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# Breastfeeding promotion and priority setting in health

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An increase in exclusive breastfeeding prevalence can substantially reduce mortality and morbidity among infants. In this paper, estimates of the costs and impacts of three breastfeeding promotion programmes, implemented through maternity services in Brazil, Honduras and Mexico, are used to develop cost-effectiveness measures and these are compared with other health interventions. The results show that breastfeeding promotion can be one of the most cost-effective health interventions for preventing cases of diarrhoea, preventing deaths from diarrhoea, and gaining disability-adjusted life years (DALYs). The benefits are substantial over a broad range of programme types. Programmes starting with the removal of formula and medications during delivery are likely to derive a high level of impact per unit of net incremental cost. Cost-effectiveness is lower (but still attractive relative to other interventions) if hospitals already have rooming-in and no bottle-feeds; and the cost-effectiveness improves as programmes become well-established. At an annual cost of about 30 to 40 US cents per birth, programmes starting with formula feeding in nurseries and maternity wards can reduce diarrhoea cases for approximately $0.65 to $1.10 per case prevented, diarrhoea deaths for $100 to $200 per death averted, and reduce the burden of disease for approximately $2 to $4 per DALY. Maternity services that have already eliminated formula can, by investing from $2 to $3 per birth, prevent diarrhoea cases and deaths for $3.50 to $6.75 per case, and $550 to $800 per death respectively, with DALYs gained at $12 to $19 each.

## Introduction

The importance of breastfeeding, particularly the protective effects of exclusive breastfeeding in the first 6 months of infancy against mortality,* and diarrhoea incidence and severity, is well-established.[1–5] Yet, in almost all countries where data are available, actual feeding practices fall well below internationally recommended standards, with the duration of any breastfeeding very short in several countries, and exclusive breastfeeding practices rare beyond the first few weeks.[6,7] Studies on the determinants of infant feeding practices have shown that health facilities practices and health professionals can have a significant effect.[8–11] Among the breastfeeding promotion interventions, one approach which has received considerable attention is the promotion of breastfeeding in health facilities, particularly at the time of birth. This includes education and support for mothers, and changing hospital routines to establish early breastfeeding contact, rooming-in of babies with mothers, withdrawal of routine bottle feeding, and post-partum counselling.[12] While there is some evidence that such programmes have an impact on breastfeeding practices,[13–15] most studies have methodological limitations or have been research studies, conducted under controlled conditions. Reliable estimates of programmes under field conditions have not been available and the costs of such programmes have rarely been measured.[5,16]

It is difficult to argue convincingly for investment in the area of breastfeeding promotion without having better information on the impacts and costs of such programmes. Governments and donors have become acutely aware of the reality of resource scarcity and are beginning to demand that health budgets give priority to interventions with a proven record of reducing the burden of illness substantially and at low cost.

This paper offers a contribution to the growing literature on the cost-effectiveness of health interventions. It presents evidence from a field study of the cost and effectiveness of three breastfeeding promotion programmes in Latin America, compares these findings with data from other health interventions and draws conclusions about the relative attractiveness of investment in health facilities-based breastfeeding promotion. Details of various aspects of this study's methodology and findings, including a paper on internal efficiency issues, can be found in companion papers.[17-20]

## Methodology

Cost-effectiveness estimates for each programme were generated in several steps. The first step was the direct measurement of the impact on breastfeeding practices and costs of promotion activities in three hospitals which have well-developed programmes, using three other control hospitals to establish baseline breastfeeding and cost levels. To enable a comparison of the breastfeeding promotion activities with other health interventions, it was necessary to translate the data on breastfeeding impact into more generalizable health units, i.e. mortality and morbidity reduction. There is a substantial body of data documenting the effect of breastfeeding practices on morbidity and mortality risk. We drew selectively on this data in order to translate differences in breastfeeding behaviour measured in our study, into mortality and morbidity effects. The mortality estimates were themselves then used as the basis for deriving estimates of disability-adjusted life years (DALYs) gained, an indicator promoted by the World Bank for comparing health interventions.[21-22] The mortality, morbidity and DALY impacts were (separately) combined with cost data to generate a set of cost-effectiveness measures. The following sections provide details on each of these steps.

### Estimating impact on breastfeeding practices

As no baseline was available for measuring the improvements in breastfeeding practices at each programme hospital, a cross-sectional design was used. Three pairs of hospitals were selected for comparison, one each in Brazil, Honduras and Mexico, based on similarity of client populations served and location in the same city. One hospital in each pair served as the control and the other, with a well-developed programme of breastfeeding promotion, served as the experimental hospital. All are government-funded hospitals serving low-income groups; the programme hospital in Honduras is financed and administered by the Social Security Institute. The programme in Brazil is the longest established (since 1975); the programme in Honduras began in 1984 and the one in Mexico began in 1989.

Data collection in Santos (Brazil), San Pedro Sula (Honduras) and Mexico City (Mexico) was undertaken during April 1992 to March 1993. Between 200 and 400 women in each hospital were interviewed prior to exit from the hospital and their exposure to breastfeeding promotion was measured using 28 variables.[b] The programme exposure variables include: practices in the delivery room, formula feeding and rooming-in experiences in maternity wards and nurseries, education and counselling, and breastfeeding activities during pre- and post-natal check-ups. In addition to hospital exit interviews, the women were followed up in their homes at one month in all countries and again at two (Brazil), three (Honduras) or four (Mexico) months to determine breastfeeding practices. Age at second follow-up was based on feeding problems and outcome indicators of greatest relevance for each country. For example, exclusive breastfeeding is the central issue for Honduras and Brazil, and duration of any breastfeeding for Mexico; and these parameters demonstrate the greatest declines at the ages selected for second follow-up.

There were no significant differences in the women lost to follow-up in Brazil or Honduras; however, more working women and lower income women dropped out than remained in the study in Mexico City hospitals. The women in control and programme hospitals within each country had similar characteristics in terms of age, parity, years of education, birth weight and sex of newborn, work status, household possessions index and past breastfeeding experience.

Infant feeding practices measured at the second household follow-up interview were used, based on a 24–hour recall in which the mother was asked to identify all liquids and solids consumed by the infant from the time it awoke the previous day to the same time on the day of the interview. Feeding practices were then categorized as exclusive, partial or no breastfeeding. Exclusive is defined as not consuming anything but breastmilk – no water, tea or juice. However, the vast majority of partially breastfed

infants in all three countries were consuming other milks in addition to water and teas.[23] The proportions of infants exclusively, partially and not breastfed in the programme and control hospitals in each country were used as a measure of programme impact.[c]

### Estimating reductions in mortality and morbidity

Using risk ratios and numbers of cases and deaths from diarrhoea and ARI estimated by recent investigations in the Latin America region, the observed differences in breastfeeding practices were translated into differences in diarrhoea morbidity rates and respiratory and diarrhoeal mortality.[d] For diarrhoea and ARI mortality relative risk by breastfeeding status, we used the conservative results of Victora et al.[4,24] which are also geographically relevant to our case.[e] In this case-control study, conducted in two urban areas of southern Brazil, each of 170 infants who died from diarrhoeal disease after the age of 7 days were compared with two neighbourhood controls, and relative risks are estimated after controlling for age, occupation of the head of household, birth weight, type of housing, water supply and preceding birth interval. The estimated relative risks of diarrhoeal morbidity are drawn from a similar study from southern Brazil.[26]

The proportionate reduction in mortality and morbidity risk was calculated as:

$$(TAR_{\text{Control group}} - TAR_{\text{Intervention group}})/TAR_{\text{Control group}}$$

where: TAR = total attributable risk = $(1*EBF) + (RR_{pbf} * PBF) + (RR_{nbf} * NBF)$

and:
- EBF = proportion of infants exclusively breastfed
- $RR_{pbf}$ = risk of mortality/morbidity in partially breastfed group relative to exclusively breastfed infants
- PBF = proportion of infants partially breastfed
- $RR_{nbf}$ = risk of mortality/morbidity in the non-breastfed group relative to exclusively breastfed infants
- NBF = proportion of infants not breastfed

Based on calculations of the proportion of deaths and morbidity averted from differences in breastfeeding practices and relative risks, the number of cases and deaths averted was calculated by multiplying this difference in morbidity and mortality risk by the baseline morbidity and mortality rates for infants under 6 months. These are taken from the literature as follows:

- 3 episodes of diarrhoea per child per year for children under 6 months;[27,28]
- 13.5 diarrhoea deaths per year per 1000 children under 6 months, based on an annual rate of 20.2 diarrhoea deaths per 1000 children under 12 months[29] and an estimated two-thirds of these occurring in children under 6 months;[30–32]
- 10 ARI deaths per year per 1000 children under 6 months, based on an annual rate of 15 ARI deaths per 1000 children under 12 months with an estimated two-thirds of these occurring in children under 6 months.

Use of these numbers of diarrhoea cases and deaths from diarrhoea and ARI assumes that there are no benefits after the first 6 months – a conservative assumption given that relative risks are in fact slightly greater than 1 in the second half of infancy. Also, mortality from other infections (shown to be 2.5 times greater in non-breastfed infants as compared with exclusively breastfed infants by Victora et al.[4]) are not included. The results therefore capture the bulk of the impact of the interventions on mortality and morbidity but not all, and our estimates should be considered the lower bound for actual values.

### Estimating additional disability-adjusted life years (DALYs)

The DALY indicator combines the impacts on lives saved with disability prevented, discounts and weights the years of life based on age, thus allowing comparisons across varied health interventions, with different health outcomes. It also permits comparisons across interventions with longer- versus shorter-term benefits and benefits accruing to different age groups. For global estimates, the World Bank[21] suggests that the death of an infant (girls and boys do not differ significantly) is equivalent to the loss of approximately 32.5 disability adjusted life years (DALYs). This is based on life expectancy of 80 years in a low-mortality population, a 3% discount rate for the value of future years of life saved, and age weights which rise steeply from 0 at birth to a peak at age 25, and taper off with age. For this analysis, we multiplied the number of diarrhoea and ARI deaths averted per

year by 32.5 to provide a conservative estimate of the total DALYs gained from the intervention per year. This does not include any effect on total DALYs of morbidity due to inadequate breastfeeding.

### Estimating costs and cost-effectiveness

The costs of breastfeeding promotion activities at the control hospitals were compared with those at programme hospitals to obtain an incremental cost which represents the value of resources used to achieve the measured impacts. Programme maintenance costs were the main focus of the study. Start up, and one-time activity costs are not included. Programmes for breastfeeding promotion seldom involve large set-up or capital investments to get started. In the programmes included here, start-up occurred over a variable period, and in Brazil and Honduras several years ago, making it difficult to accurately estimate these costs. Also, sustainability is likely to be more a function of recurring, maintenance costs than one-time costs.

The costing methodology is based on classical approaches developed by Mills et al.[33] and Phillips et al.[34] and extensively used in health programme planning and analysis.[35] Each hospital programme was first carefully elaborated in terms of activities undertaken for breastfeeding promotion. The nature and level of resources associated with each activity were then determined. This included disaggregating the time of multi-purpose staff and attributing proportions of staff time, space, materials and equipment to breastfeeding services delivered. Unit costs were obtained from expenditure records, market prices or replacement costs. Donated goods were valued at market prices.

From the profile of total costs developed, the difference in costs between breastfeeding activities at programme and control hospitals – incremental cost – was obtained. Savings due to reduced formula and other supplies were then subtracted from incremental costs to obtain net incremental costs.[f] For each programme hospital, the net incremental cost of breastfeeding activities for one year (1992) was estimated. A depreciation rate of 3% was used to calculate the annual costs for capital goods. Costs and savings are expressed in 1992 prices for Honduras and Mexico and 1993 prices for Brazil.[36–38] For the Brazil programme, Fiedler[38] provides estimates for a range of scenarios. We use the estimates that best reflect typical practices at a service hospital (the programme Brazil hospital is a teaching hospital). Postnatal clinics are estimated to dedicate 50% of their resources to breastfeeding activities and nurse salaries have been substituted for salaries of physician trainees (medical residents) in the postnatal clinics. For Honduras, it was assumed that the programme could be targeted to non-working women at the same cost per birth as the current programme which covers all women, working and non-working.

A set of cost-effectiveness indicators were derived by dividing annual net incremental costs by the estimated annual number of (i) cases of diarrhoea averted; (ii) diarrhoea deaths averted; and (iii) DALYs gained (including both diarrhoeal and ARI deaths averted). Since the objective of this analysis is to determine relative priorities among health interventions, the data on costs and effectiveness are combined to provide as close a valid comparison as possible to cost-effectiveness estimates for other interventions. The World Development Report[21] and Jamison and Moseley[22] provide the most recent estimates for other health interventions which are used here for comparisons. The principles used for developing estimates are also used here for estimating the cost-effectiveness of breastfeeding strategies. For comparisons with diarrhoeal control interventions we estimate the cost of breastfeeding promotion per diarrhoea case averted and per diarrhoea mortality prevented; for comparisons across all health interventions, cost per DALY gained is used.

In the cases of Honduras and Brazil, cross-sectional comparisons of the programme hospital net incremental costs do not adequately capture the cost-effectiveness of breastfeeding strategies. For example, the full benefit of savings generated at programme hospitals from reductions in formula (and other modifications such as rooming-in) that occurred during the course of the development of the breastfeeding programme is not included because in both countries control hospitals already limit formula feeding to very few cases (and have instituted rooming-in). To illustrate this point, and to develop a more accurate estimate of cost-effectiveness when going from formula feeding to no/limited formula feeding, we estimated cost-effectiveness based on changes at the programme hospital over time. Under this scenario, according to recall by staff who were present at the time, breastfeeding activities were similar (during pre-1975, prior to the breastfeeding programme) to those currently practiced at the control hospital, in all respects except that approximately 50% of all infants were fed formula.

In all, 6 cost-effectiveness estimates were developed for each indicator as follows:

- Brazil (restricted formula and low education compared with restricted formula and high education): this is based on comparing current practices at the control hospital with current practices at the programme hospital;
- Brazil (50% formula and low education compared with restricted formula and high education): this is based on comparing pre-1975 practices with current practices, both at the programme hospital;
- Honduras (restricted formula and low education compared with restricted formula and moderate education): this is based on comparing current practices at the control hospital with the programme hospital;
- Mexico (mostly formula and low education compared with restricted formula and moderate education): this is based on comparing current practices at the control hospital with the programme hospital.

## Results

Differences in the nature, quality and intensity of promotional activities in the control and programme hospitals, as reported at exit by mothers who gave birth in the hospitals, are shown in Table 1. All infants (except those with severely ill mothers or having serious complications) were roomed in with their mothers in five of the six hospitals. The differences in breastfeeding promotions varied across and within countries. In the cases of Brazil and Honduras, it was essentially education and support that varied since even the control hospitals had well-established policies of rooming-in and very limited bottle-feeding. In the case of Mexico, routines such as rooming-in and no bottle-feeding are vastly different in the programme and control hospitals.

Table 2 shows the estimated additional cost per head of investment in breastfeeding promotion activities for the three programmes. It also shows the net costs when savings due to differences in bottle-feeding, rooming-in and drug routines are taken into account. This is shown for two scenarios in Brazil: 1) when compared with current norms and routines in control hospitals, and 2) when compared with the norms and routines that existed historically in the programme hospital.

The incremental annual costs of the four programmes were similar, in the range of US $2.61 to US $2.73 per birth. However, the costs are relative to different starting points. For example, in Mexico, the incremental cost reflects a start-up phase in which the total coverage with services is still low; in the cases of Honduras and Brazil the comparison is being made with a more advanced baseline (control hospitals which already have several breastfeeding activities underway). The levels of savings generated from changes in routines are also different because the level of formula use at baseline varies from 100% in Mexico to 50% in Brazil (historical) to almost no formula in Honduras and (current) Brazil. Net incremental costs of breastfeeding when moving from a situation of no rooming-in and high formula use (Mexico, pre-programme Brazil) are lower (US $0.28 to US $0.37 per birth). Net incremental costs are somewhat higher when moving from a situation of rooming-in with formula feeding already removed, where the main difference is in the quality and coverage of maternal education and counselling (US $2.01 to US $2.81 for Brazil and Honduras respectively).

The differences in breastfeeding practices in the three programme and control hospitals are presented in Table 3. Each of the three country studies found that any breastfeeding and exclusive breastfeeding were higher in the programme hospitals as compared with control hospitals.

In a separate analysis, Lutter et al.[20] compared differences in the duration of exclusive breastfeeding after controlling for differences in maternal characteristics in each pair of hospitals shown in Table 3, and found significant increases in Brazil and Honduras. In Brazil, median duration of exclusive breastfeeding increased from 22 days in the control to 75 days in the programme hospital. The difference for Honduras was 14 days in the control and 40 days in the programme hospital.[8] Differences in Mexico were not significant for exclusive breastfeeding (median durations being 6 and 7 days for control versus programme hospitals, respectively, after controlling for potential confounders). However, in Mexico, significant differences in probability of any breastfeeding were found after controlling for confounding variables.[19] This suggests that the breastfeeding programme was more effective in reducing the proportion of non-breastfeeders in Mexico, and the change from partial to exclusive breastfeeding was less dramatic. Although some *a priori* differences existed in each pair of (control and programme) hospital

**Table 1.** Differences in breastfeeding promotion activities in programme and control hospitals (% of mothers who answered yes during exit interviews)

| Coverage indicator | Brazil | | Honduras | | Mexico | |
|---|---|---|---|---|---|---|
| | Programme n=236 | Control n=206 | Programme n=501 | Control n=488 | Programme n=333 | Control n=247 |
| No formula feeding | 99.6 | 90.3 | 98.0 | 98.0 | 88.2 | 0.4*** |
| BF in delivery room | 65.3 | 2.2** | 39.3 | 39.3 | 3.9 | 0.6 |
| Help BF first time | 72.0 | 33.7*** | 30.3 | 9.4*** | 31.7 | 0*** |
| Shown how to express milk | 68.2 | 5.4*** | 23.4 | 24.0 | 25.3 | 17.1* |
| Info. on milk adequacy | 49.2 | 3.9*** | 17.8 | 9.7*** | 10.3 | 0.7** |
| Info. on how to increase supply | 61.0 | 5.3*** | 45.9 | 23.3*** | 20.6 | 8.3*** |
| Info. on when to start liquids | 32.6 | 2.9*** | 20.9 | 24.9 | 10.6 | 1.2*** |

Differences between pairs of hospitals are identified as follows: * $p \leq 0.05$, ** $p \leq 0.01$, *** $p \leq 0.001$

Data from Sanghvi et al. (1994)

**Table 2.** Annual costs of breastfeeding promotion activities (1992)

| | Brazil[1] | | Honduras[2] | | Mexico[3] | |
|---|---|---|---|---|---|---|
| | Programme | Control | Programme | Control | Programme | Control |
| Annual costs | 18 620 | 10 388 | 11 516 | 1 579 | 18 896 | 410 |
| No. births | 1623 | 1188 | 3895 | 10 590 | 7010 | 4790 |
| Annual costs/birth | 11.47 | 8.74 | 2.96 | 0.15 | 2.70 | 0.09 |
| Incremental cost/birth | 2.73 | | 2.81 | | 2.61 | |
| *Saving/birth:* | | | | | | |
| Compared with control | 0.72 | | 0 | | 2.34 | |
| Compared with pre-programme baseline | 2.36 | | | | | |
| *Net incremental cost/birth:* | | | | | | |
| Compared with control | 2.01 | | 2.81 | | 0.28 | |
| Compared with pre-programme baseline | 0.37 | | | | | |

[1] Brazil data are from Fiedler (1994). Fifty per cent of postnatal clinics are dedicated to breastfeeding activities, and salaries of nurses are used to compute costs of medical interns. Exchange rate US$1.00 = 22 000 cruzeiros.

[2] Honduras data are from Phillips (1993). Exchange rate US$1.00 = 5.7 lempiras.

[3] Mexico data are from Phillips (1993a). Exchange rate US$1.00 = 3.09 New Pesos

**Table 3.** Breastfeeding status in programme and control groups (%)

| Breastfeeding status | Brazil[1] | | Honduras[2] | | Mexico[3] | |
|---|---|---|---|---|---|---|
| | Programme n=193 | Control n=161 | Programme n=144 | Control n=245 | Programme n=175 | Control n=147 |
| Not breastfed | 23.7 | 35.4 | 0.6 | 4.1 | 42.3 (42.2) | 51.0 (53.6) |
| Partially breastfed | 32.9 | 44.7 | 56.7 | 73.7 | 51.9 (51.9) | 47.6 (45.1) |
| Exclusively breastfed | 43.4 | 19.9 | 42.7 | 22.2 | 5.8 (5.9) | 1.4 (1.3) |
| Total | 100 | 100 | 100 | 100 | 100 | 100 |

[1] Brazil data are for age 3 months, from Lutter et al. (1994).
[2] Honduras data are for age 2 months. From Lutter et al. (1994) (breastfeeding practices of non-working women only).
[3] Mexico data are for age 4 months, from Perez-Escamilla et al. (1993). Adjusted prevalences, after controlling for maternal attributes found to be associated with breastfeeding duration, are in parentheses, from Perez-Escamilla et al. (1995).

populations, the nature and magnitude of differences do not suggest a systematic bias that would alter the conclusions of this paper.[h]

Differences in breastfeeding behaviour were translated into percentage reduction in diarrhoea mortality, ARI mortality, and diarrhoea morbidity using relative risk ratios as shown in Table 4. Differences in the breastfeeding promotion activities were estimated to have had a substantial, favourable impact on diarrhoeal disease incidence and mortality and on ARI mortality, and, consequently, on DALYs gained.

The net cost and effectiveness data are combined in Table 5 to give the cost per case of diarrhoea averted, per diarrhoeal death averted and per DALY gained. The DALY estimate combines diarrhoea and ARI deaths averted.

In Table 6, cost-effectiveness comparisons of diarrhoea control interventions are shown using our analysis of breastfeeding promotion and estimates in the literature for oral rehydration therapy (ORT), cholera immunization, measles immunization, rotavirus immunization and promotion of hygiene.

## Discussion and conclusions

Using a quasi-experimental, opportunistic design to measure effects on breastfeeding practices, this study has documented the nature and level of impact that can be expected from field programmes that modify breastfeeding promotion practices in maternity services. It also identifies the resource implications of achieving these changes. This has enabled us to proceed with making some judgements about the relative efficiency and attractiveness of investing in hospital-based breastfeeding promotion compared with other health investments. In this section, we first compare our findings with previous estimates in the literature of the cost-effectiveness of breastfeeding promotion, followed by a discussion of the relative cost-effectiveness of breastfeeding promotion when compared with other health interventions.

We were not able to locate any other studies which have measured directly the cost and effectiveness of breastfeeding promotion programmes in hospitals. Indeed there are few credible economic evaluations of field programmes of any breastfeeding promotion intervention. In a review of potential diarrhoeal disease control strategies,[5,40] cost estimates of breastfeeding promotion activities were made, though these were retrospective reconstructions of the value of likely inputs for programmes whose impacts were measured, rather than direct measurements of costs. That exercise generated estimates for breastfeeding promotion (one of which was hospital-based promotion) ranging from (US$ 1992) $13 to $100 (median $60) per diarrhoeal episode averted and between $538 and $14 448 (median $1344) per diarrhoeal death averted. These are substantially higher than our new estimates.

Part of the difference is explained by the generous cost estimates for breastfeeding promotion activities in the hypothetical exercise – $7 per birth – more

**Table 4.** Mortality and morbidity impacts of differences in breastfeeding status

| Location of programme | Percentage reduction in: Diarrhoeal mortality | ARI mortality | Diarrhoeal morbidity | Per 1000 births: Diarrhoeal cases averted | ARI deaths averted | Diarrhoeal deaths averted | DALY gained |
|---|---|---|---|---|---|---|---|
| | a | b | c | d | e | f | g |
| Brazil | 27.1 | 15.9 | 18.7 | 561 | 1.59 | 3.66 | 171 |
| Honduras | 25.8 | 10.2 | 13.9 | 417 | 1.02 | 3.48 | 146 |
| Mexico: | | | | | | | |
| unadjusted | 10.9 | 8.3 | 8.5 | 255 | 0.83 | 1.47 | 75 |
| adjusted | 13.5 | 10.5 | 10.7 | 321 | 1.05 | 1.82 | 93 |

*Notes:*
a,b,c are derived from Table 3, using the following relative risks equations given in the text:

Relative risk of diarrhoeal mortality is from Victora et al. (1987), as follows: compared with exclusive breastfeeding = 1, partial breastfeeding = 4.2, no breastfeeding = 14.2

Relative risk of ARI mortality is from Victora et al. (1987), as follows: compared with exclusive breastfeeding = 1, partial breastfeeding = 1.3, no breastfeeding = 3.4

Relative risk of diarrhoeal morbidity is from Martines (1988), as follows: compared with exclusive breastfeeding = 1, partial breastfeeding = 1.65, no breastfeeding = 4.22

d = 3 × c (3 diarrhoea cases per child/year in children under 6 months)
e = 10 × b (10 ARI deaths per 1000 children/year in children under 6 months)
f = 13.5 × a (13.5 diarrhoeal deaths per 1000 children/year in children under 6 months)
g = (e + f) × 32.5 years (32.5 disability-adjusted life years gained per infant death prevented)

Adjusted estimates for Mexico reflect breastfeeding prevalences estimated when controlling for other confounding variables.

**Table 5.** Cost-effectiveness of hospital-based breastfeeding promotion

| | Birth[a] | Net cost (US$ 1992) per: Diarrhoeal case averted[b] | Diarrhoeal death averted[c] | DALY gained[d] |
|---|---|---|---|---|
| Brazil (current) | 2.01 | 3.58 | 549 | 11.78 |
| Brazil (historical) | 0.37 | 0.66 | 101 | 2.17 |
| Honduras | 2.81 | 6.74 | 807 | 19.21 |
| Mexico: | | | | |
| unadjusted | 0.28 | 1.10 | 190 | 3.75 |
| adjusted | 0.28 | 0.87 | 153 | 3.00 |

[a] From Table 2

[b] a × 1000/column f in Table 4

[c] a × 1000/column d in Table 4

[d] a × 1000/column g in Table 4

**Table 6.** Comparison of the cost-effectiveness of interventions for diarrhoea control

| Intervention[1] | Cost per case averted (US$ 1992) | | Cost per death averted (US$ 1992) | | Notes |
|---|---|---|---|---|---|
| | range | median | range | median | |
| Measles immunization | 4–80 | 9 | 89–1554 | 192 | Hypothetical estimates built up from individual cost components. Assumes addition of measles to existing EPI programme. Does not take into account current high coverage and thus higher incremental costs to raise coverage further. |
| Breastfeeding promotion: | | 1 | | 150 | Based on actual programme costs. Multiple benefits (e.g. ARI) not included. |
| from formula | 0.65–1 | | 100–200 | | |
| from no formula | 3.50–6.75 | | 550–800 | | |
| Oral rehydration therapy | NA | NA | 1344–13 440 | 2688 | Hypothetical programme. Median represents US$1.34 per case treated and for every 20 cases, one death averted. |
| Rotavirus immunization | 4–40 | 7 | 188–1882 | 296 | Hypothetical programme. Assumes 100% coverage, with 80% vaccine efficiency. |
| Cholera immunization | 121–1949 | 234 | 1445–22 458 | 2688 | Hypothetical programme. Assumes 100% coverage, with 85% vaccine efficiency. |
| Promotion of hygiene | 7–672 | 13 | NA | NA | |

[1] Cost-effectiveness estimates for all interventions except breastfeeding promotion are from Martines J, Phillips M and Feachem RGA (1993) 'Diarrheal Diseases' in *Disease Control Priorities in Developing Countries* (ed.) Jamison et al. (1993), World Bank. 1982 US$ have been adjusted to 1992 US$ assuming an average annual inflation rate of 3%.

than twice any of the costs per birth actually measured in our study. The rest is explained by the conservative assumption in that study that the reduction in non-breastfeeding infants (30%, very similar to the median 33% we measured in our study) translated solely into increases in partial, but not exclusive, breastfeeding, while our study found that there were substantial increases in exclusive breastfeeding in Honduras and Brazil.

The differences in cost-effectiveness among the three countries (in large measure explained by the savings component) are discussed in more detail in Phillips et al.;[18] however, it is worth noting here that the range of cost-effectiveness estimates obtained in this analysis is indicative of expected values for varying policy contexts. Clearly, when breastfeeding promotion is accompanied by a shift from substantial formula use to almost no formula feeding (Mexico, Brazil historical), the cost-effectiveness of the programme is likely to be high. The cost-effectiveness is lower when formula has already been removed (Honduras, Brazil current).

With reference to other interventions, our estimates suggest that breastfeeding promotion in hospitals competes very closely with measles and rotavirus vaccination as the most efficient option for diarrhoeal diseases control. This is dramatically obvious in cases where hospitals still use formula (e.g. Mexico, Brazil historical). Breastfeeding promotion is markedly more cost-effective than ORT and cholera immunization even when formula has already been withdrawn (e.g. Brazil current and Honduras).

In considering priorities for future investments, hospital-based breastfeeding promotion is likely to be relatively even more attractive in terms of expansion since, unlike the vaccination options, there are many areas without promotion programmes in hospitals and initial start-up or establishment costs are not large.[18] Furthermore, where programmes already exist, effective coverage is still generally low and the scope for expansion before reaching the point of diminishing returns, or encountering resistant pockets in the population, is likely to be considerable.

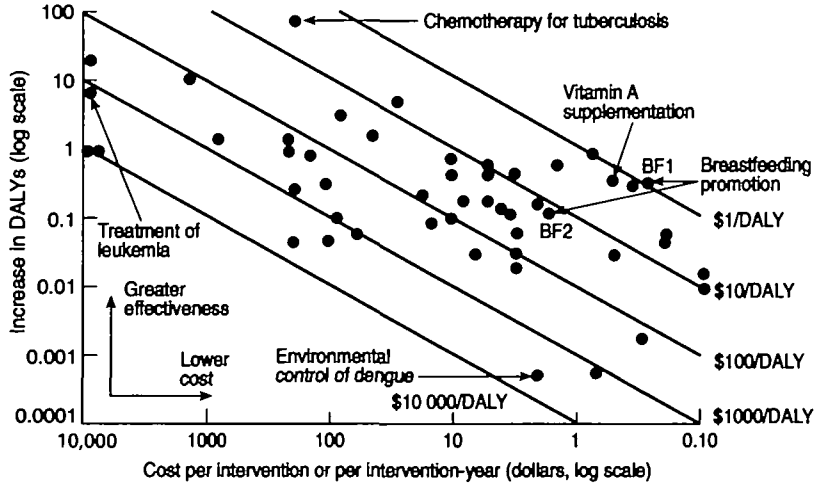
Using the DALY indicator, broader comparisons with other kinds of health interventions are possible (Figure 1). They reveal that investments in breastfeeding promotion are among the most cost-effective health interventions available. This applies not only to the case where formula is used prior to the intervention, but also to investment in education and support of mothers, even when reductions in formula use have already occurred.

This is an important finding. Altering routines has been an appealing option for policy-makers keen, in the current climate of financial constraint, to identify savings potential. What our results suggest is that to stop at the stage of changing hospital routines for formula feeding without completing the next step of establishing comprehensive support and educational activities for mothers, especially in the post-partum period, would be to miss out on a highly attractive health investment.

The budgetary requirements for maintaining breastfeeding promotion programmes are modest, and the payoffs large. At a net incremental cost ranging from about 30 to 40 US cents per birth, programmes starting with formula feeding in nurseries and maternity wards can reduce diarrhoea cases for approximately US$0.65 to US$1.10 each, prevent diarrhoea deaths for US$100 to US$200 each and reduce the burden of disease for approximately US$2 to US$4 per DALY. Maternity services that have already eliminated formula can, by investing from US$2 to US$3 per birth, prevent diarrhoea cases and deaths for US$3.50 to US$6.75 per case, and US$550 to US$800 per death respectively, with DALYs gained at US$12 to US$19 each.

We have considerable confidence in our conclusions not only because of the way in which key outcomes (breastfeeding practices) and costs were measured directly rather than imputed, but also because of the conservative approach we employed in measuring impact.[1] Modest assumptions were adopted where there was room for doubt about any values (for example, in the choice of mortality risks associated with breastfeeding practices, and by assigning a zero value to benefits from breastfeeding beyond 6 months of age). Several possibly important impacts were excluded altogether, such as the longer-term effects of promotion on breastfeeding practices with subsequent babies, the effect on birth spacing, and the effects on maternal and infant emotional health and development.

It is true that cost-effectiveness may differ in other contexts. In groups with a high proportion of women in the formal work force and without maternity leave protection, the impact of such programmes may be lower;[42] in areas where mortality and morbidity risks are different, the proportion of cases and deaths




BF1 = programmes moving from formula feeding to no formula and education (Brazil historical, Mexico)
BF2 = programmes investing in education and promotion after formula removal (Honduras, Brazil current)

**Figure 1.** Benefits and costs of health and nutrition interventions

averted and DALYs gained will change. In general, however, our results are likely to be broadly relevant to many developing country settings: they are based on interventions managed locally and implemented under normal field conditions, and not on controlled field or clinical trials, or pilot programmes with special external backing. The interventions were implemented in populations of poor, urban women with little education, a description which would fit a large proportion of developing country women. The interventions were implemented across a spectrum of rather different basic breastfeeding patterns, ranging from short durations (Mexico) to longer duration but very early supplementation (Honduras).

Countries where exclusive breastfeeding is not widely practiced in the early months, and where a significant proportion of women give birth in health facilities, should give priority to the promotion of breastfeeding in these facilities. There are both medical and economic arguments for establishing routines propitious to breastfeeding such as rooming-in and removal of formula feeding, and there is evidence from this study that investment in education and support can generate important changes in breastfeeding practices and that this is a highly efficient way of improving health status.

## Endnotes

[a] Evidence of an association of feeding mode with risk of mortality in infants comes from epidemiologic studies undertaken in several countries in Asia and Latin America. Breastfed infants are less likely to develop diarrhoea, complications such as severe dehydration when they do get diarrhoea, and have a lower risk of dying. Deaths due to respiratory infections are also lower. The risk of death is progressively worsened with a reduction in the amount of breastfeeding, from exclusive breastfeeding to partial breastfeeding to no breastfeeding at all; even the addition of juices, water and teas increases the risks. The impacts are most severe in early infancy, decline substantially after 6 months, and disappear after 12 months. The effects accrue from reduced exposure to contaminated bottle-feeds and from maternal anti-infective agents passed through breastmilk.

[b] Mothers were not eligible if they or their infants were seriously ill, were resident outside the city or did not wish to participate. In Brazil, criteria for exclusion also included birth weight $<2000$ grams, certain medications (lithium, thyroid and chemotherapy drugs), or if they planned to give their infant up for adoption.

[c] In separate analyses reported elsewhere, the increase in median duration of exclusive breastfeeding in Mexico, Brazil and Honduras,[20] and any breastfeeding for Mexico[19] was estimated through multivariate survival analyses. The results show that differences attributable to programme impact are statistically significant for exclusive breastfeeding durations in Honduras and Brazil, and for any breastfeeding (but not exclusive breastfeeding) in Mexico.

[d] The benefits of breastfeeding programmes in the early neonatal period are not captured in this study. These are substantial, as differences in in-hospital breastfeeding practices were large in Mexico and Brazil (historical), and differences in relative risks of mortality and morbidity due to breastfeeding practices are several-fold higher at younger ages.[4,25]

[e] An earlier review of several studies suggested that infants in the first 6 months of life who do not receive any breastmilk are about 25 times more likely to die and infants partially breastfed about 9 times more likely to die than those exclusively breastfed.[5] These rates are considerably higher than the ones we use.

[f] The savings generated from instituting rooming-in have not been included because detailed, reliable information was not available. A study conducted by Valdes et al.[39] compared separate recovery rooms for mothers and newborns postpartum recovery with mothers and newborns kept together in the same recovery room. Results indicated a 34% reduction in personnel time, and when $2000 was included for capital investments to make changes at start-up, depreciated over 10 years at 5%, cost of care per mother/infant pair declined from $3.57 to $3.05 (1992 US$). Our estimates of net incremental costs are likely to be higher because these savings were not included.

[g] Since the proportion and nature of employment in the two groups of women giving birth at these hospitals was different, and insufficient detail on the nature of employment was available to control for confounding through multiple regression analysis, these estimates were made for non-working women only. Eighteen per cent of the women at the control hospital worked compared with 61% of women at the programme hospital. It is very likely that the impacts of breastfeeding promotion in Honduras, and consequently cost-effectiveness, would be significantly less among working women.

[h] To test the effect of unadjusted versus adjusted prevalence, we estimated mortality, morbidity and DALYs using projected prevalence for any breastfeeding for Mexico from Perez-Escamilla et al.[19] The results showed a greater impact of the programme, with lower cost per unit of effectiveness. See Tables 4 and 5.

[i] Our estimates of mortality and morbidity reduction are considerably lower than those estimated, for example, on a population-wide basis by Monteiro et al.[41] for programme effects in São Paulo city.

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