Economic evaluation of home-based counselling to promote exclusive breastfeeding in Egypt

Bassam Y. Mohamed (bassamomda@alexu.edu.eg)  
Alexandria University  
Katarzyna Kissimova-Skarbek  
Jagiellonian University Medical College

Research Article

Keywords: Exclusive breastfeeding, economic evaluation, home-based counselling, DALYs, Egypt

Posted Date: March 24th, 2022

DOI: https://doi.org/10.21203/rs.3.rs-1450911/v1

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Corresponding author
Bassam Y. Mohamed, High Institute of Public Health, Alexandria University
MD, MPH
E-mail: bassamomda@alexu.edu.eg or bassam_omda@yahoo.com

Co-author
Dr. Katarzyna Kissimova-Skarbek, Faculty of Health Sciences, Department of Health Economics and Social Security, Jagiellonian University Medical College, Krakow, Poland
MSc, PhD
Email: kskarbek@uj.edu.pl
Abstract

Background

Home-based counselling interventions to scale up exclusive breastfeeding (EBF) rates have been shown to be effective in many countries. However, there is limited data regarding its effectiveness and cost-effectiveness in the Egyptian context. This study calculates the economic burden of not breastfeeding in Egypt, followed by an economic evaluation of a modelled intervention targeting new mothers to promote exclusive breastfeeding rates for 6 months.

Methods

Both monetary and non-monetary units of measurement were used to estimate the burden attributed to non-EBF due to diarrheal diseases, lower respiratory tract infections, and acute otitis media. Morbidity and mortality indicators: incidence, prevalence, and deaths were calculated then time lost measures. In addition, both the cost of illness and the value of statistical life approaches were used to reflect the burden of the diseases attributed to non-EBF in monetary terms.

A modelled home-based breastfeeding counselling intervention is adopted from the literature. The effectiveness of this intervention was based on 4 scenarios of decreasing the DALYs lost due to the 3 diseases attributed to non-EBF by 40%, 20%, 10%, and 5%. This is followed by conducting different economic evaluation analyses: cost-effectiveness analysis, cost-utility analysis, and cost-benefit analysis to determine the cost-effectiveness of this intervention.

Results

The cost of illness approach was calculated to be about 1.8 billion EGP in 2019. However, the value of statistical life approach revealed that the society’s willingness to pay to avoid the DALYs lost due to 3 diseases attributed to non-EBF ranged from 10 to 32 billion EGP. All the economic evaluation analyses showed that this home-based counselling intervention is cost-effective to scale up breastfeeding rates in Egypt with an incremental cos-utility ratio (ICUR) ranges from 5,520 to 44,158 EGP per each DALY averted. In addition, it will lead to annual benefits up to 12.4 billion EGP and a return on investment up to 28.8 EGP for each 1 EGP invested in this intervention.
Conclusion

Home-based counselling intervention is a very cost-effective intervention in promoting exclusive breastfeeding rates in Egypt. It is also a good investment for the government with a significant return on investment and huge cost savings.

Key Words

Exclusive breastfeeding, economic evaluation, home-based counselling, DALYs, Egypt
1. Background

1.1. Exclusive breastfeeding background

According to the World Health Organization (WHO), exclusive breastfeeding (EBF) is defined as “the infant receives only breast milk. No other liquids or solids are given – not even water – with the exception of oral rehydration solution, or drops/syrups of vitamins, minerals or medicines”.\(^1\) The WHO recommends that all babies should be exclusively breastfed from birth until 6 months of age.\(^2\)

Exclusive breastfeeding is extremely beneficial for both child and maternal health. It decreases the incidence and the severity of several infectious diseases among infants and children due to its sterile nature in comparison to other sources, especially in non-hygienic conditions, and its content of immune-related components such as secretory IgA, leukocytes, lysozyme, lactoferrin, and others.\(^3\)\(^-\)\(^4\) It is the main source of energy for children under the age of 2 years especially during critical illnesses, thus reducing morbidity and mortality related to malnutrition.

It has other several paediatric benefits as lower incidence of allergic diseases, lower risk of developing obesity and diabetes mellitus, and better cognitive development.\(^3\)\(^,\)\(^5\)\(^-\)\(^7\) Breastfeeding has great benefits for maternal health as it decreases the incidence of postpartum haemorrhage, postpartum depression, breast cancer and ovarian cancer.\(^3\)\(^,\)\(^8\)

1.1.1. Non-exclusive breastfeeding: causes, predictors, and consequences

There are several factors associated with lower rates of EBF. Maternal obesity and smoking are among the biological risk factors for shorter breastfeeding duration and a lower rate of breastfeeding initiation.\(^4\) One of the most frequent causes for non-EBF is the false perception of having an insufficient milk supply, which pushes mothers to add infant formula, thus reducing demand for breast milk with a subsequent increase in the external supply.\(^9\)\(^-\)\(^10\)

High maternal self-efficiency and intention to breastfed are factors that are positively associated with EBF.\(^9\)\(^,\)\(^11\) Healthcare-related factors such as mode of delivery, hospital practices after delivery, and clinician recommendations were associated with the duration and exclusivity of breastfeeding.\(^11\)\(^-\)\(^13\) Maternal employment was negatively associated with EBF.\(^10\)
Breastfeeding knowledge and attitudes are among the predictors that determine the duration and exclusivity of breastfeeding.\textsuperscript{(14)} Lack of training for health professionals in the prevention and treatment of breastfeeding problems is one of the key factors for lower breastfeeding rates.\textsuperscript{(15)}

Non-exclusive breastfeeding is associated with higher paediatric rates of lower respiratory tract infections (LRTIs), enteric infections, necrotizing enterocolitis, sudden infant death syndrome (SIDS), childhood obesity, otitis media, allergic reactions, malignancy, sepsis, and poor cognitive behaviour.\textsuperscript{(16)} It is also associated with a higher prevalence of breast cancer, ovarian cancer, and type 2 diabetes mellitus in mothers.\textsuperscript{(16)} According to the WHO, globally over 820,000 children's lives could be saved annually among children under 5 years, if all children 0–23 months were optimally breastfed.\textsuperscript{(17)}

\textbf{1.1.2. Exclusive breastfeeding epidemiology in Egypt}

Despite being an ideal food for infants, only 44\% of the infants 0-6 months are exclusively breastfed globally.\textsuperscript{(17)} According to the Egyptian Demographic Health Survey (DHS) in 2014, despite being common at the early months with about 71\% of the infants receiving only breast milk under 2 months of age, only 13.3\% of the infants aged 4-5 months are exclusively breastfed.\textsuperscript{(18)} It also shows that the median duration of EBF among children born in the past three years, from the date of the survey, was lower in the urban areas in comparison to the rural ones.

There was no significant difference related to mother education or working status. However, there is another study done in 2017 which showed that EBF rate is lower among working mothers which is related to the absence of any workplace facilities that support breastfeeding such as breastfeeding rooms, specific hours for breastfeeding, or privacy for breastfeeding.\textsuperscript{(19)} In the study conducted in 2018, there are several factors supporting the decision for artificial feeding rather than EBF such as maternal age < 25 years, childbirth order >3\textsuperscript{rd}, being primipara, preterm labour, complicated labour and caesarean delivery.\textsuperscript{(20)} These factors are critical to know because they allow the implementation of context-based interventions with better effectiveness and efficiency.
1.1.3. Economic burden of non-exclusive breast feeding

The total annual economic cost of not breastfeeding is estimated to exceed 23 billion USD in the Middle East and North Africa Region, in comparison to 115 billion USD in North America.\(^{(21)}\) These costs are related to higher child and maternal mortality (indirect costs which are also called value of production loss), health system costs of diseases attributed to non-EBF, direct non-medical costs such as travel costs, the value of caregiver time, and cost of milk formula.\(^{(22)}\)

According to the Global Burden of Disease (GBD) study database,\(^{(23)}\) 6.18% of the total Disability-Adjusted Life Years (DALYs) under the age of 5 are attributed to non-EBF in Egypt in 2019 with a crude rate of 200,141.65 DALYs, ranking it the 7th level-four risk factor for DALYs lost under the age of 5 among all risk factors. Furthermore, non-EBF is responsible for 8.65% of the lower respiratory tract infections DALYs under the age of 5 with about 47,559.54 attributable DALYs, and it is also responsible for 20.97% of the diarrheal infections DALYs in the year 2019 (below the age of five years) causing about 152,582.12 DALYs. Despite this heavy burden, this number of DALYs lost does not reflect the real burden of non-EBF in Egypt due to deficient data regarding its impact on other diseases not included in the GBD study. As a result, more studies about the association between non-EBF and other diseases, are recommended to be conducted to allow calculating the whole burden of non-EBF as done in other countries that used their primary data to calculate it.\(^{(24)}\)

1.1.4. Interventions to enhance breastfeeding

There are several strategies that can be used in various contexts to promote breastfeeding via targeting the risk factors for cessation of breastfeeding. Training of the health professionals for better breastfeeding support is critical and it is recommended by WHO and UNICEF via two breastfeeding enhancing programmes: the 40-hour Breastfeeding Counselling, and the five-day Infant and Young Child Feeding Counselling.\(^{(25)}\) Breastfeeding support via professionals or laypeople is a key intervention whether on an individual or a group basis.\(^{(26-28)}\)

One of the successful interventions to promote EBF is known as “Ten Steps to Successful Breastfeeding, which are the basis for the Baby-Friendly Hospital Initiative (BFHI) that is recommended by the UNICEF.\(^{(27, 29)}\) Peer counsellor is one of the best ways for scaling-up EBF rates as shown in the studies in sub-Saharan Africa.\(^{(30-32)}\) Most of these interventions are deemed to be cost-effective with a lower cost per DALYs averted or Quality-Adjusted Life Years (QALYs) gained.\(^{(33)}\)
2. Methods

2.1. Aim of the study

The aim of the study is to estimate the economic burden of diseases attributed to non-EBF in Egypt in 2019, as well as to determine the cost-effectiveness of a modelled intervention to scale up EBF rates in Egypt.

In this section, different methods used to achieve the objectives of the study are presented. A literature review is done to identify the priority diseases attributed to non-exclusive breastfeeding and to illustrate the available interventions to enhance EBF. This is followed by the economic burden analysis of three chosen diseases (diarrheal diseases, lower respiratory tract infections, and acute otitis media) attributed to non-EBF in Egypt in 2019 using both monetary and non-monetary ways of measurement based on the statistical analysis of the findings from relevant secondary data and literature. Next, the intervention modelling was based on the available data and tailored to the Egyptian context via calculating the actual cost of its implementation in Egypt in 2019. Finally, an economic evaluation was performed using cost-effectiveness, cost-benefit, and cost-utility analyses of this intervention.

2.2. Perspective of economic evaluation and data sources

The perspective of the economic analysis in this study is the provider or health system for costs and societal perspective for benefits. The societal perspective was considered via including the social preferences in the values of years of life with disability and the years of life lost due to a disease using WHO-CMH and The Lancet Commission on Investing in Health for Low- and Middle-Income Countries approaches.

Data related to the number of births in 2019 comes from the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS), while data about breastfeeding rates are based on the 2014 Egypt Demographic and Health Survey (EDHS). Global Burden of Disease study was the source for data related to the burden of diseases attributed to non-exclusive breastfeeding risk factors in Egypt in 2019. Financial data about the GDP per capita, currency conversion factors, healthcare expenditure as a percent of the GDP, and GDP deflators are based on the World Bank database.

Literature review and supportive studies were used to find the evidence about the diseases attributed to nonexclusive breastfeeding and the interventions available to promote EBF.
2.3. Literature review
This literature review has two aims, the first one is to identify the main diseases attributed to non-EBF to be able to determine the real burden of non-EBF. This is done via searching the PubMed database for all relevant systematic reviews using keywords: breastfeeding, benefits, diseases, burden, and cost. The identified articles were used to find other relevant articles via both citations and references (snowball techniques).

The inclusion criteria of this search, which was done in April 2021, were full-text systematic reviews in English published in the period from 2010 to 2021 with only summary measures such as odd’s ratio or relative risk.

The second aim of this review is to determine the types of interventions done in any country to promote breastfeeding rates and to review the studies done on cost-effectiveness of such interventions. The same search strategy of the first aim was used except for including only articles assessing incremental cost-effectiveness in case of searching for the cost-effectiveness of interventions done to scale up breastfeeding rates. The following keywords were used: breastfeeding, interventions, promotion, cost-effectiveness.

The search results were screened at the level of the title and abstract to find the relevant articles according to the inclusion and exclusion criteria until the final full text reviewing of eligible articles and choosing the included studies.

2.4. Burden of diseases attributed to nonexclusive breastfeeding
Both monetary and non-monetary ways of measurement were used to calculate the burden of diarrheal diseases, LRTIs, and otitis media infections attributed to non-EBF. The total burden and the burden attributed to non-EBF for diarrhoea and LRTIs came from the GBD study in 2019.\(^{(23)}\) DALYs, deaths, YLDs, YLLs, and prevalence were calculated by the GBD study, while the incidence of enteric infections and LRTIs attributed to non-EBF was estimated within this work using the available GBD-2019 results and the incidence approach of YLDs calculation.

In the case of otitis media, the values attributed to non-EBF were missed in the GDB study. As a result, the population attributable fraction (PAF), which is the proportional reduction in population disease or mortality that would occur if exposure to a risk factor were reduced to an alternative ideal exposure scenario, was calculated based on the published study,\(^{(36)}\) using the following formula: \(^{(37)}\)
\[ PAF = \left( \text{proportion of cases exposed to non-exclusive breastfeeding} \right) \times \frac{(OR - 1)}{OR} \]

where odds ratio (OR) is = odds of having a disease due to not breastfeeding compared with the odds of having the disease with EBF.

Then the incidence and DALYs attributed to non-EBF were calculated by multiplying PAF by the total incidence of otitis media (under the age of 5 years) and the DALYs attributed to otitis media (under the age of 5 years) respectively.

To reflect the economic burden of the diseases attributed to non-EBF, both monetary and non-monetary ways of measurements are used in this study.

2.4.1. Non-monetary units of measurement

Mortality statistics including the number of deaths due to different diseases attributed to nonexclusive breastfeeding was presented. In addition, the incidence and prevalence of these diseases were also mentioned to reflect the morbidity statistics. These figures were based on the GBD study in Egypt in 2019.

The time lost measures with and without considering the health-related quality of life (PYLL, PEYLL, and DALY) were calculated and presented to reflect the years of life lost due to the diseases attributed to non-exclusive breastfeeding.

PYLL is a measure that reflects premature death by estimating the number of years that an individual would have lived if he or she had not died earlier. It requires defining the potential limit of life such as 60 or 70 years. It is calculated using the following formula:

\[ PYLL = \sum_{x=0}^{L} d_x \times (L - x) \]


Where:

- \( d_x \) is the number of deaths at age \( x \),
- \( L \) is the potential limit of life,
- and \( x \) is the age of death.
However, PYLL has the disadvantage of assigning no value to the deaths occurring at ages above the cut-off year. In addition, the length of life estimated through PYLL calculations is not realistic if a given death was prevented as it depends on how the limit to life is chosen.

PEYLL is an indicator of the mortality gap expressed in the local period life expectancy at a given age for specific sex in each country at the actual age at the time of death.

This leads to a more realistic measure of the number of years of life gained by averting a death than PYLL. It is calculated using the following formula:

\[ PEYLL = \sum_{x=0}^{L} d_x \times e_x \]


Where:
- \( d_x \) is the number of deaths at age \( x \) (changing from 0 to \( L \)),
- \( L \) is the age of the oldest survivors,
- \( e_x \) is life expectancy at age of death.

DALY is a health gap measure that combines both times lost due to premature mortality and disability due to non-fatal health states of diseases, injuries and risk factors. It can be calculated using the following formula:

\[ DALY = YLD + YLL \]

Where:
- \( YLL \) = Years of Life Lost
- \( YLD \) = Years Lived with Disabilities

In the initial stages of development of the GBD study DALY included social preferences – age weighting (differentiated values depending on the age of a person – reflecting changes in the way the value of an individual’s life during the life cycle is assessed) and discounting periods of life lost due to death and disability. Since the 2010 GBD study the DALY measure is not age weighted and not discounted. In this study DALY applied is not age weighted and not discounted.
2.4.2. Monetary units of measurement

Both cost of illness and value of statistical life approaches are used to reflect the burden of the diseases attributed to non-exclusive breastfeeding in monetary terms.

Cost of illness approach for the diseases attributed to nonexclusive breastfeeding

Both provider and societal perspectives are considered in this approach via estimating both direct medical cost and productivity loss, respectively.

1- Direct medical costs of diseases attributed to non-exclusive breastfeeding:

There is a problem with the availability of data regarding the costs of medical care in Egypt. That is why costs of governmental outpatient visits and hospital admissions in Egypt were estimated based on a UK study from the year 2009.\(^{(16)}\)

The special approach was applied to adjust the UK costs to the context in Egypt in year 2019 estimates. First the UK cost data were converted from 2009 GBP to 2019 GBP value using GDP deflators in UK:\(^{(39)}\)

\[
\text{Cost in 2019 in GBP} = \text{cost in 2009 in GBP} \times \left( \frac{\text{GDP deflator in UK in 2019}}{\text{GDP deflator in UK in 2009}} \right)
\]

then the calculated value in 2019 was converted from British Pounds (GBP) to International dollars using conversion factor for 2019.\(^{(40)}\) Finally, the UK value in international dollar was adjusted to Egypt value in international dollar using adjustment factor which is based on the formula:\(^{(41)}\)

\[
\text{Adjustment factor} = \frac{\text{GDP per capita in Egypt 2019}}{\text{GDP per capita in UK 2019}} \times \frac{\text{healthcare expenditure as % of GDP in Egypt in 2019}}{\text{healthcare expenditure as % of GDP in the UK in 2019}}
\]

The percentage of patients who seek medical advice was based on the DHS 2014, however, the percentage who needed hospitalization is based on expert opinion.
2- **Indirect cost (Productivity loss) due to diseases attributed to nonexclusive breastfeeding:**

Production loss in 2019 was calculated by multiplying the working years lost in 2019 due to the diseases attributed to low exclusive breastfeeding rates by the average annual gross salary in 2019 corrected by the labour participation rate in Egypt in year 2019.\(^{(42)}\)

The data about the average gross salary and labour participation rate came from CAPMAS\(^{(43)}\) and International Labour Organisation statistics (ILOSTAT), respectively. Working years lost are calculated as the discounted (with 3% discount rate) Potential Years of Life Lost (PYLL) for all deaths due to the analysed disease in age group 15-60 then corrected by the labour participation rate of 44.83 \% in Egypt in year 2019.

**National Income Loss due to non-inclusive breastfeeding (Value of Statistical life approach)**

Based on the global burden of disease (GBD) study in 2019, the DALY metric was used to determine income loss in Egypt.

**Monetary value of a DALY**

Two methods were used to estimate the burden of diseases in monetary value using VSL approach:

1- The WHO Commission on Macroeconomics and Health (CMH) which recommends valuing a DALY at between one and three times GDP per capita (referred to as CMH1 and CMH3, respectively).\(^{(44)}\)

2- The Lancet Commission on Investing in Health which recommends valuing a DALY at 2.3 times GDP per capita for low- and middle-income countries. Egypt is a lower middle-income country according to the WB World Development Indicators Project, with Gross National Income (GNI) per capita of current international dollar (I$) I$ 11,840 in year 2019.\(^{(45)}\)
2.5. Home-based counselling intervention modelling
Breastfeeding counselling in Egypt is done mainly by the community healthcare workers (CHWs) based on sessions in the primary healthcare units and home visits. However, the focus of these visits or sessions is about many other aspects of counselling such as family planning, child health, health diet, breast cancer screening, female genital mutilation and other health education topics. This led to lower focus on breastfeeding and less effective messages. As a result, there is a need for a more focused and intensive breastfeeding enhancing intervention which is proposed in this study.

2.5.1. Structure of the intervention
The intervention is adopted from the work done in Uganda which is part of the PRMOMISE-EBF (Promoting infant health and nutrition in Sub-Saharan Africa: Safety and efficacy of exclusive breastfeeding promotion in the era of HIV) Trial conducted in Burkina Faso, South Africa, Uganda, and Zambia. This study aimed to estimate the impact of individual home-based counselling for promoting exclusive breastfeeding for 6 months after birth.\(^{(30-31)}\)

The intervention included 5-6 home visits, once in the third trimester and during the first week of birth, and in weeks four, seven and ten via lay counsellors to encourage women to exclusively breastfeed for six months. Lay counsellors were trained for 1 week followed by fortnightly to monthly monitoring via supervisors. This community-based intervention was compared with the standard health facility breastfeeding promotion services. The intervention was obviously effective in promoting exclusive breastfeeding rates.

The 12-week exclusive breastfeeding (EBF) prevalence in the intervention group was 82%, compared to 44% in the control group with a prevalence ratio of 1.89 (95% CI 1.70 - 2.11). Similarly, the prevalence of EBF at 24 weeks was 58.6 and 15.5 for the intervention group and the control group, respectively, with a prevalence ratio of 3.83 (95% CI 2.97- 4.95).\(^{(34)}\)

In our study, we follow the same structure of this intervention which will include at least 5 visits with extra visits can be offered if needed. The timeline of this visits, as shown in figure 1, will be as follows: one in the 3rd trimester, one during the first week of birth and one in weeks four, seven and ten. The intervention will be done via community health workers as this will ease the process of visiting homes due to the current trust between community health workers and the public. The content of the visits will be similar to the PRIMOSE-EBF Trial which followed the WHO counselling course but tailored to the Egyptian context.\(^{(46)}\)
This course will include explanation of the advantages of exclusive breastfeeding or of using breast milk, management of breastfeeding (good breastfeeding technique), preventing early stopping of breastfeeding by explaining common breast problems and the ways to manage it, consequences of early stopping of breastfeeding on the baby and the mother and discussing any concerns regarding exclusive breastfeeding. The duration of each session will be about 60 minutes of counselling.

**Figure 1. Timeline for the home-based counselling intervention**

1st visit (3rd trimester)  2nd visit (1st week)  3rd visit (4th week)  4th visit (7th week)  5th visit (10th week)

*Source: Author’s work*

### 2.4.2. Costing of the intervention

Costing of the intervention is performed from the provider perspective. The budget needed for this intervention is based on the PRIMOSE-EBF Trial, which included start-up costs, training costs, overheads, human resources costs (CHWs and supervisors salaries). Start-up costs includes the cost for recruitment, workshops, initial training for 1 week, and physical resources such as flyers or places needed for training.

The startup period is estimated based on local data to be 3-6 months in average, which followed by a 1-year post start-up period begins with the first CHWs home visit.

Training costs represent costs for continuous monthly training for the counsellors by the supervisors. CHWs’ monthly salary is about 2000 EGP, based on local data in 2019.

The number of CHWs needed to cover all births in 2019 in Egypt (2,304,832 births) was calculated, based on the actual visit time in the PRIMOSE-EBF Trial, to be about 60 minutes plus similar duration for travel taking into consideration the higher population density in Egypt. As a result, each visit will take 2 hours in average and the average full time working hours is 36 hours per week, so the total annual number needed is 14,405 CHWs in 2019.
With the assumption that each 20 CHWs will need 1 full time nurse for supervision, so the total number of full-time nurses needed is 720 in 2019 with an average monthly salary of 3000 EGP. Based on the PRIMOSE-EBF Trial, the combined average start-up cost, training costs, and overheads were about 20% of the total cost. In summary, the total cost of the population level intervention was calculated to be about 445,984,992 EGP (103,334,723 I$) in 2019.

2.4.3. Impact of intervention
In Uganda study, the intervention was very effective as it significantly increased the prevalence of EBF at 12th week from 44% to 82% and at 24th week from 15.5% to 58.6% in comparison to the control group. Due to the different context which may lead to different results, the outcome of the intervention will be based on modelled breastfeeding scenarios to conduct economic evaluation of this intervention in different scenarios. The scenarios impact will be based on the base case which is the real situation in 2019 when the breastfeeding rate at 4-5 months is 13.3%, and the number of births is 2,304,832 births. In addition, the current burden of the 3 diseases included in this study will be considered and presented.

There are 4 scenarios developed based on the predicted positive change in prevalence of EBF after the intervention namely 5%, 10%, 20% and 40%. This positive change is predicted based on the Break-Even Point (4%) calculated, where no Net Monetary Benefit is achieved, and costs of intervention are equal to the monetary benefits (when DALY is evaluated using CMH1 – the most conservative valuing approach). For each scenario, the net monetary benefit, cost benefit ratio and return on investment were calculated to reflect the cost benefit analysis. In addition, the cost utility and the cost effectiveness analyses represented by the cost per DALY averted and the cost per PEYLL averted, respectively were calculated.

2.4.4. Economic modelling of the intervention
The aim of the economic modelling was to provide the inputs for doing an economic evaluation of the intervention in different scenarios depending on the expected DALYs averted when breastfeeding rates are increased to certain levels.

The societal perspective was used in this analysis via using the WHO-CMH approach which gives a value of one to three GDP per capita for a DALY.

The framework used in this economic modelling is based on the work done in other study.\(^{(24)}\)

This framework in figure 2 is formed of 5 steps as follow:

1- Developing breastfeeding policy scenario: Several realistic breastfeeding policies were developed based on the available studies and the expected DALYs averted relative to
the current “base case”. First, we calculated the breakeven point for the intervention to be cost beneficiary. It was found that each intervention that gives more than 4% DALYs averted will be cost beneficiary. As a result, four policy scenarios were developed assuming 5%, 10%, 20%, 40% DALYs averted which represent 18%, 22%, 31%, 48% assumed exclusive breastfeeding rates respectively.

2- Determine the reference population: the reference population was children aged 0-5 years in 2019 in Egypt. The base case in this population is represented by the exclusive breastfeeding rates at 6 months among them which was 13.3% and the DALYs lost due to this low rate of exclusive breastfeeding because of only 3 diseases (diarrheal diseases, lower respiratory tract infection, and otitis media) which was in total 201,995 DALYs.

3- Determine the expected number of DALYs averted in each scenario in comparison to the base case.

4- Estimate the total cost of the intervention versus the outcomes in each scenario. DALY was valued using WHO-CMH approach mainly despite other methods can be used.

5- Conducting economic evaluation using different methods namely cost-effectiveness, cost-utility and cost-benefit analyses under each policy scenario.
2.5. Economic evaluation of the modelled intervention

Economic evaluation is defined as the comparison of alternative options in terms of their cost and consequences.\(^{(47)}\) Based on these consequences, we present three types of economic evaluation of the home-based counselling intervention namely: cost utility, cost benefit and cost effectiveness analyses.
2.5.1. Cost-Utility Analysis

This analysis was conducted to compare the intervention with no intervention in terms of both cost and utility. This utility, which is a measure of the value that an individual gives a particular health state, is measured in disability adjusted life years (DALYs) which are a measure of both length of life lost (Years of Life Lost) and decrease in quality of life (Years Lived with Disability).

YLLs are calculated by summing up the number of deaths in each age group multiplied by standard life expectancy (derived from the lowest observed death rate for any age group in countries with population higher than 5 million globally). For each age group the YLL can be calculated using the formula:

\[ YLL = M \times L \]

Where:

- \( M \) = total number of deaths from the specific cause in the age group and
- \( L \) = standard life expectancy after the average age at death in the age group from the cause of interest

YLDs are usually estimated by multiplying the prevalence counts with the average disability weight for a given disease or injury or incidence number with the duration of disease or injury and it’s disability weight. A Bayesian meta-regression modelling tool, DisMod-MR 2.1, is used to ensure consistency between all epidemiologic metrics for most causes. YLDs can be calculated using both incidence and prevalence approaches. In case of prevalence approach, it is calculated using the following formula:

\[ YLD = P \times DW \times 1 \text{ year} \]

Where:

- \( P \) = point prevalence number
- \( DW \) = disability weight (in the range 0-1)
YLD can be calculated also via the incidence approach (which is a case in this study) using the following formula:

\[ \text{YLD} = I \times DW \times D \]

Where:

- \( I \) = the number of incident cases in the reference period,
- \( DW \) = the disability weight (in the range 0-1) and
- \( D \) = the average duration of the case until remission or death (years or months)

DALY has values between 0 and 1 where 1 represent death and 0 represent perfect health in DALYs. In this study, we used DALYs as the cost utility measure due to availability of data about it as it the main measure used in the GBD studies, and it is widely used among LMIC as Egypt. For each outcome scenario, the DALYs averted was calculated then the cost per DALY averted was calculated to determine the incremental cost utility analysis as follows:

\[ ICUR = \frac{Cost \ of \ Intervention - Cost \ of \ NO \ Intervention}{DALYs \ averted \ with \ Intervention - DALYs \ averted \ with \ NO \ Intervention} \]

The intervention cost effectiveness is based on the WHO approach where it is considered highly cost effective if the cost/ DALY averted is less than once the annual GDP per capita in Egypt in 2019 and is considered cost effective if it is less than three times the national annual GDP per capita.\(^{(49)}\)

### 2.5.2. Cost-Effectiveness Analysis

In this analysis a comparison between doing the intervention and the doing nothing in terms of costs and effectiveness. The effectiveness in this analysis is expressed in PEYLL averted. The incremental cost effectiveness ratio (ICER) was used to assist policy decision whether to adopt this intervention or not according to the ICER threshold. The ICER was calculated using the following formula:

\[ \text{ICER} = \frac{Cost \ of \ intervention - Cost \ of \ no \ intervention}{Effect \ of \ intervention - Effect \ of \ no \ intervention} \]

The unit of ICER is the cost per PEYLL averted. The intervention cost effectiveness is determined based on ICER per life year gained in Egypt in 2019.
2.5.3. Cost-Benefit Analysis
The outcome in this analysis is valued in monetary terms using value of statistical life approach. The WHO CMH method, which recommends valuing a DALY at between one- and three-times GDP per capita, was used to value the DALY averted.

Three methods are used to reflect the cost benefit of the intervention in each scenario:

A- Net benefit which is the difference between the benefits of the intervention in monetary values and the cost of the intervention. It is calculated by following formula:

\[ \text{Benefits of the intervention in EGP} - \text{Cost of the intervention in EGP} \]

B- Cost benefit ratio is interpreted as the cost of one monetary unit (one EGP) saved with the intervention. It is calculated by the following formula:

\[ \frac{\text{Cost of the intervention (EGP)}}{\text{Gross benefits of the intervention (EGP)}} \]

C- Benefit cost ratio (Return on Investment- ROI) is the benefits brought in EGP per one monetary unit (one EGP) invested in the intervention. It is calculated by the following formula:

\[ \frac{\text{Gross benefits of the intervention(EGP)}}{\text{Cost of the intervention (EGP)}} \]
3. Literature review

3.1. Diseases attributed to nonexclusive breastfeeding

There is extensive literature regarding the impact of breastfeeding on incidence of many diseases. After the inclusion and exclusion criteria were applied, eight systematic reviews (out of 426 results on the first hit) presented in table 1 were found eligible, discussing 10 paediatric (intelligence, diarrheal diseases, LRTIs, acute otitis media, malocclusion, diabetes mellitus, leukaemia, obesity, hypertension, and cholesterol level) and 7 maternal (breast cancer, ovarian cancer, diabetes mellitus, lactational amenorrhea, postpartum depression, postpartum weight change, and osteoporosis) health outcomes.

Higher or more EBF rates in comparison to lower or less EBF rates were found beneficial in 8 out of the 10 paediatric health outcomes: leukaemia (OR= 0.8, 95% CI: 0.72; 0.90), diarrhoea (RR= 0.69, 95% CI: 0.58 ;0.82), LRTIs (RR= 0.68, 95% CI: 0.60 ;0.77), type 2 diabetes mellitus (OR= 0.67, 95% CI: 0.56; 0.80), Obesity (OR= 0.74, 95% CI: 0.70; 0.78), malocclusions (OR= 0.54, 95% CI: 0.38; 0.77), acute otitis media (OR= 0.57, 95% : 0.44; 0.75), and intelligence (mean difference= 3.44 points, 95% CI: 2.30; 4.58). There was no association found between breastfeeding and total cholesterol or blood pressure.

Breastfeeding is protective against 4 maternal health outcomes: breast cancer (OR= 0.78, 95% CI: 0.74; 0.82), ovarian cancer (OR= 0.70, 95% CI: 0.64; 0.77), diabetes mellitus (RR = 0.68, 95% CI: 0.57–0.82), and lactational amenorrhea.

There are other 3 paediatric diseases that are likely to be attributed to non-optimal breastfeeding; childhood allergic diseases, Sudden infant death syndrome (SIDS), and Necrotizing enterocolitis (NEC).

In this study, we included only diarrheal diseases, LRTIs, and acute otitis media in the economic evaluation due to the availability of local data needed for the analysis and the strong relation between them and breastfeeding.
<table>
<thead>
<tr>
<th>Author</th>
<th>Aim</th>
<th>No. of studies included (n)</th>
<th>Summary measures</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horta BL, 2015 (51)</td>
<td>To estimate the association between breastfeeding and performance in intelligence tests.</td>
<td>17</td>
<td>Higher IQ [mean difference: 3.44 points (95% confidence interval: 2.30; 4.58)] in favour of breastfeeding</td>
<td>Breastfeeding is related to improved performance in intelligence tests.</td>
</tr>
<tr>
<td>Amitay EL, 2015 (52)</td>
<td>To estimate the association between breastfeeding and childhood leukaemia</td>
<td>17</td>
<td>Odds ratio = 0.80; 95%CI, 0.72-0.90 in favour of any breastfeeding for 6 months or more versus no or short duration of breastfeeding</td>
<td>Promoting breastfeeding for 6 months or more may help lower childhood leukaemia incidence.</td>
</tr>
<tr>
<td>Horta BL, 2019 (53)</td>
<td>To estimate the association between breastfeeding and type 2 diabetes.</td>
<td>14</td>
<td>Odds ratio = 0.67 (95% confidence interval, 0.56; 0.80) in favour of breastfeeding versus non breastfeeding</td>
<td>The updated systematic review and meta-analysis suggests that breastfeeding protects from type 2 diabetes.</td>
</tr>
<tr>
<td>Horta BL, 2013 (54)</td>
<td>To assess the effect of breastfeeding on respiratory infections and diarrheal disease in childhood.</td>
<td>15 (diarrhoea) &amp; 4 (LRTIs)</td>
<td>Relative risk of diarrhoea incidence = 0.69 (95% confidence interval: 0.58; 0.82) in favour of more intense breastfeeding versus less intense breastfeeding. AND for lower respiratory tract infections: pooled relative risk = 0.68 (95% confidence interval: 0.60; 0.77)]</td>
<td>Breastfeeding reduces the risk of diarrhoea and respiratory infection</td>
</tr>
<tr>
<td>Author</td>
<td>Aim</td>
<td>No. of studies included (n)</td>
<td>Summary measures</td>
<td>Conclusion</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>-----------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Peres KG, 2015 (55)</td>
<td>To investigate whether breastfeeding decreases the risk of malocclusions.</td>
<td>41</td>
<td>OR= 0.54; (95% CI 0.38; 0.77) in favour of exclusively breastfeeding versus absence of exclusive breastfeeding</td>
<td>Breastfeeding decreases the risk of malocclusions</td>
</tr>
</tbody>
</table>
| Horta BL, 2015 (56) | To review the evidence on the associations between breastfeeding and overweight/obesity, blood pressure, total cholesterol, and type 2 diabetes | 105 (overweight/obesity) & 11 (diabetes) | For overweight/obesity: odds ratio= 0.74 (95% confidence interval (CI): 0.70; 0.78)  
For DM: [pooled odds ratio= 0.65 (95%CI: 0.49; 0.86)] in favour of breastfeeding. | Breastfeeding decreased the odds of type 2 diabetes and based on high quality studies, decreased by 13% the odds of overweight/obesity. No associations were found for total cholesterol or blood pressure. |
<p>| Bowatte G, 2015 (57) | To synthesise the evidence on the association between duration and exclusivity of breastfeeding and the risk of acute otitis media (AOM). | 24                          | OR= 0.57 (95% CI 0.44, 0.75) in favour of exclusive breastfeeding for the first 6 months versus nonexclusive BF followed by ‘more vs less’ breastfeeding (OR= 0.67; 0.59, 0.76) and ‘ever vs never’ breastfeeding (OR= 0.67; 0.56, 0.80). | Breastfeeding protects against AOM until 2 years of age |</p>
<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Aim</th>
<th>No. of studies included (n)</th>
<th>Summary measures</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chowdhury R, 2015 (58)</td>
<td>To evaluate the effect of breastfeeding on long-term (breast carcinoma, ovarian carcinoma, osteoporosis, and type 2 diabetes mellitus) and short-term (lactational amenorrhoea, postpartum depression, postpartum weight change) maternal health outcomes</td>
<td>163</td>
<td>Breast cancer: OR= 0.78 (0.74; 0.82) for ever breastfeeding vs never breastfeeding and OR= 0.74 (0.69; 0.79) for breastfeeding &gt; 12 months vs never and OR= 0.91 (0.87; 0.96) for breastfeeding 6-12 months versus never Ovarian cancer: OR= 0.70 (0.64; 0.77) for ever breastfeeding vs never breastfeeding and OR=0.63 (0.56; 0.71) for breastfeeding &gt; 12 months vs never and OR= 0.72 (0.66; 0.78) for breastfeeding 6-12 months versus never. DM: (RR = 0.68 95% CI: 0.57–0.82) with longer duration of lifetime breastfeeding compared with shorter durations.</td>
<td>Breastfeeding is protective against breast and ovarian carcinoma, and exclusive breastfeeding and predominant breastfeeding increase the duration of lactational amenorrhoea. Breastfeeding reduces the risk of type 2 diabetes.</td>
</tr>
</tbody>
</table>

Source: Author’s work.
3.2. Effectiveness and cost-effectiveness of interventions promoting exclusive breastfeeding

There are different interventions that were implemented to scale up breastfeeding rates and exclusivity targeting various risk factors for non-optimal breastfeeding. Intervention available for breastfeeding can be divided into the following two categories:

1- Support:\(^{59-61}\) there are several types of support based on the way of delivery (individual or group-based), the target of intervention (pregnant women or staff), the people providing the support (peer versus professional), the mode of support (face-to-face, by telephone or via the internet)\(^ {62}\), the time of support (antenatal, postnatal or both), the intensity of intervention (number and duration of sessions), the content of this support (education material, training, behaviour change,\(^ {63-64}\) and counselling), the setting of intervention (rural or urban), the rank of pregnancy (primipara or multipara)\(^ {65}\) and the place of intervention (home-based, primary health care units, hospitals or workplace)\(^ {66}\). Most of these methods are found to be effective to increase the duration and the exclusivity of breastfeeding.\(^ {59}\) These different types of support aim to promote breastfeeding duration and exclusivity via acting on barriers of breastfeeding such as knowledge, attitudes, and beliefs about breastfeeding; workplace, and hospital policies. This includes breastfeeding learning materials, mother training about breastfeeding techniques, media promotion, workplace policies such as extension of paid maternity leave and provision of breastfeeding-friendly environment such as private rooms for breastfeeding, and provision of baby-friendly hospitals as recommended by the UNICEF and WHO.\(^ {46, 67}\)

2- Financial incentives: financial incentives have been found effective in increasing breastfeeding rates in many high-income countries.\(^ {68-70}\) This may give a clue that these interventions may be more effective in low-middle income counties.

Five studies were found eligible based on the inclusion and exclusion criteria mentioned in the method section. Key characteristics of the 5 included studies are described in table 2. Three of the studies were based in Africa (South Africa and Uganda) and the other two studies were based in the UK. Four of the studies included interventions that provide support via peer counselling, enhanced staff contact, group education, and staff training and supervision. Only one study demonstrated the cost-effectiveness of financial incentives to scale up breastfeeding rates. All interventions were found to be cost-effective to promote breastfeeding except 1 study done in Uganda, where it takes into consideration only the impact of breastfeeding in decreasing the incidence of diarrhoea from the provider perspective.
Table 2. Cost-effectiveness of intervention to scale up breastfeeding rates

<table>
<thead>
<tr>
<th>Author (Year)</th>
<th>Evaluation type/ outcome</th>
<th>Intervention</th>
<th>ICER/ Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desmond, 2008 (South Africa) (32)</td>
<td>CEA/Month of exclusive breastfeeding</td>
<td>Group education at antenatal clinics, up to 4 antenatal home visits, and 14 postnatal home visits by a lay breastfeeding counsellor</td>
<td>U$ 23- U$ 126/additional month of exclusive breastfeeding Likely to be cost-effective</td>
</tr>
<tr>
<td>Rice, 2010 (UK) (71)</td>
<td>CUA/QALY</td>
<td>Enhanced staff contact for mothers with low-birth-weight infants in a neonatal unit to promote breastfeeding</td>
<td>The intervention was less costly and more effective (dominant) than the comparator. Likely to be cost-effective</td>
</tr>
<tr>
<td>Chola, 2015 (Uganda) (34)</td>
<td>CEA; CUA/Month of exclusive breastfeeding; DALY</td>
<td>Community-based peer counselling in addition to the standard care</td>
<td>U$ 68/month of exclusive breastfeeding; U$ 11,353/ DALY. Not likely to be cost-effective if just considering decreasing incidence of diarrhoea</td>
</tr>
<tr>
<td>Anokye N, 2020 (UK) (70)</td>
<td>CEA/additional baby breast fed</td>
<td>Offering a financial incentive (over a 6-month period) on breast feeding to women living in areas with low breastfeeding prevalence</td>
<td>The cost per additional baby breast fed at 6–8 weeks was £974. Likely to be cost-effective</td>
</tr>
<tr>
<td>George G, 2020 (South Africa) (72)</td>
<td>CEA/ Additional mother practicing EBF</td>
<td>CHW training and supervision to scale up EBF rates</td>
<td>The cost per additional mother practicing EBF was calculated to be US$7647, 88, with lower cost if it done at the population level. Likely to be cost effective.</td>
</tr>
</tbody>
</table>

Source: Author’s work
4. Results
All the results in this study are presented in 2019 Egypt’s local currency (EGP) and international dollar values using purchasing power parity of dollar in Egypt (USD ppp – IS; 1 EGP = 0.2317 in year 2019).

4.1. Burden of diseases attributed to nonexclusive breastfeeding

4.1.1. Non-monetary units of measurement
The morbidity and mortality indicators of diarrheal diseases, LRTIs, and acute otitis media in Egypt in 2019 among children under the age of 5 are illustrated in table 3. This table shows the incidence, prevalence, DALYs, deaths, YLDs and YLLs attributed to these diseases.

Among the three diseases, diarrheal diseases have the highest burden in terms of DALYs lost with about 727,302 DALYs lost in 2019 in comparison to 552,132 and 4,793 DLAYs lost due to LRTI and acute otitis media, respectively.

Table 3. Total morbidity and mortality of diarrheal diseases, LRTIs, and otitis media in Egypt among age group <5 years in 2019

<table>
<thead>
<tr>
<th>Total</th>
<th>Diarrheal diseases</th>
<th>LRTI</th>
<th>Otitis media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>22,373,905.74</td>
<td>1,217,399.68</td>
<td>3,941,183.70</td>
</tr>
<tr>
<td>Prevalence</td>
<td>398,516.77</td>
<td>29,732.54</td>
<td>306,332</td>
</tr>
<tr>
<td>Deaths</td>
<td>7,731.31</td>
<td>6,247.18</td>
<td>0</td>
</tr>
<tr>
<td>YLLs</td>
<td>679,860.33</td>
<td>550,282.72</td>
<td>0</td>
</tr>
<tr>
<td>YLDs</td>
<td>46,441.92</td>
<td>1,849.3</td>
<td>4,793.22</td>
</tr>
<tr>
<td>DALYs</td>
<td>726,302.25</td>
<td>552,132.03</td>
<td>4,793.22</td>
</tr>
</tbody>
</table>


Table 4 demonstrates the morbidity and mortality indicators of such diseases that are attributed only to nonexclusive breastfeeding. Diarrheal diseases attributed to nonexclusive breastfeeding are responsible for about 152,582 DALYs lost in 2019 among children under the age of five. Lower respiratory tract infections and acute otitis media that are attributed to nonexclusive breastfeeding were responsible for 47,560 and 1,854 DALYs lost in 2019 among the same age group, respectively.
Table 4. Morbidity and mortality of diarrheal diseases, LRTIs, and otitis media attributed to nonexclusive breastfeeding in Egypt among age group <5 in 2019

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Diarrheal diseases</th>
<th>LRTI</th>
<th>Otitis media</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incidence</td>
<td>1,931,346</td>
<td>31,855</td>
<td>1,524,275</td>
</tr>
<tr>
<td>Deaths</td>
<td>1,679</td>
<td>536.38</td>
<td>0</td>
</tr>
<tr>
<td>YLLs</td>
<td>148,573</td>
<td>47,511</td>
<td>0</td>
</tr>
<tr>
<td>YLDs</td>
<td>4,009</td>
<td>48.39</td>
<td>1,854</td>
</tr>
<tr>
<td>DALYs</td>
<td>152,582</td>
<td>47,560</td>
<td>1,854</td>
</tr>
</tbody>
</table>

Source: Author’s work based on data from IHME

Figure 3 shows the undiscounted time lost measures (PYLL, PEYLL, and DALY) of the burden of these 3 diseases. Due to the lower life expectancy in Egypt than the world standardized life expectancy, the value of PEYLL lost due to these diseases is lower than YLL giving values of 152,913 and 196,084 respectively.

Figure 3. Time lost measures of the burden of diarrheal diseases, LRTIs, and otitis media attributed to nonexclusive breastfeeding in Egypt among age group <5 in 2019

Source: Author’s work

The previous measures are important in identifying the burden of non-EBF, however, valuing this burden in monetary units is crucial for decision making and for comparison between different conditions.
4.1.2. Monetary units of measurement

Cost of illness approach

The direct medical cost of diarrheal diseases, LRTIs, and acute otitis media attributed to non-EBF are demonstrated in table 6. Based on an average value of 34 EGP per one outpatient visit, the total outpatient costs for diarrheal diseases, LRTIs, and acute otitis media attributed to non-EBF are 36,317,237 EGP, 737,660 EGP, and 35,763,497 EGP, respectively. An average of 5% of the outpatients’ visits needs hospitalizations and about 1,777.5 EGP, and 1,937.5 EGP needed for hospitalization of one case of diarrheal diseases and LRTIs, respectively, the total hospitalization cost for both diseases is about 97 million EGP. This leads to a total direct medical cost of about 170 million EGP (39 million I$) for the 3 diseases’ cases attributed to nonexclusive breastfeeding.

Taking into consideration the societal perspective, table 5 illustrates the productivity lost due to deaths resulting from these 3 diseases. Only diarrheal diseases and LRTIs could lead to death, so they were included in the analysis. Based on an average weekly gross salary of 1283 EGP in 2019, a discount rate of 3%, working age of 15-60 years, and the calculated discounted Potential Years of Life Lost (PYLL), the productivity loss due to premature mortality from diarrheal diseases and LRTIs attributed to non-EBF was about 1.64 billion EGP in 2019. This leads to a total cost of about 1.8 billion EGP (418 million I$) lost due to diarrheal diseases, LRTIs, and acute otitis media attributed to non-EBF in children under the age of 5 in Egypt in 2019. As a result, the average cost of a case with diarrhoea, LRTI, and acute otitis media is about 710 EGP, 12,524 EGP and 23.5 EGP respectively. In addition, the average cost for each child (out of 2,304,832 new births in 2019) attributed to these 3 diseases in 2019 is about 783 EGP (182 I$) annually. The morbidity indirect costs are not included in this study.

Table 5. Direct and indirect costs of diarrheal diseases, LRTI and otitis media attributed to nonexclusive breastfeeding in Egypt among age group <5 in 2019

<table>
<thead>
<tr>
<th>Disease</th>
<th>Total direct medical cost (EGP)</th>
<th>Total indirect cost (EGP)</th>
<th>Total cost (EGP)</th>
<th>Total cost (I$)</th>
<th>Average cost (EGP)/ case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrheal diseases</td>
<td>131,240,617</td>
<td>1,239,702,841</td>
<td>1,370,943,458</td>
<td>317,647,599</td>
<td>710</td>
</tr>
<tr>
<td>LRTIs</td>
<td>2,839,206</td>
<td>396,120,602</td>
<td>398,959,808</td>
<td>92,438,988</td>
<td>12,524</td>
</tr>
<tr>
<td>Otitis media</td>
<td>35,763,497</td>
<td>35,763,497</td>
<td>8,286,402</td>
<td>23.5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>169,843,320</td>
<td>1,635,823,442</td>
<td>1,805,666,763</td>
<td>418,372,989</td>
<td>783 *</td>
</tr>
</tbody>
</table>

Source: Author’s work (*Average cost per child in 2019)
Value of statistical life approach

In this approach, a monetary value is given to a DALY based on WHO-CMH or the Lancet Commission on Investing in Health recommendations as shown in table 6. This reflects the community’s willingness to pay to avoid a disability or a death caused by diarrheal diseases, LRTIs and acute otitis media attributed to non-EBF. The results of the analysis based on this approach showed that people are willing to pay from 10.7 to 32.1 billion EGP (to avoid the DALYs lost due to these three diseases which are attributable to nonexclusive breastfeeding.

Table 6. National Income Loss due to non-inclusive breastfeeding using value of statistical life approach

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diarrheal diseases</th>
<th>LRTI</th>
<th>Otitis Media</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>DALYs (non-discounted non age weighted)</td>
<td>152,582.12</td>
<td>47,559.54</td>
<td>1,853.80</td>
<td>201,995.46</td>
</tr>
<tr>
<td>attributable to non-EBF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GDP per capita in 2019 (I$)</td>
<td>12,283.80</td>
<td>12,283.80</td>
<td>12,283.80</td>
<td></td>
</tr>
<tr>
<td>GDP per capita in 2019 (EGP)</td>
<td>53,015.97</td>
<td>53,015.97</td>
<td>53,015.97</td>
<td></td>
</tr>
<tr>
<td>Income loss due to disease (EGP)- CMH1</td>
<td>8,089,288,932.48</td>
<td>2,521,415,094.74</td>
<td>98,281,261.40</td>
<td>10,708,985,288.63</td>
</tr>
<tr>
<td>Income loss due to disease (I$)- CMH1</td>
<td>1,874,288,245.66</td>
<td>584,211,877.45</td>
<td>22,771,768.27</td>
<td>2,481,271,891.38</td>
</tr>
<tr>
<td>Income loss due to disease (EGP)- CMH3</td>
<td>24,267,866,797.45</td>
<td>7,564,245,284.23</td>
<td>294,843,784.21</td>
<td>32,126,955,865.89</td>
</tr>
<tr>
<td>Income loss due to disease (I$)- CMH3</td>
<td>5,622,864,736.97</td>
<td>1,752,635,632.36</td>
<td>68,315,304.80</td>
<td>7,443,815,674.13</td>
</tr>
<tr>
<td>The Lancet Commission on Investing Health (2.3 GDP) (EGP)</td>
<td>18,605,364,544.71</td>
<td>5,799,254,717.91</td>
<td>226,046,901.23</td>
<td>24,630,666,164</td>
</tr>
<tr>
<td>The Lancet Commission on Investing Health (2.3 GDP) (I$)</td>
<td>4,310,862,965.01</td>
<td>1,343,687,318.14</td>
<td>52,375,067.01</td>
<td>5,706,925,350</td>
</tr>
</tbody>
</table>

*Source: Author’s work*
4.2. Home-based counselling intervention

4.2.1. Structure of the intervention

The structure of the home-based intervention is illustrated in table 7, which shows that implementation of this intervention to cover the whole number of women who gave birth in 2019 (2.3 million) will need 14,405 full-time community healthcare workers annually and 720 full-time nurses as supervisors for this project. Each community health worker will be responsible for doing 3 home visits per day with an average of 2 hours per visit including travel time. This means that each community health worker will be responsible for 160 pregnant women annually.

**Table 7. Structure of the home-based counselling intervention**

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of visits/ woman</td>
<td>5.4</td>
</tr>
<tr>
<td>Time (hrs)/ visit</td>
<td>2</td>
</tr>
<tr>
<td>Time needed/women</td>
<td>10.8</td>
</tr>
<tr>
<td>Number of births 2019</td>
<td>2,304,832</td>
</tr>
<tr>
<td>Number of full-time CHWs needed annually</td>
<td>14,405</td>
</tr>
<tr>
<td>Annual number of women per CHWs</td>
<td>160</td>
</tr>
<tr>
<td>Monthly number of Women per CHWs</td>
<td>13</td>
</tr>
<tr>
<td>Average number of visits per months per Full Time Equivalent (FTE)</td>
<td>72</td>
</tr>
<tr>
<td>Average number of visits/days per FTE</td>
<td>3</td>
</tr>
<tr>
<td>Average number of supervisors needed (nurses)</td>
<td>720</td>
</tr>
</tbody>
</table>

*Source: Author’s work*

4.2.2. Cost of the intervention

The cost of the home-based counselling intervention as illustrated in table 8 is based on the average 2019 salary of about 2000 EGP and 3000 EGP for CHWs and nurses, respectively. In addition, training and administrative costs are calculated as 20% of the human resources cost. As a result, the total cost of the intervention is about 446 million EGP (103 million IS).
Table 8. Cost of the home-based counselling intervention

<table>
<thead>
<tr>
<th>Item</th>
<th>Annual Cost (2019)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average salary of CHWs - full time (EGP)</td>
<td>2,000</td>
</tr>
<tr>
<td>Average salary of nurses - full time (EGP)</td>
<td>3,000</td>
</tr>
<tr>
<td>CHWs’ salaries (EGP)</td>
<td>345,724,800</td>
</tr>
<tr>
<td>Nurses’ salaries (EGP)</td>
<td>25,929,360</td>
</tr>
<tr>
<td>Training cost (EGP)</td>
<td>37,165,416</td>
</tr>
<tr>
<td>Administrative/ Overheads (EGP)</td>
<td>37,165,416</td>
</tr>
<tr>
<td>Total (EGP)</td>
<td>445,984,992</td>
</tr>
<tr>
<td>Annual Cost per child</td>
<td>193.5</td>
</tr>
<tr>
<td>Annual Cost per child (I$)</td>
<td>12.33</td>
</tr>
<tr>
<td>Average cost per visit (EGP)</td>
<td>35.8</td>
</tr>
<tr>
<td>Average cost per visit (I$)</td>
<td>8.3</td>
</tr>
</tbody>
</table>

Source: Author’s work

4.2.3. Impact of the intervention

There are four scenarios, as illustrated in table 9, developed to predict the impact of the intervention based on the percent decrease in DALYs lost to 40%, 20%, 10%, and 5% of the current situation. These four scenarios are expected to decrease DALYs loss of about 80,798 for scenario 1, 40,399 for scenario 2, 20,200 for scenario 3, and 10,100 for scenario 4. Furthermore, these four scenarios are expected to coincide with EBF rates of 48%, 31%, 22%, and 18% respectively given a current rate of 13.3%.

Table 9. Policy scenarios predicting the impact of the home-based counselling intervention on DALYs due to three diseases attributed to non-EBF

<table>
<thead>
<tr>
<th>Disease</th>
<th>Diarrheal diseases</th>
<th>LRTI</th>
<th>Otitis Media</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1 (40% decrease in DALYs)</td>
<td>61,032.85</td>
<td>19,023.82</td>
<td>741.52</td>
<td>80,798</td>
</tr>
<tr>
<td>Scenario 2 (20% decrease in DALYs)</td>
<td>30,516.42</td>
<td>9,511.91</td>
<td>370.76</td>
<td>40,399</td>
</tr>
<tr>
<td>Scenario 3 (10% decrease in DALYs)</td>
<td>15,258.21</td>
<td>4,755.95</td>
<td>185.38</td>
<td>20,200</td>
</tr>
<tr>
<td>Scenario 4 (5% decrease in DALYs)</td>
<td>7,629.11</td>
<td>2,377.98</td>
<td>92.69</td>
<td>10,100</td>
</tr>
</tbody>
</table>

Source: Author’s work
4.3. Economic evaluation of intervention

4.3.1. Cost-Utility Analysis

Table 10 shows the Cost-Utility Analysis of the intervention compared to no intervention in terms of the incremental costs and utility (DALYs averted) in different scenarios. Considering the provider perspective, the incremental cost of the intervention is 445,984,992 EGP. The incremental utility (DALYs averted) of the intervention, based on the different scenarios, is 80,798 for scenario 1; 40,399 for scenario 2; 20,200 for scenario 3; and 10,100 for scenario 4. As a result, the incremental cost-utility ratio (ICUR) ranges from 5,520 to 44,158 EGP (1,279 to 10,231 I$) per DALY averted. Given a GDP in Egypt in 2019 of 53,015.97, the intervention is very cost-effective as all the value of ICUR are less than 1* GDP in Egypt in 2019.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>DALYs averted (number)</th>
<th>Intervention cost (EGP)</th>
<th>ICUR (EGP)</th>
<th>ICUR (I$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>80,798</td>
<td>445,984,992</td>
<td>5,520</td>
<td>1,279</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>40,399</td>
<td>445,984,992</td>
<td>11,039</td>
<td>2,558</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>20,200</td>
<td>445,984,992</td>
<td>22,079</td>
<td>5,116</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>10,100</td>
<td>445,984,992</td>
<td>44,158</td>
<td>10,231</td>
</tr>
</tbody>
</table>

Source: Author’s work

4.3.2. Cost-Benefit Analysis

Table 11 summarizes the net savings (net monetary benefits) resulting from the implementation of the intervention with different outcome scenarios. The net saving ranged from 89.5 million EGP to 3.8 billion EGP in case of using the WHO-CMH1 approach for valuing a DALY and ranged from 1.2 billion EGP to 12.4 billion EGP in case of using the WHO-CMH3 approach. There is another way of presenting the cost-benefit analysis as shown in table 12. The cost-benefit ratio of the intervention ranged from 0.1 to 0.8 when using the CMH1 approach and ranged from 0.03 to 0.28 in case of using the CMH3 approach. This means that one EGP saved due to the intervention costs the provider from 0.1 to 0.8 EGP if using the CMH1 approach and 0.03 to 0.28 EGP if using the CMH3 approach. All the results showed cost beneficiary results.

Also, return on investment (ROI) due to the intervention showed beneficiary results with each one EGP invested in the intervention brings from 1.2 (when the less optimistic scenario 4 and
CMH1 valuation of DALY averted is considered) to 28.8 EGP benefits (when the most optimistic scenario 1 and the CMH3 valuation of DALY averted is analysed).

Table 11. Net monetary benefit of the intervention

<table>
<thead>
<tr>
<th>Scenario</th>
<th>DALYs averted</th>
<th>Net monetary benefit (CMH1-EGP)</th>
<th>Net monetary benefit (CMH1-I$)</th>
<th>Net monetary benefit (CMH3-EGP)</th>
<th>Net monetary benefit (CMH3-I$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>80,798</td>
<td>3,837,609,123</td>
<td>889,174,034</td>
<td>12,404,797,354</td>
<td>2,874,191,547</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>40,399</td>
<td>1,695,812,066</td>
<td>392,919,656</td>
<td>5,979,406,181</td>
<td>1,385,428,412</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>20,200</td>
<td>624,913,537</td>
<td>144,792,466</td>
<td>2,766,710,595</td>
<td>641,046,845</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>10,100</td>
<td>89,464,272</td>
<td>20,728,872</td>
<td>1,160,362,801</td>
<td>268,856,061</td>
</tr>
</tbody>
</table>

Source: Author’s work

Table 12. Cost-benefit ratio and return on investment of the intervention

<table>
<thead>
<tr>
<th>Scenario</th>
<th>DALYs averted</th>
<th>Cost benefit ratio (CMH1)</th>
<th>Cost-benefit ratio (CMH3)</th>
<th>Benefit cost ratio (ROI) for (CMH1)</th>
<th>Benefit cost ratio (ROI) for (CMH3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>80,798</td>
<td>0.1</td>
<td>0.03</td>
<td>9.6</td>
<td>28.8</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>40,399</td>
<td>0.2</td>
<td>0.07</td>
<td>4.8</td>
<td>14.4</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>20,200</td>
<td>0.4</td>
<td>0.14</td>
<td>2.4</td>
<td>7.2</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>10,100</td>
<td>0.8</td>
<td>0.28</td>
<td>1.2</td>
<td>3.6</td>
</tr>
</tbody>
</table>

Source: Author’s work

4.3.3. Cost-Effectiveness Analysis

Table 13. illustrated the results of cost-effectiveness analysis of the intervention compared to no intervention alternative in terms of the incremental costs and effectiveness (PEYLL averted) in different scenarios. Based on the provider perspective, the incremental cost of the intervention is 445,984,992 EGP. The incremental effectiveness (PEYLL averted) of the intervention, based on the different scenarios, is 61,165.47 for scenario 1; 30,582.74 for scenario 2; 15,291.37 for scenario 3; and 7,645.68 for scenario 4. As a result, the incremental cost-effectiveness ratio (ICER) ranges from 7,291.5 to 58,331.6 EGP (1,689 to 13,515 I$) per PEYLL averted. The intervention is likely to be cost-effective.
5. Discussion and conclusion

5.1. Burden of diseases attributed to nonexclusive breastfeeding

Our study finds that the burden of non-EBF in Egypt in 2019 is substantial but it differs from other studies in high and low-middle income countries due to different perspectives of analysis, incidence of diseases, and diseases considered in the analysis.\(^\text{16, 22, 73}\) Most of these studies considered only the provider perspective, while our study used both the provider and the societal perspectives.

Only three diseases (diarrheal diseases, LRTIs, and acute otitis media) are considered for this study due to the availability of data. However, the literature review identified many other diseases with a strong relation to non-EBF both at the level of the child and the maternal health. For mothers, breast cancer is one of the diseases that are related to non-EBF with an odd’s ratio of 0.78 in favour of ever breastfeeding versus non breastfeeding.\(^\text{8}\) In one study done in the UK regarding the impact of breastfeeding on breast cancer, it was found that 371 QALYs would be gained across the lifetime of 313,817 first-time mothers if 50% of those who are not breastfeeding currently were motivated to breastfeed for up to 6 months in their lifetime.\(^\text{16}\) This gives a clue of the huge burden of breast cancer attributed to non-EBF at the population level. As a result, including just 3 diseases out of at least 15 paediatric and maternal diseases attributed to non EBF reflects just a part of the burden due to non-EBF, not the real burden.

Both non-monetary and monetary units of measurements are used to calculate the burden of the 3 diseases attributed to non-EBF considering both the provider and the societal perspective. These 3 diseases attributed to non-EBF were responsible for 201,995 DALYs lost in 2019 with

Table 13. Cost-effectiveness analysis of the intervention compared to no intervention alternative based on the life year gained in different scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Life years gained</th>
<th>Intervention cost (EGP)</th>
<th>Cost/ PEYLL averted (EGP)</th>
<th>Cost/ YL gained (I$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>61,165.47</td>
<td>445,984,992</td>
<td>7,291.5</td>
<td>1,689.43</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>30,582.74</td>
<td>445,984,992</td>
<td>14,582.9</td>
<td>3,378.86</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>15,291.37</td>
<td>445,984,992</td>
<td>29,165.8</td>
<td>6,757.72</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>7,645.68</td>
<td>445,984,992</td>
<td>58,331.6</td>
<td>13,515.43</td>
</tr>
</tbody>
</table>

Source: Author’s work
a direct medical cost of about 170 million EGP. Due to a lack of data, the direct non-medical costs could not be calculated. In one Indonesian study calculating the cost of diarrheal and respiratory diseases due to not breastfeeding, the direct non-medical cost was estimated to be about 1/3 of the direct medical cost. These missing costs should be considered to avoid underestimating the real cost of this problem.

The indirect cost which is known as productivity loss calculated using discounted PYLL was found to be about 1.64 billion EGP. However, this productivity loss considered only the loss due to paediatric mortality, not considering the mother’s productivity loss due to the time needed for caring for their sick children.

This study also included the community willingness to pay via using the value of statistical life approach considering the WHO-CMH and the Lancet Commission on Investing in Health recommendations which indicates that people are willing to pay from 10 to 32 billion EGP to avoid the DALYs lost due to these three diseases attributed to non-EBF. This indicates that considering only the provider perspective usually underestimates the real burden of the problem with less effective policies.

5.2. Home-based counselling intervention
The home-based counselling intervention adopted in this study is based on the literature review which found support, including home-based counselling, is the main type of interventions used to scale up breastfeeding rates in most countries. The intervention structure is adopted from the one done in Uganda as part of the PROMISE-EBF trial which showed high efficacy with an EBF prevalence ratio of 3.83 at 24 weeks in favour of the intervention group in comparison to the standard care. This study was adopted because of the similar context of the high initiation BF rate in Egypt and the success of other home-based counselling of many other problems such as vaccination coverage, breast cancer screening and family planning programs.

The cost of this intervention was tailored to the Egyptian context given the higher population density and the average salaries. The total cost of the intervention was calculated to be about 446 million EGP with an average cost per woman 193.5 EGP or 44.8 I$ in 2019. This cost is much lower than other interventions such as financial incentives given to promote breastfeeding in one study in the UK which cost on average 140 I$ in 2019 value with a lower efficacy. The cost per woman also is much lower than the cost in the study in Uganda in
2019 values because implementation at the population level has lower average fixed and variable cost than the trial.

The impact of the intervention is based on scenarios targeting the percentage of DALYs averted by the intervention. These scenarios are developed after calculation of the breakeven point (4%) where no Net Monetary Benefit is achieved, and costs of intervention are equal to the monetary benefits (when DALY is evaluated using CMH1). As a result, any intervention which decreases the DALYs attributed to diseases due to non EBF by more than 4% will be cost-beneficiary. A similar approach was used in another study done in the UK, but with a different target of the % increase in EBF. (16) Given the results from the study in Uganda, the proposed scenarios, ranging from 5% to 40% DALYs averted due to this intervention, are considered realistic and attainable targets.

5.3. Economic evaluation of intervention

Cost-Utility Analysis

Cost-utility analysis is considered the main method in this study as it depends on the expected DALYs averted with each scenario. The incremental cost-utility ratio (ICUR) of the intervention in this study ranges from 5,520 to 44,158 EGP or from $1,279 to $10,231 per DALY averted. The intervention is considered very cost-effective as all the value of ICUR in different scenarios are less than 1* GDP in Egypt in 2019, given a GDP per capita of 53,016 EGP or 12,283.8 I$. In contrast, a similar intervention was considered not cost-effective in one study done in Uganda with ICUR equal 11,353 I$/ DALY averted, when the GDP per capita in Uganda was US$ 1653. (30) This can be attributed to the lower non-EBF related DALYs considered in this study as they just included the DALYs attributed to diarrheal diseases. As a result, including more diseases attributed to non-EBF in the analysis, which is not attainable in our study, should more impact on the cost-effectiveness of this intervention with a better chance to be adopted by the policymakers.

Cost-Benefit Analysis

The monetary value of the benefits (DALYs averted) due to the intervention is calculated using the WHO-CMH approach using both CMH1 and CMH3. As a result, the net monetary benefit from this intervention ranged from 89.5 million EGP to over 3.8 billion EGP when using the WHO-CMH1, and from 1.2 billion EGP to 12.4 billion EGP in case of using the WHO-CMH3 approach. In addition, the cost-benefit ratio revealed that one EGP saved due to the intervention
cost the implementor from 0.1 to 0.8 EGP when using WHO-CMH1 and 0.03 to 0.28 if using WHO-CMH3. Finally, each EGP invested in the intervention brings from 1.2 to 28.8 EGP benefits. In another study in Vietnam, they found similar positive results that investing in a national breastfeeding promotion study could generate monetary benefits of I$ 2.39 for every I$ 1 or a 139% return on investment. These results indicate that any scenario would be a cost-beneficiary option to be adopted by the decision-makers.

**Cost-Effectiveness Analysis**

The outcome of this analysis is the ICER per PEYLL averted. The PEYLL averted due to the intervention is an indirect measure to the life-year gained due to the intervention. PYELL was used instead of YLL used to calculate DALY because YLL considers the standardized life expectancy which has a higher value than PYELL which consider the Egyptian life expectancy that is lower than the standardized one. This leads to a more realistic measurement of the ICER.

The incremental cost of the intervention was 445,984,992 EGP, while the incremental PEYLL averted ranged from 61,165.47 to 7,645.68 giving ICER ranging from 7,291.5 to 58,331.6 EGP or 1,689 to 13,515 I$ per PEYLL averted. As a result, the intervention is likely to be cost-effective as the GDP per capita in Egypt in 2019 was 53,016 EGP or 12,283.8 I$ and this is much less than the threshold (upper value suggested) 3 x GDP per capita in Egypt in 2019.

**5.4. Limitations**

There are several limitations that are encountered to conduct this study. The main one is the lack of local data regarding several inputs in the economic evaluation analyses. There were deficient data regarding the burden of diseases attributed to non-EBF, which was overcome via searching the literature and databases for such data. In addition, the direct costs for different diseases whether medical or non-medical were missing, which led to using and adjusting the data from other countries with subsequent possible inaccurate results. There is also a lack of high-quality research regarding the problem of non-EBF in Egypt with the last official data about the rate of non-EBF in 2014 via the Egyptian Demographic Health Survey (DHS).

Due to the lack of studies on similar interventions in Egypt, the adoption of this intervention from other countries with different contexts may lead to different results from this country. This was dealt with via including the scenario-based approach in expecting the effectiveness of the intervention. Ideally, a pilot study should be implemented to have local and valid data before the implementation of such costly interventions at the population level.
Finally. The decision regarding the cost-effectiveness and adoption of any proposed intervention should be based on a clear threshold that indicates the amount of money that the provider is willing to pay for a QALY gained or DALY averted. For example, The National Institute for Health and Clinical Excellence (NICE) in the UK is using a cost-effectiveness threshold range between 20,000-pound sterling and 30,000-pound sterling. Such thresholds act as a guide for the researcher to find the best way to achieve a cost-effective intervention to be adopted by the government.

5.5. Conclusion
The health and economic consequences of non-EBF are substantial. It has a negative impact not only on the children and their families but also on the governments and the whole economy. This study presented the relevance of exclusive breastfeeding through its critical role in preventing many paediatric and maternal diseases. By including just 3 diseases attributed to non-EBF, namely diarrheal diseases, LRTIs, and acute otitis media, this study found that about 201,995 DALYs are lost annually due to these 3 diseases which are caused by non-EBF risk factor.

Based on the literature, a modelled home-based intervention was adapted with expected effectiveness based on different scenarios. Different methods of economic evaluation were conducted to determine the cost-effectiveness of such an intervention. All the analyses showed that this home-based counselling intervention is cost-effective to scale up breastfeeding rates in Egypt with an ICUR range from 5,520 to 44,158 EGP (1,279 to 10,231 I$) per each DALY averted. Implementation of such intervention will lead to a decrease in the morbidity and mortality related to diarrheal diseases, LRTIs and acute otitis media. In addition, it will lead to cost savings of up to 12.4 billion EGP (2.9 billion I$) and a return on investment up to 28.8 EGP for each 1 EGP invested in this intervention.
List of abbreviations:

EBF = Exclusive breastfeeding
PYLL = Potential Years of Life Lost
PEYLL= Period Expected Years of Life Lost
SEYLL = Standard Period Expected Years of Life Lost
DALY = Disability-Adjusted Life Years
QALYs = Quality-Adjusted Life Years
LRTIs = lower respiratory tract infections
SIDS = sudden infant death syndrome
DHS = Demographic Health Survey
GBD = Global Burden of Disease
IHME = Institute of Health Metrics and Evaluation
YLD = years of life with a disability
YLL= years of life lost
VSL = value of statistical life
COI= cost-of-illness
GDP = growth domestic product
PAF = population attributable fraction
OR = odds ratio
CHWs = community healthcare workers
ICER = incremental cost effectiveness ratio
ICUR = incremental cost utility ratio
ROI = Return on Investment
Declarations

- Ethics approval and consent to participate - not applicable
- Consent for publication - not applicable
- Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
- Competing interests: The authors declare that they have no competing interests
- Funding: No funding bodies
- Authors' contributions: BM did the literature review, data analysis, and manuscript writing, while KS was responsible for reviewing the analysis and the writing because of her great experience in that field.

Acknowledgement

Not applicable.
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