbidity, mortality and health care expenditures, and subsequent increases in human capital investment (for example, education), and productivity and labour supply (when affected children reach adulthood). To the extent that breastfeeding is protective against chronic disease for both women and children, this would boost investment by diverting savings away from health treatment costs which do not contribute to economic growth (McGovern et al., 2017).

A recent report on this subject commissioned by UNICEF<sup>1</sup> examined the potential consequences of investment in effective services to increase and sustain breastfeeding rates in the UK. This study mainly adopted a cost of illness approach, where the predicted reductions in costs associated with diseases affected by breastfeeding were modelled. Moderate increases in breastfeeding (45% of women exclusively breastfeeding for four months, and 75% of babies in neonatal units being breastfed at discharge) are expected to save £17 million per year via decreases in infant-related gastrointestinal disease, respiratory disease, otitis media, and necrotising enterocolitis. These savings are accrued through fewer GP consultations, hospital admissions, and treatment costs. Results also found that if half of mothers who currently do not breastfeed were to breastfeed for up to 18 months in their lifetime, the estimated savings due to a reduction in lifetime breast cancer prevalence and associated health service costs would be £31 million per cohort of first-time mothers.

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<sup>5</sup> Victora, C.G., Bahl, R., Barros, A.J.D., França, G.V.A., Horton, S., Krasevec, J., Murch, S., Sankar, M.J., Walker, N., Rollins, N.C., 2016. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *The Lancet* 387, 475–490. [https://doi.org/10.1016/S0140-6736\(15\)01024-7](https://doi.org/10.1016/S0140-6736(15)01024-7)

Impacts on economic productivity are more difficult to model due to lack of adequate data, though the Lancet Breastfeeding series suggests these effects are very large. In our analysis, we are able to provide direct evidence on this question, using survey information on the current earnings of children who were breastfed in the 1950s in the UK.

**“Not breastfeeding is associated with lower intelligence and economic losses of about \$302 billion annually or 0.49% of world gross national income”** (The Lancet *Breastfeeding Series*, 2016 p.1)<sup>2</sup>

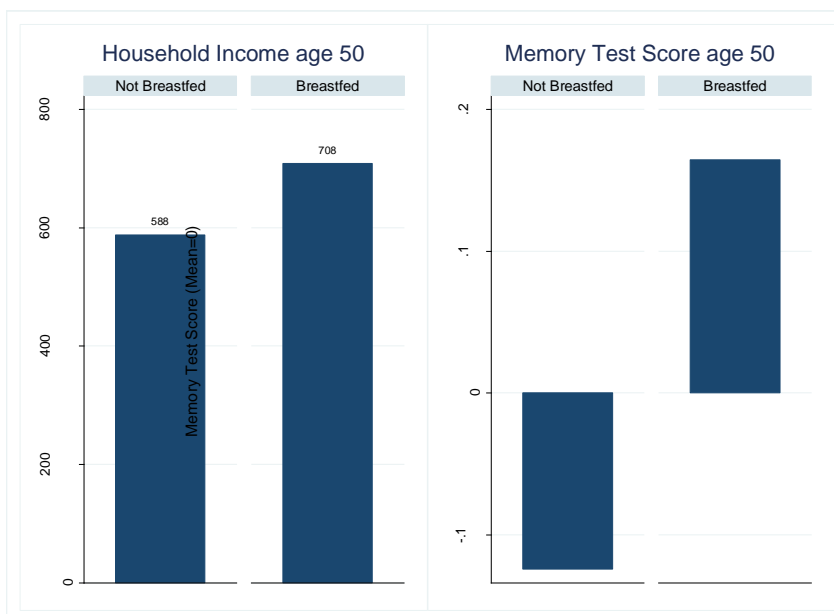
## Estimating the Effects of Breastfeeding on Long Run Outcomes

In our paper, we directly analyse long-run economic effects of breastfeeding for individuals. We use information from a survey which has tracked a nationally representative sample of babies born in England, Wales and Scotland in 1958. The National Child Development Study (NCDS) has followed these children since birth and continues to do so (cohort members are now in their 60s). These data provide valuable insights for a number of reasons. First, the survey collected information on whether the infants were breastfed (defined as having been breastfed for at least a month) in 1958 as reported by their mothers at the time, rather than retrospectively. Second, the data allow us to measure the economic and cognitive outcomes of cohort members as they age, which enables us to see whether those who were breastfed go on to enjoy economic and cognitive benefits across their life course. In total, there are around 9,000 cohort members for whom we have information at age 50 around 2008. These individuals reported their household income, and also participated in standardised tests during the survey which means we can measure their cognitive performance.

We observe a socioeconomic gradient in who was breastfed in our data in 1958 which is similar to the disparities currently observed in Northern Ireland. Mother’s education, father’s social class, and grandfather’s social class are all positively associated with the likelihood of being breastfed. The other positive predictor was birth weight, while mother’s age, mother’s BMI, mother’s smoking, non-standard birth, absence of ante-natal visits, number of previous births, multiple births, and region of birth (for those born in Scotland, Wales, and the North of England) were all negatively associated with being breastfed.

In order to assess whether breastfeeding confers long run economic benefits, we measured the current income, memory, and cognitive processing speed of cohort members. We examined whether these outcomes were higher for those who were breastfed as infants in 1958 compared to those who were not breastfed in 1958. A summary is shown in **Figure 2**. Those who were breastfed have an average weekly household income of £588 at age 50, compared to £708 for those who were breastfed. Likewise, those who were breastfed score around 0.2 standard deviations higher on a standardised memory test. This test is normalised to have a mean of 0 overall in the population, and this difference between being breastfed and not breastfed is similar to the memory gradient associated with maternal education (the gap in memory scores of children born to mothers with the lowest levels of education compared to the highest).

Figure 1 Association between Being Breastfed and Outcomes at Age 50





However, this represents a correlation, and does not necessarily demonstrate that breastfeeding causes higher incomes or better memory at age 50. Therefore, we also implemented statistical regression models which allow us to adjust for other factors available in the data which could provide alternative explanations for these results. For example, the associations we observe with breastfeeding could be due to the fact that those who were not breastfed in 1958 came from more disadvantaged backgrounds, and it could be this factor rather than breastfeeding per se which determines their outcomes at age 50. Using a simultaneous equation approach which allows for flexible modelling of correlation structures (Marra et al., 2017; Marra and Radice, 2011), we also test whether there are potential unobserved factors which could be biasing our estimates (which we find no evidence of). A summary of these findings are shown in **Table 1**.

Point estimates, our best measure of the breastfeeding effects, and corresponding confidence intervals (which show a range of values capturing the fact that these estimates are uncertain) are shown in parentheses. Memory and cognition are measured in standard deviation units, therefore an estimate of 0.15 indicates that those who were breastfed score 0.15 standard deviation units higher on the memory test. There is no evidence of an effect on cognitive processing speed as this point estimate (-0.01) is close to 0 and not statistically significant (the confidence interval includes 0). The effect of household income is measured on the log scale, and therefore a point estimates of 0.10 indicate that those who were breastfed have incomes which are 10% higher on average at age 50.

*Table 1 Regression Estimates for the Effect of Breastfeeding on Outcomes at Age 50*

Outcome	Breastfeeding Effect at Age 50
<b>Cognition: Memory</b>	<b>0.15***</b>
(In Standard Deviation Units)	(0.07 - 0.23)
<b>Cognition: Processing</b>	<b>-0.01</b>
(In Standard Deviation Units)	(-0.08 - 0.07)
<b>Log Household Income</b>	<b>0.10***</b>
(In Percent)	(0.04 - 0.15)

95% Confidence Interval in Parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## Assessing the Economic Potential for Breastfeeding Intervention Programmes in Northern Ireland

We can use these estimates to begin to quantify the direct long run economic benefits of being breastfed, and ask how much extra income this would generate over the course of a lifetime. The additional 10% we estimate is substantial in magnitude, and compares very favourably with other economic-focused interventions which have been studied in social science. For example, it is comparable to the estimates of the effects of an additional year of schooling (e.g. Dickenson, 2014). However, an additional year of schooling is very expensive compared to breastfeeding interventions; average school spending per pupil by the government in England is roughly £6,000 per annum, and this does not even represent the full economic cost.

In contrast, based on the literature on breastfeeding interventions, it should be possible to achieve an additional breastfed child for between £150 and £200. Based on the 10% estimate above, this implies the cost-benefit ratio and return on investment associated with these programmes should be substantial based on the direct economic effects alone. For example, if we take the assumption that a cohort member will work for 45 years on average and have a constant household income of £20,000, then a 10% increase for those who were breastfed would translate into a net present value of gross lifetime benefits of around £45,000 (discounted at the National Institute for Health and Care Excellence-recommended rate of 3.5% to account for the fact that benefits in the future are considered less valuable). This translates into a tax gain to the government of around £9,000 assuming one working person in the household earning on the lower rate. There are around 24,000 births in Northern Ireland annually, therefore a small increase in breastfeeding of 10% would translate into a gross gain in net present value per annual birth cohort of £108 million, or £21.6 million in additional tax revenue alone. In contrast, the costs of such a programme set at £200 per additional breastfed child would be less than £500,000. These estimates are quite conservative in the sense that they purely capture the direct economic effects, and not any of the savings in health expenditures

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described above. Including these additional savings would only further raise the estimates of the economic return to breastfeeding intervention programmes. What is clear is that these benefits are large compared to programme costs.

This calculation is intended to illustrate the implied magnitude of the breastfeeding benefits, and is not designed to be a definitive estimate. Further analysis is required, including to take account of the uncertainty inherent in these estimates as well as age/cohort earnings and tax profiles. It is also important to acknowledge the limitations of this analysis. Although they represent the best estimates we have of the direct effect of breastfeeding on economic outcomes, these data are not from a randomised trial and we should therefore be appropriately cautious in interpreting the results. There is also further research to be done in terms of external validity (the extent to which we can generalise the results from those born in 1958 in England, Wales and Scotland to those born today in other locations), and how breastfeeding is measured (such as estimating the effect of exclusive and non-exclusive breastfeeding up to various ages).

We can use this analysis to consider whether there is potential for additional large-scale breastfeeding interventions in Northern Ireland to complement those already being promoted by local organisations such as Health and Social Care services and community organisations. The cost benefit ratios implied by the above indicate that such programmes would be likely to have substantial returns and should be viewed as economic investments. Just as importantly, the evidence supports there being potential for cost-effective interventions which are likely to be successful at raising breastfeeding rates. It is beyond the scope of this review to identify the features of high-quality programmes, but there are several literature reviews which provide a summary of such interventions.<sup>3 6 7</sup>

The UNICEF report on breastfeeding in the UK considered the potential impact of a large-scale programme to be conducted in Lancashire.<sup>1</sup> Although somewhat smaller than Northern Ireland in terms of population and fertility, this case study may be useful for demonstrating the feasibility and benefits of a similar intervention here. The authors suggest a programme cost of £446,300 in its first year, with a recurring annual cost of around £329,300. Based on their cost of illness analysis, they estimate potential short-term cost savings of £355,000 per year. Therefore, even on the basis of only the reduced treatment costs for the four acute infant diseases they consider, such an intervention could be economically attractive.

When our direct estimates on income are added to this, the potential benefits imply an even greater return on investment. Not only could breastfeeding promotion interventions provide a positive impact on population health in the short-term, but in the longer run the evidence supports the hypothesis that these public health programmes could raise human capital and productivity across the life course and therefore constitute a viable economic investment strategy.

INDEX TERMS: Maternal and Child Health, Health Economics, Return on Investment, Breastfeeding, Cost-Effectiveness

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<sup>6</sup> Interventions that promote increased breastfeeding rates and breastfeeding duration among women. An umbrella review. Marie Sutton, Emma O'Donoghue, Martin Keane, Louise Farragher, Jean Long. Health Research Board. Dublin. 2016. [http://www.hrb.ie/uploads/tx\\_hrbpublications/Interventions\\_that\\_promote\\_increased\\_breastfeeding\\_rates\\_2016.pdf](http://www.hrb.ie/uploads/tx_hrbpublications/Interventions_that_promote_increased_breastfeeding_rates_2016.pdf)

<sup>7</sup> McFadden, A., Gavine, A., Renfrew, M.J., Wade, A., Buchanan, P., Taylor, J.L., Veitch, E., Rennie, A.M., Crowther, S.A., Neiman, S., MacGillivray, S., 2017. Support for healthy breastfeeding mothers with healthy term babies, in: Cochrane Database of Systematic Reviews. <https://doi.org/10.1002/14651858.CD001141.pub5>

