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Murphy, Peter James, Hinde, Sebastian, Fulbright, Helen Athena et al. (2022) Methods of assessing value for money of UK-based early childhood public health interventions:A systematic literature review. British Medical Bulletin. Idac035. ISSN: 1471-8391

<https://doi.org/10.1093/bmb/ldac035>

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Invited Review

Methods of assessing value for money of UK-based early childhood public health interventions: a systematic literature review

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Received 14 June 2022; Revised 25 October 2022; Accepted 11 November 2022

Abstract

Introduction: Economic evaluation has an important role to play in the demonstration of value for money of early childhood public health interventions; however, concerns have been raised regarding their consistent application and relevance to commissioners. This systematic review of the literature therefore aims to collate the breadth of the existing economic evaluation evidence of these interventions and to identify the approaches adopted in the assessment of value.

Source of data: Recently published literature in Medline, EMBASE, Econ-Lit, Health Management Information Consortium, Cochrane CENTRAL, Cochrane Database of Systematic Reviews, Health Technology Assessment, NHS EED and Web of Science.

Areas of agreement: The importance of the early childhood period on future health and well-being as well as the potential to impact health inequalities making for a strong narrative case for expenditure in early childhood public health.

Areas of controversy: The most appropriate approaches to evaluating value for money of such preventative interventions relevant for UK decision-makers given the evident challenges.

Table 1 Summary of the evaluations

Author year	Intervention category	Intervention (comparator)	Population	Type of evaluation	Study type	Time horizon	Outcomes captured (quality of life instrument)	Primary result of the evaluation
Anokye 2020 ⁴⁰	Breast feeding	Nourishing Start for Health, NOSH (usual care)	Newborn	Non-QALY-based CEA	Trial based	1 year	Proportion baby breast fed at 6 weeks	£974 per additional breast-fed baby
Hoddinott 2012 ⁴¹	Breast feeding	FEEding Support Team, FEST (reactive telephone support)	Newborn	Non-QALY-based CEA	Trial based	6–8 weeks	Any breastfeeding; exclusive breastfeeding	£87 per additional woman any breastfeeding; £91 per additional woman exclusively breast feeding
Jacklin 2007 ³⁸ NICE 2008 ³⁹	Breast feeding	Breast feeding peer support (unclear)	Newborn	QALY-based CEA	Model based	Unclear	QALYs (unclear); premenopausal breast cancer averted; infant infections averted	No ICER reported
Pokhrel 2015 ⁴²	Breast feeding	Breast feeding support (no breast feeding support)	Newborn	CCA (not specified but reports costs and outcomes separately)	Model based	1 year for three acute conditions (GI, LRTI and AOM); lifetime for maternal BC; neonatal unit stay for NEC	Cost savings. Includes a cost derived using NMB assuming 20 000/QALYs for the breast cancer benefits.	Report outcomes using three different types of policies: Policies A, B and C (impacts on acute diseases (GI, LRTI and AOM)); Policy D (impacts NEC) and Policy E (impacts BC). Policy A2 saves £11.04 m; policy D2 saves £6.12 m and policy E2 saves £31.42 m (this includes QALYs gained)
Bamford 2007 ⁴³	Childhood screening	Alternative SES programmes (no SES)	4–5 years	QALY-based CEA	Model based	11 years	QALYs (HUI)	£2445 per QALY
Carlton 2008 ⁴⁴	Childhood screening	Amblyopia (and strabismus) screening (no screening)	3–5 years	QALY-based CEA	Model based	100 years	QALYs (utility values from the literature)	Screening at 3 years without autorefractive was the most cost-effective, ICER of £527 375 per QALY.
Craig 2011 ⁴⁵	Childhood screening	Grote strategy for short stature screening (UK strategy)	Under 3 years	QALY-based CEA	Model based	12 years	QALYs (utility values from literature and expert opinion)	£1144 per QALY
Fayter 2007 ⁴⁶	Childhood screening	Short stature screening (no monitoring)	5 years	QALY-based CEA	Model based	Lifetime	QALYs (utility values from literature)	£9500 per QALY gained
Fortnum 2016 ⁴⁷	Childhood screening	Hearing screening (no screening)	4–5 years	QALY-based CEA	Model based	4 years	QALYs (utility values from literature)	The SES programme is dominated
Grill 2006 ⁴⁸	Childhood screening	Hospital hearing screening (community)	Newborn	Non-QALY-based CEA	Model based	10 years	Quality weighted detected child months	£2423 per detected child; £25 per quality weighed detected child month
Barber 2015 ⁴⁹	Health promotion	Preschoolers in the Playground, PiP (usual care)	1–4 years	QALY-based CEA	Trial based	1 year	QALYs (EQ-5D and PedsQL)	£19 588 per QALY

(Continued)

Table 1 Continued.

Author year	Intervention category	Intervention (comparator)	Population	Type of evaluation	Study type	Time horizon	Outcomes captured (quality of life instrument)	Primary result of the evaluation
Trotter 2006b ⁷³	Health protection	Meningococcal vaccination (current schedule)	Under 2 years	Non-QALY-based CEA	Model based	75 years	Life years gained	Strategy 2: £4 498 000 per life year; Strategy 3a: (2, 4, 13 months) –£ 2000 per life year gained; Strategy 3ab: (3, 13 months) –£4 811 000 per life year gained; Strategy 4: –£16 419 000 per life year gained
Achana 2016 ⁷⁴	Injury prevention	Six intervention combinations of education, equipment, home inspection and fitting (usual care)	Under 4 years	QALY-based CEA and non-QALY-based CEA	Model based	100 years	QALYs (utility values from the literature) and numbers of poison cases avoided	Non-QALY-based CEA: lowest ICER was education at £2888 per poison avoided. QALY-based CEA: lowest ICER was education at £41 330 per QALY gained.
Kendrick 2017a ⁷⁵	Injury prevention	(i) Functional smoke alarm (usual care) (ii) Safe hot tap water temperature (usual care) (iii) Promoting safety gate possession and use (usual care) (iv) Promoting the safe storage of medicines (usual care) (v) Promoting the safe storage of household and other products (usual care)	Under 5 years	QALY-based CEA	Model based	100 years	QALYs (utility values from literature)	(i) Education + equipment is £34 200 per QALY gained. (ii) Education is £40 271 per QALY gained. (iii) Education is £284 068 per QALY gained. (iv) Education is £41 330 per QALY gained. (v) All interventions were more costly and less effective than usual care.
Kendrick 2017b ⁷⁵	Injury prevention	IPB with or without facilitation (usual care)	Under 3 years	Non-QALY-based CEA	Trial based	1 year	Probability of having a fire escape plan	Injury prevention briefing only: £1260 per additional fire escape plan, injury prevention briefing +£616.13 per additional fire escape plan
Phillips 2011 ⁷⁶	Injury prevention	Scald prevention (waiting list)	Under 5 years	Non-QALY-based CEA and ROI (not stated)	Trial based	1 year	Risk reduction (scalds)	Scald prevention intervention: net savings of £7273 per scald avoided (NHS perspective), £53 949 per scald avoided (societal perspective). The benefit per £1 spent is £1.41 for an NHS perspective and (£0.47) for a lifetime perspective.
Saramago 2014 ⁷⁷	Injury prevention	Fire injury prevention interventions (usual care)	Under 5 years	QALY-based CEA	Model based	100 years	QALYs (utility values from literature)	Non-dominated interventions: education plus low cost/free safety equipment, £34 200 per QALY gained; education plus low cost/free safety equipment plus fitting plus home inspection at £3 466 635 per QALY gained.
Bessey 2019 ⁷⁸	Newborn screening	SCID screening (no screening)	Newborn	QALY-based CEA	Model based	5 years	QALYs (EQ-5D-3L)	£18 222 per QALY gained

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Table 1 Continued.

Author year	Intervention category	Intervention (comparator)	Population	Type of evaluation	Study type	Time horizon	Outcomes captured (quality of life instrument)	Primary result of the evaluation
Bessey 2018 ⁷⁹	Newborn screening	X-ALD screening (no screening)	Newborn	QALY-based CEA	Model based	Lifetime	QALYs (EQ-5D-5L)	Screening dominates (positive QALYs, negative costs)
Burke 2012 ⁸⁰	Newborn screening	(i) Universal newborn hearing screening and (ii) one-stage universal screening (selective screening)	Newborn	Non-QALY-based CEA	Model based	Unclear	Cases detected	£36 181 per case detected.
Davies 2000 ⁸¹	Newborn screening	Neonatal screening nurse follow-up (targeted screening)	Newborn	Non-QALY-based CEA	Model based	Unclear	SCD cases identified	Range of ICERs reported for various disease incidence rates. For example, prevalence of 0.1 or 0.3 per 1000 births, results in ICERs in the range £25 000– £100 000 per case identified
Ewer 2012 ⁸²	Newborn screening	Pulse oximetry screening (clinical examination)	Newborn	Non-QALY-based CEA	Model based	1 year	Detection of CHD	£24 900 per timely diagnosis
Griebsch 2007 ⁸³	Newborn screening	Congenital heart defect screening (clinical examination)	Newborn	Non-QALY-based CEA	Model based	1 year	Timely diagnosis of life-threatening congenital heart defects	Pulse oximetry is £4894 per additional timely diagnosis; screening echocardiography £4 496 666 per additional timely diagnosis.
Knowles 2005 ⁸⁴	Newborn screening	Congenital heart defect screening (clinical examination)	Newborn	Non-QALY-based CEA	Model based	1 year	Timely diagnosis	£4894 per timely diagnosis
Pandor 2004 ³⁶	Newborn screening	Inborn errors of metabolism screening (screening for PKU only)	Newborn	Non-QALY-based CEA	Model based	80 years	Life years gained; cases of inborn error of metabolism detected	–£7359 per case of inborn error of metabolism detected; ICER for cost per life year gained are not reported.
Pandor 2006 ³⁷	Newborn screening	Congenital heart defect screening (clinical examination)	Newborn	Non-QALY-based CEA	Model based	1 year	Case of timely diagnosis	£24 900 per timely diagnosis of significant congenital heart defects
Roberts 2012 ⁸⁵	Newborn screening	Cystic Fibrosis screening (no screening)	Newborn	QALY-based CEA	Model-based	Lifetime	QALYs (QWB)	£6864 per QALY
Simpson 2005 ⁸⁶	Newborn screening	Newborn Hearing Screening Programme (NHSP) (infant distraction test)	Newborn	Non-QALY-based CEA	Trial based	10 years	Cases detected	£12 527 per case detected
Uus 2006 ⁸⁷	Newborn screening	3-, 6-, 12-, 18-, 24- and 36-month dental check recall policies (unclear)	3 months	Non-QALY-based CEA	Model based	6 years	Number of teeth free from decay, fillings or extraction	No ICERs reported.
Davenport 2003 ⁸⁸	Oral health	The provision of free toothpaste and toothbrushes to 3 months (doing nothing)	1 year	Non-QALY-based CEA	Trial based	4 years	Decayed, missing and filled teeth reduction by one unit; child kept free of caries experience; child kept free of extraction experience	£80.83 per tooth saved from carious attack; £424.38 per child kept free of caries experience; £679.01 per extraction avoided

(Continued)

Table 1 Continued.

Author year	Intervention category	Intervention (comparator)	Population	Type of evaluation	Study type	Time horizon	Outcomes captured (quality of life instrument)	Primary result of the evaluation
Kay 2018 ⁹⁰	Oral health	Supervised tooth brushing (no intervention)	5 years	QALY-based CEA	Model based	3 years	QALYs (utility values from literature)	Spending <£55 per child on supervised tooth brushing is cost-effective; spending <£100 on varnish would be cost-effective over 3 years
Kowash 2006 ⁹¹	Oral health	Out-reach education programme (unclear)	Under 1 year	CBA and non-QALY-based CEA	Trial based	3 years	Monetary and decayed, missing or filled tooth or tooth surface	The B/C ratio is 5.6. Cost-effectiveness ratio is 1.8.
O'Neill 2017 ⁹²	Oral health	Caries prevention (advice only)	2–3 years	Non-QALY-based CEA	Trial based	3 years	Proportion caries free; number of carious surfaces; number of episodes of pain	£2092.59 per caries free person; £250.58 per carious surface; £259.07 per number of pain episodes
Tickle 2016 ⁹³	Oral health	NIC-PIP caries prevention (prevention advice alone)	2–3 years	Non-QALY-based CEA	Trial based	3 years	Caries-free person; carious surfaces; episodes of pain	£2092.59 per proportion caries free; £250.58 per number of carious surfaces; £259.07 per episode of pain
Barnardo's 2012a ⁹⁴	Parenting support	Barnardo's Children's Centre Service: Stay and Play (unclear)	Under 2 years	SROI	Cohort study	5 years	Monetary outcomes	Approximately £2 for every £1 invested
Barnardo's 2012b ⁹⁴	Parenting support	Barnardo's Children's Centre Service: Family Support Worker (unclear)	Under 5 years	SROI	Cohort study	5 years	Monetary outcomes	£4.50 for every £1 invested
Edwards 2007 ⁹⁵	Parenting support	The Webster-Stratton Incredible Years basic parenting programme (waiting list)	3–4 years	Non-QALY-based CEA	Trial based	1 year	ECBI-I	£71 per one point change in the ECBI-I score
Gardner 2017 ⁹⁶	Parenting support	IY Basic parenting programme (no intervention)	5 years	Non-QALY-based CEA and ROI	Model based	25 years	ECBI-I	A WTP of £109 per point improvement on the ECBI-I is 50% probability of being cost-effective. In the 'high-cost' scenario, the ROI is 'nearly fourfold'. Assumed to be an ROI of 4 for the results.
McAuley 2004 ⁹⁷	Parenting support	Home Start support (no home start support)	Under 5 years	Non-QALY-based CEA and CCA	Cohort study	1 year	PSI; EPDS; RSE; BITSEAS; MSSSI	The intervention was assumed to be dominated (no effect difference and increases costs in the Home Start arm)
Morell 2000a ³⁵ Morell 2000b ⁹⁸	Parenting support	Postnatal support from a community midwifery support worker (no support worker)	Newborn	CCA (not specified but reports costs and outcomes separately)	Trial based	6 months	SF-36; Duke functional social support; Edinburgh postnatal depression scale; number breastfeeding only; number formula milk feeding only	No evidence of differences in SF-36, Edinburgh postnatal depression scale, and Duke functional social support scale) and rates of breast feeding between the two groups. The difference in total NHS costs between the groups was £178.61.

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and ROI). Yet, caution is required when considering these results. None of the SROI or ROI evaluations incorporated the opportunity cost and it was made explicit in only one CBA.⁷⁰ The exclusion of such a fundamental aspect of economic evaluations results in an overestimation of the value of the intervention and risks doing more harm than good to the public by neglecting the health foregone through the net effect of spending. Furthermore, four out of five of the SROI and ROI evaluations were conducted without a comparator. The lack of the inclusion of the opportunity cost or a comparator may feed into the previously reported challenges of allocation decision using ROI.¹⁰⁵

The broad range of the types of evaluation and outcomes may reflect the diverse nature and needs of the decision-makers relevant to such interventions. Public health commissioning decisions in the UK are often the responsibility of local commissioners of services, such as local authorities and clinical commissioning groups (CCGs), not national decision-makers such as NICE. Although NICE's public health approach allows for flexibility in the methods, evaluations conducted using the NICE methods guide may fall short of reflecting the challenges faced by CCGs.¹⁰⁶

Although only a minority, a number of evaluations attempted to incorporate the wider social value of the intervention beyond the value to the health care system. A total of 18 evaluations adopted a 'societal perspective' but the results identified a lack of consistency in the included aspects of value. The inclusion of lost productivity to the parent or caregiver (in the form of wages lost) featured heavily in the evaluations, as did incorporating costs falling on special education services and legal services, yet none featured consistently. The implication of such inconsistencies is that value judgements about what 'should' count are falling on the researchers rather than socially legitimate decision-makers.¹⁰⁷ Public health guidance issued by NICE¹⁰⁸ does allow for flexibility in the costs and outcomes considered in an economic evaluation, but the lack of explicit value judgements may facilitate such inconsistencies.

The results showed the most common time horizons were either 0–5 years or those that extended beyond 76 years. Reasons for this appear to be based around whether an intervention was a trial-based evaluation or those that incorporated decision modelling to model the long-term costs and outcomes. Guidance in the economic evaluation literature indicates that time horizons should be long enough to reflect all of the important differences in costs and outcomes between comparators.^{10,11} Such horizons may be well defined for patient-focussed health technologies but not for population-focussed interventions that aim to change behaviour, education, housing and so on. Given the evidence linking the social determinants of health and life expectancy,¹⁰⁹ it stands that a lifetime horizon may be more appropriate.

One aspect of relative consistency in the methods was the lack of the formal incorporation of equity considerations. Interventions implemented in early life have considerable potential to disrupt existing inequalities⁷ and remain a fundamental reason for targeting these important years. Yet, the formal incorporation of equity does not appear to be common practice in economic evaluation in this setting. There are now a number of approaches to formally incorporate equity considerations into CEAs.¹¹⁰

The focus of this review was to identify interventions relevant to UK decision-makers. However, there may be important information available in an international context to aid learnings around the use of methods and approaches relevant to the UK. Future research may consider describing the methods and approaches adopted in the global evidence base to highlight consistencies in the demonstration of value for money in those economic evaluations developed for an international context.

Limitations

A limitation is that there may be relevant and uncaptured evaluations in the grey literature. This is evidenced through the identification of evaluations produced by NICE,³⁸ Social Value UK,¹⁰¹ Barnardo's⁹⁴ and the Joseph Rowntree Foundation,⁹⁷

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